SHOWING TO TELL: INTEGRATING QUANTITATIVE GRAPHICS INTO COMPOSITION INSTRUCTION

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Composition is changing. More specifically, the types of documents students in our composition courses read and write, both within and outside of our courses, are changing. While that statement may not come as a surprise to readers of this journal, it entails surprises for changes in our composition curricula.

In this article, we focus on one change, the change toward informational graphics, or more specifically, toward the use of quantitative graphics in the documents our students read and write. We will first provide evidence that the world of composition is increasingly visual and that composition teachers need to make corresponding changes in what they teach. Focusing on quantitative graphics, we will then offer suggestions about what might be taught in a composition class. Finally, we will provide an example of how students can be taught to use quantitative graphics in their own writing.

The Changing World of Composition: Moving Toward the Visual

Visuals have always been an important part of written documents. Even a cursory glance at ancient scrolls and books will bear this out. The visual, however, has not received much

attention from composition teachers and researchers. A good deal of evidence, however, reveals that this oversight is changing. Theorists have begun to argue for an emphasis on visual elements in composition. Richard Lanham, for example, claims that

> The digitized word is renegotiating the icon/alphabet ratio which we have since the invention of printing taken as holy writ. The oscillation between verbal and visual appeal which *exphrasis* used to build into speech and writing now finds itself extraordinarily enhanced. ... This alternation of word and picture has swept through the world of business communication and we may expect scholarly communications to come limping behind. (76)

At the 1994 CCCC, Gunther Kress argued that where most documents used to be text primary with visuals serving as illustrations, many documents are now becoming visual primary with text serving to explain the visuals.

Composition practitioners as well are beginning to take the visual into account. The recent *Standards for the English Language Arts*, which contains twelve standards created by the NCTE and IRA, includes five that speak directly to the issue of visuals in composing:

1. Students read a wide range of print and non-print texts...
3. Students apply a wide range of strategies to comprehend, interpret, evaluate, and appreciate... textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).
4. Students adjust their use of spoken, written, and visual language... to communicate effectively...
7. Students... gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, and people)...
12. Students use spoken, written, and visual language to accomplish their own puposes. (3)

A quick survey of four current readers (Peterson, Brereton, and Hartman; Bizzell and Herzberg; Hatch; and Feldman) shows that all four include visual materials in some of their readings. All four include charts; threee include graphs, tables, and photographs; two include diagrams; one includes paintings; and one includes line art illustrations. (This survey is meant to be illustrative rather than scientific. This is certainly an area that would bear close study.)

In addition to readers including a wider variety of visual materials, handbooks are now including instruction specifically on visual communication. Most notably, Hairston and Ruszkiewicz's *Handbook for Writers, 4th edition*, includes a fifteen-page, full-color section titled "Document Design" that includes material on typography, charts and graphs, photographs, web pages, brochures, newsletters, and overhead transparencies. (Other handbooks and textbooks also include information on visual communication. We mention Hairston and Ruszkiewicz's here because it seems to be one of the most thorough treatments.)

All of this evidence supports a change that has become increasingly evident: the material composition students encounter within courses is increasingly visual in nature. This increase in visual communication holds true as well for documents our students encounter outside of class. For example, a recent (4 November 1996) *Newsweek* magazine included 96 visuals—including 81 pictures, and a handful of diagrams, tables, drawings, icons, and maps—in just 48 pages of articles. The *U.S. News & World Report* for the same date included 90 visuals—66 pictures, 4 quantitative graphics, 10 drawings, and a handful of tables, icons, and maps—in 49 pages of articles. (Again, these figures are provided as illustrations of our contention that print documents are becoming more visual. Research on the use of visuals in news magazines would also bear careful study.) Newspaper design is now categorized, according to Paul Martin Lester, as "BU" (Before *USA Today*) and "AU" (After *USA Today*), representing the sudden

visual shift that occurred when a full-colored, visually-intensive *USA Today* hit the newspaper stands in 1982.

