

Writing across the curriculum: An analysis of the writing conventions in multiple disciplines

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When analyzing writing across the curriculum (WAC), it's easy to overlook the abundance of differences each paper contains depending on the discipline and its given conventions. The field of WAC has allowed students and teachers across colleges and universities to examine these differences and learn from them in order to become better writers in various classes or professional settings. In this paper, I have chosen to analyze the differences between writing in the disciplines of social science, natural science, and applied fields. In the WAC curriculum, areas where conventions often vary are within the language, structure, and reference. Language in writing is defined as how ideas are communicated through written words. Structure often includes how a paper is organized and what organizes those ideas. Lastly, reference refers to how others' ideas are cited in someone's paper. Through the examination of each of these aspects in six different sources within three academic disciplines, I hope to discover the differences between language, structure, and reference in writing in these difference disciplines.

Literature Review

When a person hears the phrase "writing across the curriculum," also known as WAC, the understanding surrounding the topic is usually fairly limited. Some may think of WAC as something explored in English or writing classes, while some may think of it as a broader subject. Most sources will define WAC as a program not only set to improve writing, but also to improve other writing programs in order to improve the education and future professional lives of students. Writing is said to raise our overall cognitive function according to Emig (1977). On a similar track as Emig (1977), explaining how writing is said to higher our overall cognitive function, McLeod (1987) emphasizes that writing is a way to express information and put our

thoughts somewhere other than our heads, as well as something that is a way for humans to learn when practicing this skill among various curriculums. While writing in certain classes can help expand the student's knowledge of the content, it also teaches skills that help students store information and understand it better. It can obviously be quite challenging for students to jump from class to class and have to write under completely different conventions and different expectations from each professor they encounter, as seen in McCarthy (1987) and Stout's (2010) research, which will be expanded on later. The WAC program strives to make these transitions easier on students and make them overall more well-rounded and balanced writers who use writing as a way to learn. The question for researchers now is at what point should WAC programs be implemented into a curriculum and what are the costs and challenges involved?

Effects of Writing Across the Curriculum

In order to find out how writing across the curriculum benefits a student's academic success and their ability to effectively write, some researchers have utilized experimentation. Research by McCarthy (1987) used experimentation with a college student in order to see how students deal with WAC in various classes, when a WAC program is not directly implemented in the school. Throughout this study, four methods were used to conclude the results, including observation, interviews, sessions with retrospective interviews, and a text analysis. This student was enrolled in three different classes where his writing was analyzed. It was concluded that in this study, students who learn the writing conventions and understand the purpose of writing become more effective writers. Meanwhile, those who were not able to grasp the conventions on each disciplinary struggled immensely, like the student observed in this article. This underscores the importance of understanding writing conventions, as they differ greatly depending on the discipline. This study gives us an idea on how implementing WAC programs could potentially

greatly benefit students such as the one in this study. This source agrees with other research, such as Luthy, et al.'s (2009) when concluding that learning writing conventions can be valuable.

Similar to McCarthy, research by Luthy, et al. (2009) investigates how the various writing conventions can affect a student, but this research took place with the implementation of a WAC program. Although these two sources were similar, they also differ slightly in order to allow us to get a broader understanding of WAC and its effect on students. In Luthy, et al.'s (2009) research, a WAC curriculum was implanted into a nursing program in order to find out how exactly it effects/benefits nursing students specifically, rather than McCarthy's writing, which focused on a student who was in a variety of classes. This did end up being a struggle for not only the students, but also the nursing faculty who were not as advanced when it came to writing across the curriculum. Although, with the help of a workshop for faculty, they were able to properly convey the importance of WAC to nursing students. In the end, this benefited nursing students greatly because they leaned skills such as oral communication, which is very important in the healthcare field that nursing students enter. This source really helped to conclude that this program is a benefit to students in nursing, and to get an idea of how this could work out in other disciplines.

The format of Stout's (2010) article differs a bit, as a professor took a WAC standpoint into his classroom. Although this was not an official implemented program, he used techniques that force students to write beyond just the given curriculum. Stout's (2010) journal article is written in first person from the perspective of a chemistry professor who teaches their class differently than your typical general chemistry class. In this class, there is a writing assignment, but rather than it being a report about a specific element, this professor asks his students to write about an element in a story-telling form. This caused a lot of controversy in his class. Those who

were in the science field struggled greatly with the creativity aspect, while those who were taking the class for a general education requirement were more likely to succeed. Those who did learn to adjust to whatever the current assignment's conventions required were more likely to succeed in the class. Stout (2010) builds Luthy, et al. (2009) but broadens it more to show that not only nursing students are benefited by WAC, but also other types of students like this chemistry class, since it was very diverse with student specialties and was a general education requirement. This source is fairly similar to Luthy, et al.'s (2009) article regarding the nursing curriculum, as it utilizes WAC in a classroom or classrooms and sees how it effects the students. The difference is that Stout implemented this in only one class, while Luthy, et al.'s study incorporated WAC in an entire nursing program. In both studies, it was found that the implementation of a WAC program had a positive impact on the students. It helped them gain crucial skills that will allow them to succeed in the future.

