IMPROVING STUDENT OUTCOMES IN HIGH-ENROLLMENT STATISTICS CLASSES WITH THE STRUCTURED WRITING APPROACH

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Abstract

In this article we provide evidence for the positive impact of writing on student learning in statistics and offer a tested solution for the challenge of making writing feasible in high-enrollment classes. We introduce a structured writing assignment to promote critical thinking and deep learning for students and ease of grading for instructors. The structured writing assignment simplifies writing for students by providing them with specific components to complete that follow categories of Blooms taxonomy. The assignment requires students to explain a complex statistical concept to a 5th grader, thus promoting deeper learning because students need to think through statistics concepts without using field-specific terminology. The assignment is also easy to implement and grade for instructors because the teaching materials represent an LMS-ready unit, and structured writing makes reading more efficient. We assess student outcomes using exam scores and surveys, and instructor outcomes via grading-time data.

Key Words: introductory statistics; classroom activities; teaching materials for hypothesis testing; writing across the curriculum; writing in high-enrollment classes; structured writing

Introduction

A key part of developing statistical literacy is learning how to interpret, critically evaluate and communicate statistical information (Gal, 2002); it is a way of "transnumerative thinking" that enables students to make sense of data in order to interpret the world around them (Chick, Pfannkuch, and Watson, 2005). Clearly, writing is beneficial for developing such literacy. Not only does writing encourage students to think critically and apply new concepts to everyday life, it also promotes overall interest in a particular area of study (NCTM, 2000; Cheng et al, 2017; Hulsizer & Woolf, 2009; Parke, 2008; Radke-Sharpe, 1991, Snee 1993), which, in turn, helps develop higher-level quantitative skills (Hayden, 1989) and conceptual understanding (Lipson & Kokonis, 2005). Writing also improves learning outcomes, especially for students who are not well grounded in mathematics (e.g., Gordon et al, 2005; Holcomb & Ruffer, 2000; Kaplan et al, 2014), because it supports mental processing and understanding (Aspinwall et al, 2008, Pfannkuch et al, 2014). It shows to students the true interdisciplinary nature of statistics and that communicating clearly is key to being a good statistician (e.g., Bailar, 1988; Moore, Peck & Rossman, 2000; Pfannkuch & Wild, 2004; Stromberg & Ramanathan, 1996).

While the skills of effectively communicating about statistics are incredibly important, developing such skills is not the only benefit of including writing into statistics classes. Writing-to-learn, as different from learning to write/communicate about statistics, proved to be a helpful tool in understanding statistics concepts (Pfannkuch, Arnold, & Wild, 2015). The focus of writing-to-learn is not to produce a polished text through multiple revisions but to catalyze further learning and meaning making (Fisher & Frey, 2004; Knipper & Duggan, 2006). Learning through writing is possible because the processes of writing and learning have many similarities (e.g., Emig, 1977; Hayes, 2000; Winne, 2001), and writing supports the learning strategies of rehearsal, elaboration, organization, and self-monitoring (e.g., McCrindle & Christensen, 1995). Although it is common to use writing as a tool for learning (Thaiss & Porter, 2010), writing-to-learn is too demanding of teacher time to be used in high-enrollment (>200 students) introductory statistics classes, as are most writing assignments (Wild, Triggs, & Pfannkuch, 1997).

In this article, we offer a new writing-to-learn format, structured writing or creating texts with blocks of content that follow a fixed set of rules. We show that using the structured writing approach, we help students to improve their understanding and application of the concept of hypothesis testing. In addition, this approach allows making writing-to-learn feasible in high-enrollment statistics classes from the instructors' viewpoint. In what follows, we first describe the concept of structured writing, the

assignment setup, and the data collection and analysis. We then analyze and interpret the results of the study. Finally, we provide concluding remarks and directions for future research.

Structured Writing

The concept of structured writing stems from technical communication and is broadly defined as writing that follows a specific set of explicit constraints that serve a defined purpose (Baker, 2015). For instance, a recipe presents a very basic example of what structured writing would look like. There are typically two sections in a recipe. The ingredients section presents a list of items one needs together with amounts for each item. The directions section is a numbered list, with each point on the list representing a step in the cooking process. We are so used to this structure of recipes that, with some experience, it takes us seconds to scan and evaluate a recipe. The structure makes it easier to follow a recipe because you can find the step you are on faster. The structure also simplifies the work of the author because there are not many decisions about how to write, so the authors can concentrate on what to write. Structured writing has many facets for technical communication (e.g., determining information types; machine readability). Yet for our project we rely on its basic concepts for the following benefits:

- structured writing is easily learned and, once learned, it helps writers to start writing and to write fast
- documents created with the structured writing approach are more user-friendly because they provide a more intuitive and consistent experience for readers (Horn, 1998).

In such a way, not only does structured writing help students write, it can make grading more straight-forward and more time efficient because writing created with the structured approach maximizes the efficiency with which texts can be read, understood, and evaluated.