The 1992 and 1996 presidential campaigns used visual communication extensively, for example Ross Perot's graphic-laden television infomercials. The O.J. Simpson trial relied on bar charts made to look like test tubes, maps of streets and houses, timetables, and a myriad of other visual materials designed to show guilt or innocence. Our students now communicate within a context that is very nearly as visual as it is textual. While some compositionists might choose to bemoan that fact, composition teachers can help students become more effective communicators within this new context.

Because writing about all types of visual materials, such as informational graphics, photographs, video, comics, typography, diagrams, and photography would necessitate at least a book-length work, we focus on one visual element that has become increasingly important in disciplinary and public discussions: the quantitative graphic. We will not discuss the history of this element (for that, see Tufte, *Visual*). Instead, we focus on what students need to know about quantitative graphics and on incorporating this material into composition courses.

After we determine that freshman composition students should be taught about quantitative graphics, we need to ask "What should they be taught?" We have divided our answer to that question into two sections: rhetorical issues in using quantitative graphics and techniques for creating readable quantitative graphics.

Rhetorical Issues in Using Quantitative Graphics

Four issues address some of the most important rhetorical functions of quantitative graphics.

Issue 1. Filtering information. Some theorists and researchers suggest that graphics serve as mere conduits of information, linking the reader directly to statistical facts. For example, Cochran, Albrecht, and Green suggest that a good quantitative graphic "can transmit information accurately" and only bad graphics "filter, distort and hide" information (25). The issue,

however, is more complicated than that. Because quantitative graphics tell stories, their authors filter information, including and excluding pieces of information. Also, numbers within a graphic can be rearranged to support multiple interpretations.

Even Edward Tufte, a pre-eminent exponent of the transmissional approach to quantitative graphics, notes that such graphics are "instruments for reasoning about quantitative data" (*Visual* 54). As tools of reasoning, quantitative graphics are like words, and therefore serve as selections and deflections (to use Kenneth Burke's terms) of reality. In their ability to focus on certain pieces of information organized into particular patterns and relationships, quantitative graphics serve rhetorical functions. Students can encourage readers to see the world in particular ways by filtering that world through the structuring power of quantitative graphics.

Issue 2. Inviting attention. Quantitative graphics serve a second rhetorical function in documents when they invite readers to read or to attend to particular material. This function is noted fairly consistently by people who write about these types of graphics. Roger Parker, a well-known document design specialist, argues that quantitative graphics can "breathe life into complex relationships between numbers . . . adding interest to your documents" (215). Kostelnick makes a similar claim, that quantitative graphics can "stimulate *reader interest*" (44, emphasis in the original). Paul Martin Lester attributes a good deal of the popularity of *USA Today* to its use of highly visual quantitative graphics.

The argument is actually quite simple: Because we live in a visual culture, visual displays of quantitative data are more interesting to readers than strictly textual displays and compete more effectively with the many other visual stimuli they encounter. Rhetorically, then, quantitative graphics can help students attract and maintain reader interest in the things they write.

Issue 3. Increasing persuasive force. Probably the most traditional rhetorical issue involved in the use of quantitative graphics is the effect of such graphics on the persuasive abilities of a written document. While the principle that "a picture is worth a thousand words" is for most people merely a cliché, in using quantitative graphics it might almost be true. By increasing reader interest and filtering information efficiently, a quantitative graphic can convey a message quickly and powerfully.

A good line graph can show a dramatic increase or decrease in sales that carries much more drama than does the word "dramatic." In addition, by juxtaposing a second line on the graph showing a correlating increase or decrease in temperatures, a complex message about the relationship between sales and weather can be sent to the reader in a very limited space. As Kostelnick argues, this ability gives graphic displays of quantitative data greater argumentative force: "For example, a bar graph can often argue with statistics more clearly and emphatically than [text] displays of figures" (44). To this, Paul Martin Lester adds that graphical displays carry more emotional force, combining "intellectual satisfaction . . . with the emotional power of visual messages" (194). This combination of intellectual reasoning and visual force leads Tufte to declare quantitative graphics to be "the simplest and at the same time most powerful" method for analyzing and communicating quantitative information (*Visual* 9). As students write about issues that use numbers, they can generate additional persuasive power by including well-constructed quantitative graphics.