In the end, all three of these sources concluded that WAC programs do have a positive effect on a variety of students, no matter what they are studying. The cohesive conclusion these sources come up with provide great evidence that this is the type of program worth implementing. Unfortunately, there is another side to WAC programs than just the positive outcomes. These programs can often have a lot of challenges included.

Challenges Involving Writing Across the Curriculum

A lot goes into implementing WAC programs into a normal curriculum. Many question whether the costs of WAC programs outweigh the effects. Now that the effectiveness of WAC has been analyzed, it's important to look at the few downsides WAC curriculums have on school systems. The research of Luthy, et al. (2009) emphasizes that while the WAC program lead to success for their students in this nursing program, the faculty had to be put through various

workshops in order to expand their knowledge of WAC and how to teach it. This proved to be a challenge and really tested the willingness of faculty to work for this program in hopes of its success. These workshops often lasted for many weeks and forced educators to put this new idea of writing to learn into their heads. Building off of Luthy, et al.'s study, McLeod (1987) also emphasized the extreme use of faculty workshops in order for the program to succeed. These programs can be very costly and take a lot of time to put in place, which not every school system has the luxury to do.

Discussion

It's important to research WAC and its implementation in school systems in order to investigate its effectiveness and see if it's worth using in classrooms. Looking at these sources and their analyses can help professors and other school faculty decide if this program will lead to the results they wish for. This also overall helps others know exactly what writing across the curriculum is, which allows for better understanding of what the program entails. In the future, this research could be used to develop a more efficient way to implement WAC in schools in order to more easily get these positive effects on students.

Methods

When finding sources in three different disciplines, I decided to pick three fields that were fairly similar in order to underscore the fact that no matter how similar different fields are, their different writing conventions change the writing completely. With that in mind, I decided to pick the fields of psychology in the social sciences, biomedical engineering in the applied fields, and biology in the natural sciences. In order to find sources, I began by researching popular and relevant topics in each field I chose. From there, I searched those topics into the Web of Science database through the Greenwood Library. For example, to find Shan's article about honeybee

viruses, I searched “varroa mites honeybee virus”. I chose two articles from each field that seemed interesting to me and a good representation on the given field. When it came to reading the sources, I skimmed through the content for the most part, as I was more interested in the WAC aspects of the sources than the actual content. While reading the articles, I created an outline with a structure, language, and reference section for each source. I then wrote key aspects of each article in its corresponding section on my outline. When it came to language, the aspects I looked out for most was the active/passive voice, as well as the use of numerical language in the sources. With structure, I looked out for any graphs/charts, and structural elements the sources did/did not include such as IMRaD and an abstract. Lastly, with reference, I analyzed which format the references were in as well as any other reference sections included such as acknowledgements. I think writing the literature review surrounding WAC enhanced this research, since I knew which conventions to look out for when writing my results section and analyzing each article.

Results and Analysis

After examining six samples of writing from the academic disciplines of natural science, social science, and applied fields, I have been able to analyze and understand that different disciplines often have different language conventions required. These three disciplines specifically include the fields of biomedical engineering, biology, and psychology. It is clear to see when comparing and contrasting these six different sources that they contain both similarities and differences. Since there were two articles within each field, I started by comparing each two in order to find common ground to represent that field.

Language

While looking at the articles in the applied fields, it was clear that active voice was used for both. Li, et al.(2018) used phrases such as “To deliver active thrombin solely to tumor sites in a highly controlled way, we developed a DNA nanorobotic... elements” (p.258) and Durikovic, et al. (2001) stated “we succeeded in modelling... and functional representation” (p.294). These biomedical engineering articles are extremely specific and detailed with their language, especially when describing the research that took place. This allows other researchers in the same field to have the ability to replicate the research if desired. When looking at the title of each of these articles in the applied fields, they are extremely clear, while also being descriptive. Both articles use many numerical values throughout the writing. Durikovic, et al. (2001) uses many mathematic equations in his writing, such as what is seen below (p. 288).

$$F_i(\mathbf{r}) = \int_{V_i} \frac{dv}{1 + s^2 r^2(v)^2}$$

Meanwhile, Li, et al. (2018) incorporated numerical values into their descriptive language when using sentences such as “using a Cy5.5-labeling approach for thrombin quantification, the average number of thrombin on each DNA origami sheet was calculated to be 3.8 ± 0.4 ” (p.259). Another language aspect to note is that these articles are not using language that the average person can easily understand, rather language that is more specific to their field. This is known as the use of jargon. Lastly, a language convention present here is the lack of hedging used in both papers. This is predictable, as applied fields papers are typically straight to the point. Both of these authors included conventions that accurately represented typical conventions of applied fields.