Issue 4. Creating alignments. Quantitative graphics can create visual alignments between documents. For example, the *Wall Street Journal* and *USA Today* use very different visual forms in their quantitative graphics. One is very staid, conservative, and plain; the other is very contemporary and colorful. This striking difference in tone between the two is what led Paul Martin Lester to identify *USA Today* as representing a major shift in newspaper publication, as indicated above.

Creating quantitative graphics like those in *USA Today* would suit a marketing brochure, but would be much less effective in a paper written for a physics journal. Tone is only one way graphics are aligned. Other elements—such as captioning techniques, use of multiple graphs without intervening text, labels and legends, use of particular symbols—can all align a graphic, and therefore both document and writer, with other graphics and other documents. Through this sort of visual alignment, documents and writers can create or lose credibility with their audience(s). Students should understand that the default data displays in their favorite spreadsheet or word processing programs will have particular appearances, and those appearances are appropriate for some writing situations and inappropriate for others.

Although this list does not exhaust all potential rhetorical functions of quantitative graphics, it indicates the kinds of rhetorical issues to introduce to students in freshman composition courses. If students are taught to consider quantitative graphics as rhetorician tools, they will be better prepared to create and use quantitative graphics effectively in their writing.

Readability of Data Graphics: The Interplay of Types, Formats, and Expectations

Although kinds of graphics may be as various as kinds of sentences, the sorts of data graphics that students are likely to produce on a computer fall into four major types. Each of those could be formatted numerous ways—some choices will improve readability, while others undoubtedly muddle the information. Before students proceed to create a graphic from a collection of data, they should understand some basic readability issues connected to graphics in general, and data graphics in particular, especially those employing two rectilinear axes.

We read written texts differently than we view pictures. However, many data graphics not only combine pictures with writing (both words and numerals), they also represent a hybrid of the two representational media on another level. The majority of

data graphics are pictures which readers are invited to follow in the same order that alphabetic writing is read throughout most of western culture—left to right, and top to bottom. Consequently, there are formal expectations (in the Burkean sense) which the author ought to know and abide by, or risk confusing the readers of such graphics.

Those formal expectations include conventional notions about the direction in which time flows, certain connotations of "up" and "down," and, according to some scholars, an expected cause-effect relationship between the right and left sides of a table or graph. Beyond these general reader expectations, there are formal limitations to what certain types of charts can represent. For example, pie charts can display only one set of variables, while line and bar graphs can display several. Then there is the dimensional limitation imposed by paper or monitor (what Tufte calls the problem of "mere flatland" [*Envisioning*]) and the complications which a third graphic dimension can present.

Finally, after choosing an appropriate type of chart, and giving due consideration to reading habits and expectations, the student must be careful not to clutter the graphic with extraneous, non-informative ink. In the world of data graphics, less is often more, as "cleaner" graphics (wherein more of the ink represents data, and less is used to show the grid) are usually easier to read.

Techniques for Creating Readable Quantitative Graphics in College Compositions

This final section illustrate how quantitative graphics can be incorporated into a composition course in just two classroom meetings. To accomplish this, we have simplified the material based on the following premises:

- While there are at least four fundamental types of quantitative graphics, two (time series and relational) are used much more often than the others (Tufte, for example, indicates that time series alone accounted for more than 75% of the graphics identified in a random sampling of newspapers and magazines

[*Visual* 28 n.8], and about 40% of the graphics published in scientific literature have a relational form [47]).

- The teacher has incorporated the rhetorical issues described above into other portions of the course that deal with text-based rhetoric. If that is not the case, the teacher could add a day to cover that material either preceding or following these two days.
- The teacher is teaching in a computer classroom that has word processing (e.g., *Microsoft Word, WordPerfect*) and spread sheet (e.g., *Lotus 1-2-3, Microsoft Excel*) software or an integrated package (e.g., *Claris Works*); if this is not the case, the material described here could be presented in class using transparencies or handouts, and the students would need to be assigned to perform the tasks as out-of-class exercises.