The next discipline I studied was the natural sciences. From this discipline, I chose two articles from the field of biology. The language of the articles in this field had many similarities to those in the applied field. One similarity included the fact that the titles of both these sources

are also very clear and descriptive with their language, an example being “The role of varroa mites in infections of Kashmir bee virus (KBV) and deformed wing virus (DWV) in honeybees” (Shen, et al., 2005). A difference between the titles of the two biology articles is that the article by Diez-Fuertes, et al. (2019) utilizes jargon and has vocabulary that is not easy for the average person to comprehend, while Shen, et al.’s (2005) title uses simple language. Throughout both articles, the language remains very sophisticated and detailed with use of jargon, similar to both articles in the biomedical engineering field. Another similarity between the applied fields papers and the natural science papers is the use of numerical values within the writing. In Diez Fuetes, et al.’s (2019) writing, numerical values are used to display statistics in a sentence such as “a statistical power of 80.3% at the 2.0×10^4 significance level was reached for rs1127888 using the sample size included in the study and the allelic frequencies observed” (p.109). This is similar in Shen, et al.’s (2005) writing, with examples such as “six pupae were randomly selected and immediately frozen at 80 -C to serve as baseline controls” (p.147). Lastly, when it comes to similarities between the language conventions of these two fields, both do not use hedging, which once again is very common in both the applied fields and natural sciences. There was only one major language difference between the articles in these two fields. As mentioned before, the applied fields articles used active voice. This is different in the natural science field, where the authors used passive voice. Diez Fuentes, et al. (2019) states in passive voice that “Samples were processed following current procedures and frozen immediately after they were received” (p.108) and Shen, et al. (2005) states “honeybee pupae were collected from Colony 14 in the Penn State Apiary, University Park, Pennsylvania” (p.147). These two fields tend to be very similar, as they both have a similar science background.

The last field examined was psychology in the social sciences, specifically writing by Jackson, et al. and Hudson, et al. Similar to the articles from the fields of biomedical engineering and biology, the titles of both psychology articles are very clear and straightforward. For example, Jackson, et al. (2007) titled the paper “Knowledge of memory aging and Alzheimer’s disease in college students and mental health professionals” (p. 258). When it comes to the use of jargon, both Jackson, et al. (2007) and Hudson, et al. (2008) do not utilize it as much as the articles in the other two fields. These articles use numerical values as well, like the other fields. They utilize graphs as well as numerical values implemented into sentences. A graph by Jackson, et al. (2007) is shown below (p. 260). A final major language difference between the previous fields and the psychology field is that the psychology articles use a combination of both active and passive voice, while the other fields stuck to one or the other.

Table 3. Pre- and post-lecture mean FSA scale scores as a function of group.

Group/score	Pre-lecture		Post-lecture	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
College students				
Total	66.79	10.13	69.29	12.63
AL	24.41	5.23	24.98	6.82
D	18.90	3.16	19.81	4.07
AV	23.47	4.71	24.50	4.39
Mental health professionals				
Total	60.07	8.34	59.82	9.61
AL	21.73	3.94	21.04	4.26
D	16.73	2.77	17.18	4.33
AV	21.60	4.67	21.61	4.47

Notes: AL = antilocution, D = discrimination, AV = avoidance.

Structure

When studying six articles within these three disciplines, there were clear differences in the overall structure of the writing. Starting with the articles in the engineering field, the overall structure is not completely IMRaD, but has some of those subcategories as well as subcategories of its own, such as conclusion and methods sections, or morphing and animation sections. A common feature between the two engineering articles, written by Li, et al. (2018) and Durikovic,

et al. (2001) is that they utilize sub headers within each subtitle. This allows the writing to be more organized and easier for the reader to read and comprehend. For example, under the “methods” section, Li, et al. inserts subcategories such as “DNA origami design details” and “rectangular DNA nanosheets” (2018). Durikovic, et al. includes subcategories as well, such as “Model of Stomach” and “Central Skeleton” (2001). In addition, both articles contain an abstract, although neither explicitly labels “abstract.” Another similarity is that both journal articles are written in a two-column format. Both articles, overall, follow a methodological framework, which is common in research papers like these. A methodological framework within a paper represents a framework where the paper follows the exploration of a topic through the development of a general method to study the topic. Another similarity is that both Li, et al. (2018) and Durikovic, et al. (2001) utilize visual displays of quantitative data throughout their writing, such as tables, graphs, and diagrams. Examples of these are seen below. These factors are the most important to note going forward as the comparing and contrasting of other sources begin.