Day 1: Understanding and Creating Quantitative Graphics.

In one hour students can learn to make clear, appropriate, and succinct data graphics that convey much, possibly complex, information in a brief space. Since charting software does not lend itself to the kind of chicanery regularly cited in indictments of data graphics, we can ignore the problems created by such graphical half-truths as "the disappearing baseline" and concentrate on clear, appropriate and succinct graphics.

An easy place to start is with time-series graphics. From the most basic before-and-after photo to a line graph recording the daily highs and lows (be they financial or barometric), time-series let people see in one glance what the passage of time and limitations of memory prevent them from retaining in actual vision or grasping conceptually.

Before we make a data graphic, we must examine the relationship between a graph and the table it is generated from. Most tables contain a combination of words and numbers. Booth, Colomb and Williams tell us that "tables are useful when you want

to convey precise values, . . . when you do not know (or do not want to say) which aspects of the data will be most important to readers who need the data in front of them. . . . Tables seem objective and encourage the readers to draw their own conclusions" (179). Conversely, charts are more "rhetorical" in the sense of Lanham's rhetoric as an "information system that functions economically, that allocates emphasis and attention" (61).

Table 1 includes four, discrete, independent elements (the colleges) systematically related to the dependent elements (the enrollment figures) which change with time.

Table 1: Enrollment by College, 1991-1995

	1991	1992	1993	1994	1995
Arts and Science	573	526	476	498	584
Business	318	342	388	402	324
Education	423	413	401	389	367
Engineering	246	257	298	265	271

Although Table 1 may appear to be nothing more than the straightforward presentation of the available data, even such a simple table reflects at least two separate arrangement choices, which were based upon two criteria: the readers' formal expectations and the way graphing software makes a chart from a table. The first choice was to put the years along the horizontal axis and the colleges in the vertical; it would have been just as easy to do the opposite, but there are good reasons not to.

One reason to put the years along the horizontal axis is that it conforms to our conventional representation of time as a line which runs from left to right. (Had we entered the years along the horizontal, but in descending order, the resultant graphs would depict time running from right to left, directly opposite the way we customarily depict the movement of time.) Another reason to arrange time horizontally is that it leaves the left vertical axis free

for the independent variables, and, according to Booth, Colomb, and Williams, "readers generally take what is at the left as the cause or source of what appears to their right" (181).

The second choice was the order of the independent variables. In this case, absent any desire to list colleges by size, we chose alphabetical as the "default" or neutral order.

After entering the data from Table 1 into the data sheet of a graphing utility and selecting all the cells with all the data, the next step is to choose a chart type.

Graphing utilities let the user choose from among a variety of different graph types. Microsoft Excel offers nine different graph types, with ten variations of each type, not counting the six 3-D versions. (Purists rail against so-called 3-D graphics—actually faux 3-D as they do not depict a Y-axis—because the third graphic dimension adds no new information and may in fact interfere with easy reading of the chart by imparting a spurious volume which could exaggerate the viewer's perception of differences among the data displayed.)

Among the nine varieties, there are really four basic types of charts: line, column, bar and pie. (The terminology is not universal--some call column charts "vertical bar" charts, while others reserve the term "graph" for line figures only.)

We start by creating a simple chart aimed at showing change in enrollment figures. Figure 1 represents one of numerous possible ways (given the multiple choices of chart type, format and orientation) to display the data in Table 1.

After selecting the range of cells to chart, we pick a chart type. Among our four basic types, all but a pie chart could work. (Pie charts can display only one set of values adequately; in this case, a single pie chart would be able to display only one year's enrollment.) The type and orientation of the chart depend upon what we want the reader to notice. In Figure 1, we picked a column chart because of its ability to clearly show differences in magnitude and because its vertical orientation is consistent with

linguistic conventions about "rising" and "falling," or "high" and "low" enrollment.

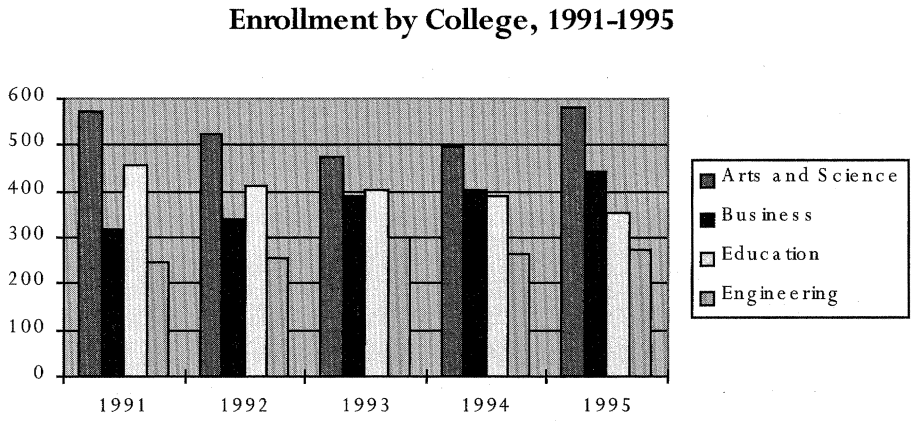

Figure 1: Column chart with "Data Series in Rows."

The second choice is to pick a "format" for the column chart. We selected one with horizontal rules extending across the plot area, because they help the reader approximate the quantities on the right side of the chart.

The third choice is orientation, a decision which requires more thought than the other choices because the selection can make a big difference in what the reader sees. (Most graphing utilities include a synchronous WYSIWYG feature which allows the user to see the results, in miniature, as the graph progresses, and back up if not satisfied with a choice.) The user may be presented with a choice between "Data Series in Rows" or "Data Series in Columns." In Figure 1, we picked "Data Series in Rows" with the result that what appeared in a row of Table 1 (identical with the range of cells in the data sheet of the graphing utility) comprises the series in the chart.

Had we chosen "Data Series in Columns," we would get a different chart of the same data, shown in Figure 2.

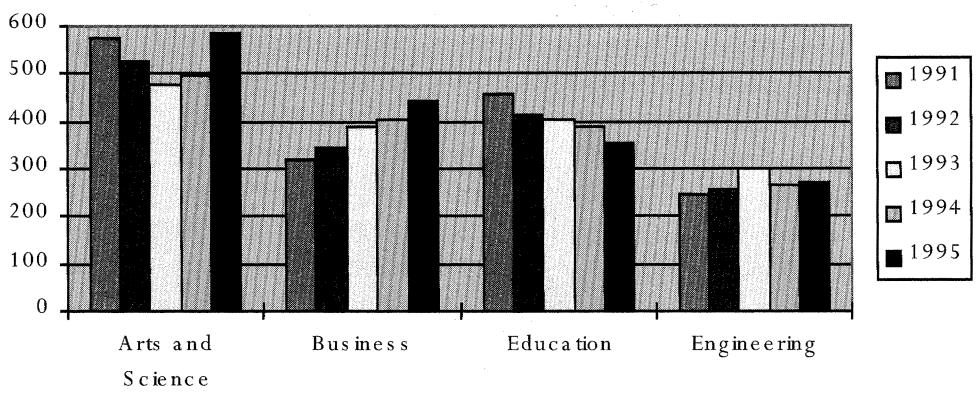

Figure 2: Column chart with "Data Series in Columns."

Note the different emphases of Figures 1 and 2. Figure 1 directs the reader's attention to the relative size of each college in any given year. It is easy to see that throughout the five-year period, Arts and Sciences was the largest college and Engineering the smallest, but Business and Education trade places as second and third largest.

On the other hand, Figure 2 directs the reader's attention to the growth or decline of each individual college over the five-year period. Arts and Science experienced a fall and rise, Engineering a rise and fall, while Business experienced steady growth, as the College of Education steadily declined.