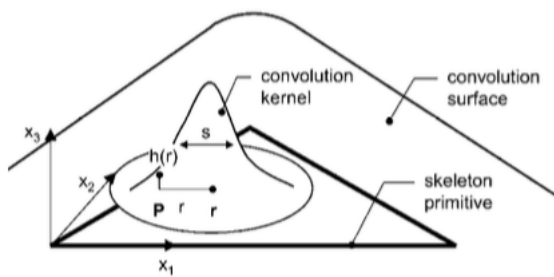
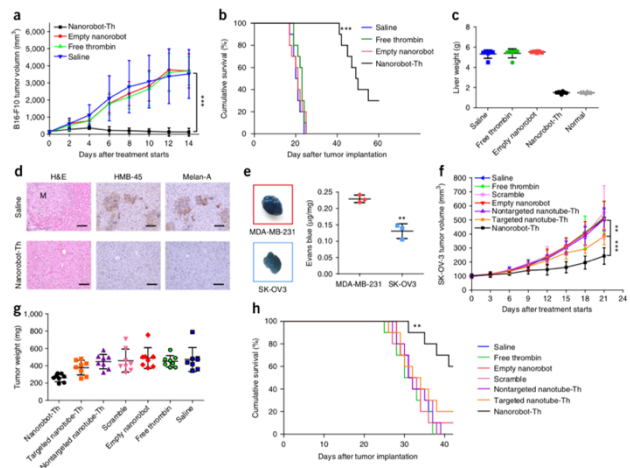


Figure 1. The convolution kernel.



When examining the articles in the psychology field, written by Hudson, et al. (2008) and Jackson, et al. (2007) the first structural component I noticed was the clear presence of IMRaD.

Unlike the readings in the engineering field, the psychology articles had clear sections including introduction, methods, results, and discussion. Although this was a difference, a common structural aspect between the two fields was that both articles included many sub headers in the psychology field, just like in the engineering field. The psychology articles had sub headers such as “overview of scoring and analysis” (Jackson, et al., 2007) and “participants” (Hudson, et al., 2008). Both articles contain an abstract, similarly to the engineering papers, although in Jackson, et al.’s (2007) paper, the abstract is in paragraph form, while Hudson, et al.’s (2008) breaks the abstract down into sections including objective, methods, results, and conclusion (Hudson, et al., 2008). Also, identical to the engineering articles, these articles follow the two-column format and have generally methodological framework. Like the papers in the applied fields, these papers in the social sciences include visual representations of quantitative data, but this time it is only in the form of data tables, as seen below by Hudson, et al., (2008) and Jackson, et al., (2007). There are many common themes between the two fields, and it will be interesting if the trend continues with the natural science field.

Table 1. Proportion of each non-cases, sub-threshold and actual cases fulfilling PCL criteria B-D and scoring above the cut-points.

	No trauma	Criterion A only	Criterion A + atleast one other	PTSD case (criteria A + B + C + D)
<i>N</i>	41	26	23	10
Percentage fulfilling PCL criterion B	24	23	65	90
Percentage fulfilling PCL criterion C	12	19	17	80
Percentage fulfilling PCL criterion D	21	31	48	90
Percentage scoring above 50 on PCL	2	4	4	40
Percentage scoring above 36 on PCL	10	12	17	90

Table 1. Pre- and post-lecture mean K-MAQ scores as a function of group and question type.

Group/question type/DK option	Pre-lecture		Post-lecture		Mean
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
College students					
Normal	0.69	0.14	0.75	0.16	0.72
DK normal	0.06	0.08	0.02	0.05	
Pathological	0.69	0.12	0.78	0.14	0.74
DK pathological	0.08	0.11	0.02	0.04	
Mental health professionals					
Normal	0.78	0.07	0.83	0.09	0.81
DK normal	0.04	0.06	0.01	0.03	
Pathological	0.88	0.08	0.94	0.06	0.91
DK pathological	0.02	0.06	0.01	0.02	

Note: Entries are proportion correct.