As mentioned earlier, a pie chart cannot handle the multivariate data included in the original table because a pie chart can display only one set of values. However, if we wish to display the percentages of the total students enrolled in each college in any one given year, a pie chart works fine, as Figure 3 indicates.

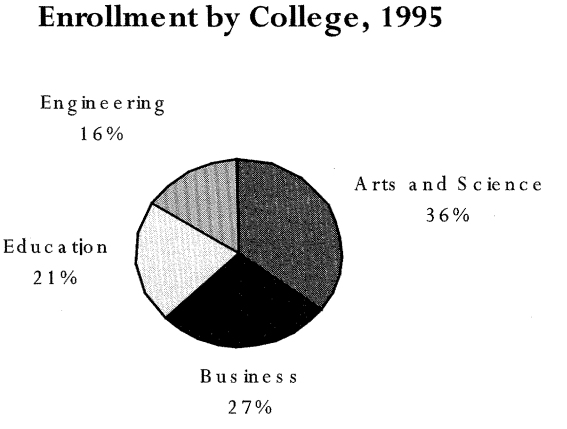

Figure 3: Pie chart depicting percentages of total students enrolled in each college in one year.

Day 2: Integrating Quantitative Graphics into Texts

Once students know how to make a chart which shows what they want the reader to see, they need to know how to integrate the chart into their documents. In most composition courses, the documents are going to be primarily verbal, linear texts, such as the traditional academic essay. When we speak of integrating a chart object into a word processed document, there are two levels of integration to consider, the rhetorical and the mechanical. Mechanically, integrating a chart into an essay can be very simple when using a charting utility built into the word processor. It can be a bit trickier if importing or linking a chart object from another application, such as a spreadsheet program.

First, let's look at the rhetorical integration of the chart. The conventional wisdom in academic writing is that the text and the chart should exhibit a certain independent redundancy. James D. Lester insists that illustrations or tables should conform to twelve

guidelines, of which numbers 4 and 5 clearly express this notion of redundancy:

> 4. Make certain that the text adequately explains the significance of the illustration. Describe the illustration so that your reader may understand your observations without reference to it, but avoid giving too many numbers and figures in your text.
>
> 5. Label your illustration so that your reader can understand it without reference to your text discussion.

Lester's third guideline demands that the author "place the illustration or table as immediately *after* the text discussion as possible. The illustration or table should not precede the first mention of it in the text" (226). While these guidelines prescribe an arrangement strategy which dictates the proper transition from text to graphic, they don't tell us how to get from the graphic back to the subsequent text. An approach similar to a time-honored speech format might recommend "tell them what you are going to show them, show them, and then tell them what you've shown them."

To illustrate this arrangement strategy, we will reuse Figure 4 (the column chart which displayed the data series in columns) and integrate it into an academic essay concerning trends in enrollment figures:

> Enrollment figures for the past five years would seem to indicate that two colleges in the State University are experiencing noteworthy trends. As Figure 4 shows, both Arts and Science and the College of Engineering enrolled roughly the same number of students last year as they had in 1991. However, both Business and Education have experienced consistent, unidirectional changes in enrollment.

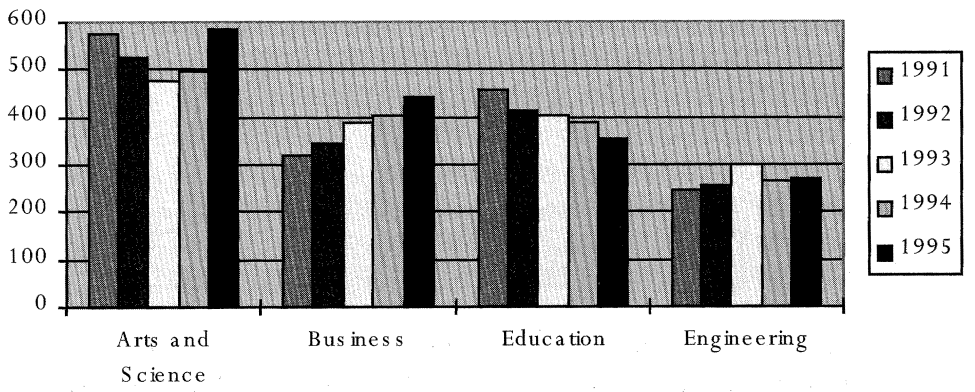

Figure 4: Student Enrollment at the State University by College over the Past Five Years. Source: Board of Regents (258).

> These apparent trends might be dismissed as local anomalies if it weren't for the fact that neighboring states are experiencing similarly increased enrollments in their business schools and declining numbers in their colleges of education.

The caption for Figure 4 explains the material which is shown in the chart and also includes an abbreviated in-text citation in MLA format which points to the full citation that would appear in the Works Cited page.

The technical side of the integration is easy if the word processor has its own integrated graphing utility. Conversely, integration can become fairly tricky when linking objects made in one software application to documents written in another. In addition, some aspects of integration which are primarily technical, e.g., the size of a figure, have rhetorical implications if they force the author to reconsider the global arrangement of a

text in order to fit a graphic all on one page. When academic essays were primarily words only, only in rows, arrangement issues belonged largely to rhetoric. Now, the integration of a graph into an essay can become a page-layout issue which may induce an author to insert a page or section break in the text in order to force the graphic to appear in the desired location.

Conclusion

If students are to be successful participants in visual-laden communicative interactions, they need to understand how to use visual tools, such as the quantititative graphic. Information about the rhetoric and readability of quantitative graphics will be of use to these students and can serve as a model for issues and instruction involved in bringing other visual elements into the composition classroom.

Addressing the rhetorical issues of quantitative graphics and teaching students how to create and integrate such graphics into their compositions demand class time and new skills and content for both teacher and student. However, as we have shown, the effect is worthwhile.

WORKS CITED

Bizzell, Patricia and Bruce Herzberg. *Negotiating Difference*. Boston: Bedford Books of St. Martin's Press, 1996.

Booth, Wayne C., Gregory G. Colomb, and Joseph M. Williams. *The Craft of Research*. Chicago: University of Chicago Press, 1995.

Cochran, Jeffrey K., Sheri A. Albrecht, and Yvonne A. Green. "Guidelines for Evaluating Graphical Designs: A Framework Based on Human Perception Skills." *Technical Communication* 36 (1989): 25-32.

Feldman, Ann Merle. *Writing and Learning in the Disciplines*. NY: HarperCollins College Publishers, 1996.

Hairston, Maxine and John J. Ruszkiewicz. *The Scott, Foresman Handbook for Writers, 4th edition*. NY: HarperCollins College Publishers, 1996.

Hatch, Gary Layne. *Arguing in Communities*. Mountain View, CA: Mayfield Publishing Co., 1996.

Kostelnick, Charles. "A Systematic Approach to Visual Language in Business Communication." *The Journal of Business Communication* 25.3 (1988): 29-48.

Kress, Gunther. "The Multi-modal Text: Writing in the Context of the Turn of the Visual." Paper presented at the 1995 Conference on College Composition and Communication.

Lanham, Richard A. *The Electronic Word: Democracy, Technology and the Arts*. Chicago: University of Chicago Press, 1993.

Lester, James D. *Writing Research Papers: A Complete Guide*. 8th ed. New York: Harper Collins, 1996.

Lester, Paul Martin. *Visual Communication*. Belmont, CA: Wadsworth Publishing Company, 1994.

National Council of Teachers of English and International Reading Association. *Standards for the English Language Arts*. Urbana, Illinois: NCTE and Newark, Delaware: IRA, 1996.

Parker, Roger. *The Makeover Book*. Chapel Hill, NC: Ventana Press, 1989.

Peterson, Linda H., John C. Brereton, and Joan E. Hartman. *The Norton Reader, shorter 9th edition*. NY: W.W. Norton & Co., 1996.

Tufte, Edward R. *Envisioning Information*. Cheshire: Graphics Press, 1990.

-----. *The Visual Display of Quantitative Information*. Cheshire: Graphics Press, 1983.