When reading the articles in the natural sciences, there were noticeable similarities and differences when compared to those in the applied fields and social sciences. For starters, the natural science articles follow a strict IMRaD format, similarly to those in the social sciences. Unlike some of the other fields, the natural science articles provide a clearly labeled abstract as well. Similar to both the social sciences and the applied fields, the natural science articles utilize sub headers within each major subtitle, specifically within the methods and results section with titles such as “plasmids and viral stock production” (Diez-Fuentes, et al., 2019) and “the presence of KBV RNA in adult and nymph mites” (Shen, et al., 2005). Also similar to the other fields, the natural science papers use the two-column format as well as follow a methodological framework. Natural science articles also provide many forms of data visualization. Overall, the main similarities between these six articles are the presence of two-column format, data visualizations, and abstracts.

Reference

My six chosen articles had many similarities and differences when it came to reference. To begin with the applied fields, these two articles showed few differences when it came to reference. Both articles utilized a small number when in-text citing their references. Later in the reference page, these numbers each represented a source. A difference between the two articles and their in-text citations is that Li, et al. (2018) often cited the figure that was being mentioned, for example; “In addition, most of nanorobot-Th maintained their nanostructures over a 24-h period in the presence of bovine serum albumin (BSA) or fetal bovine serum (FBS) (Supplementary Fig. 21), suggesting a potential high stability in blood circulation” (p.260). When looking at the references section, the authors use similar, but not the same citation style. This is seen to be IEEE format, commonly used in the field of engineering. One major reference

difference between the two articles is that Durikovic, et al. (2001) includes both an author biography section as well as an acknowledgements section. These are not present throughout Li, et al.'s writing. The author biography inclusion in Durikovic et al.'s article is probably due to the fact that there were only two or three authors, while Li, et al.'s had over 10 authors.

The next field to examine is psychology. When studying the in-text citation style, it is hinted that APA formatting is being used by the author, year format. This is shown in examples by both Jackson, et al. (2007) and Hudson, et al. (2006), respectively: "Fraboni et al. (1990) showed the FSA to have adequate overall internal consistency reliability (0.86)" (p.260) and "Those with PTSD may somatize and present to general medical services instead of mental health services (van Zelst et al., 2006)" (p.672). The APA format is also present in the reference sections at the end of the articles. Here, the sources are listed alphabetically by last name, rather than numbered by mention like the applied fields. Neither of the social science articles reference or cite their data visualization as common as that in the applied fields. These articles have an interesting similarity to those in the applied fields, as one contains an acknowledgements section, while the other does not. The reference section stands out as a clear difference between the applied fields and social science fields.

The last field to study reference for was the natural sciences. The two articles I chose differ slightly when it comes to references. Similar to the applied fields, Diez-Fuentes, et al. (2019) in the natural science field utilized a number system to cite and those sources show up in order of how they were mentioned in the references section. Although Shen, et al. (2005) takes the approach the authors in the social science field did by citing the author's name and year in the in-text citations and listing them in alphabetical order in the references section. For example, Diez-Fuentes, et al. (2019) says "The importance of UBXN6 in HIV-1 immunopathogenesis

could be explained by the specific role of UBXN6 as a cofactor of the complex formed by CAV1 and VCP [27]” (p. 113), while Shen, et al.’s (2005) in-text citations look like this; “In addition, migratory beekeeping practices and the importation of infested stocks of bees have aided the rapid distribution of varroa mites through large geographical regions (Sammataro et al., 2000)” (p. 141). The formatting for the citations for both articles seems to be in CSE, which makes sense, as this is a science paper. One last thing I noticed, similar to some papers in the two other fields, was that both natural science papers included an acknowledgements section. It’s clear to see here that each discipline has its own way of referencing sources utilizing many different formats based on the subject or discipline the writing pertains to.

Discussion

Throughout the process of completing this project, the main takeaway I learned was that conventions in writing vary so much by just the slight change of a subject or discipline. For example, biomedical engineering and biology are fields that are similar, yet the conventions that each discipline require are completely different and underscore the importance of learning to write across the curriculum. Through this research, the understanding of WAC is expanded by highlighting the major language, structure, and reference convention differences between various fields. What often isn’t seen through surface level reading of these articles is examined and analyzed more thoroughly in this research. There are holes to this research that can be further examined in the future. For example, what types of writing conventions do students often struggle the most with while writing across the curriculum, and why is that? What effect do these constantly changing conventions have on students and their ability to write? I hope that this research is able to contribute to ongoing research regarding WAC in the future.

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