Assignment Setup

In the spring of 2016, we developed a structured writing assignment that asked students to explain a specific concept (hypothesis testing) to a specific audience (5^{th} graders) (see also Gordon et al. (2005) and Niglas & Osula (2005) for the benefits of using everyday language). We used hypothesis testing as a topic because it is a cornerstone of the introductory statistics course and notoriously difficult to master for students (see also Watson & Chance, 2012).

The assignment required students to write under structured writing constraints and only include content related to the following sections: brief definition of the concept, long example or personal experience, compare and contrast, and short example and application (see Table 1). The structure of the writing assignment broadly follows stages of Bloom's taxonomy (Bloom, 1964). Each component of the structured writing assignment is related to a different stage of learning and broadly follows a related 'action verb.' Giving students the task to write a short explanation of a concept from the course and including a brief example, real-life context, or scenario is not uncommon in statistics classrooms (e.g. Callingham et al, 2018; Stromberg & Ramanathan, 1996; Green & Blankenship, 2015). The novelty of our assignment is its very specific imposed structure combined with the inclusion of a novice, lay audience.

Together, all four components must be no longer than 500 words—the common length for 'short' papers recommended in an introductory statistics course (e.g., Cheng, et al, 2017). This restriction not only trains students to be concise in their writing but also limits the amount of reading the instructor has to do.

To make implementation easy for instructors, we created a detailed module that can be easily incorporated into common learning management system platforms such as Blackboard or Canvas. The module for the structured writing assignment consists of the explanation of the assignment, the sample of the structured writing assignment (standard deviation), and the constrained writing environment. The module is designed in such a way that it can be easily reused and no time for explanation during class is needed (the sample assignment and the assignment prompts are available online at[1]).

[1] Web address deleted throughout the manuscript for the blind peer review process

Table 1: Overview of the Writing Tasks, Their Explanation, and Correlated Bloom's Taxonomy Verbs[2]

Task	Explanation	Bloom's taxonomy 'action verb'
Define hypothesis testing	Student provide the definition that is one sentence long, must be written in their own words, and must be understandable for an audience without any prior knowledge of statistics (5th grader). A requirement was to not use any technical terms.	Define (helps students to improve basic comprehension and knowledge)
Provide a long example or describe a personal experience	Students relate the learned material to their own lives and bring the material to life by creating a personal story. This form of reflection improves the retention of key concepts and helps students reach a more advanced stage of comprehension.	Apply (pushes students to use their knowledge beyond the level of remembering)
Compare and contrast	Students are required to think about similarities and differences to other statistical concepts and thus reach the learning goal of analysis.	Analyze (encourages students to deconstruct the concept)
Describe an application of the concept or provide a short example	Students are required to apply the concept to everyday life or to think of a very concise illustration of the concept. This part of the assignment helps students reach the learning goal of synthesis.	Generate/design (encourages students to put the parts of the concept together to form a new, integrated whole)

Data Collection and Analysis

We ran the preliminary study during fall 2016 and used this preliminary study to gather feedback from students about the sample writing material, grading, and assignment prompts. Based on the feedback, we revised the assignment in fall 2017 and included an alternative writing assignment to establish an additional control group. The alternative writing assignment asked students to write a memo about a newspaper article and suggest how the use of hypothesis testing could improve the article. Students self-enrolled into three groups: 1) no additional writing assignment (control group 1); 2) alternative writing assignment (control group 2) and 3) the structured writing assignment (treatment group).

While students took four exams, to measure the effects of the structured writing assignment we use the scores for exam 3 and the final exam because those were the only two exams that contained questions related to hypothesis testing. Students completed the writing assignment for extra credit and submitted it the day before exam 3. Final exam and exam 3 are usually less than a week apart and students did not

[2] Student handouts are available online at

receive feedback and scores for their submissions until after the final exam. The homework, including the structured writing assignment, and exams were completed using an online platform; exams consisted of multiple choice questions. It is worth noting that the final exam is optional, so participation in the final exam dropped as compared to exam 3 by 28%.

The study includes data from two classes from fall 2017 (see Table 2)—530 students who consented to participate in this study[3]. Out of these 530 students, 416 students completed the structured writing assignment and 29 completed the alternative writing assignment. We use information about academic level and the prior number of business and math classes to control for maturity, study skills, and ability of students in the regression analysis and as confounders for propensity score matching. We use the major of students to control for possible engagement in the class: Business Statistics is a core class in the Business and Economics curriculum, thus students in these majors likely display a different level of effort in this class. We use participation in homework assignments to also control for the level of students' engagement in the class.

[3] The researchers obtained an IRB approval for the use of the student data.

Table 2: Descriptive Statistics

	N	Mean	StDev	Min	Max
Exam 1 %	527	80.1%	13.1%	20%	100%
Exam 2 %	522	74.9%	13.9%	28%	100%
Exam 3 %	522	69.1%	14.7%	28%	100%
Final %	377	70.3%	14.5%	20%	100%
points structured writing[4]	416	20.769	5.8	0	30
points alternative writing	29	24.828	5.745	10	30
Homework participation	530	92.6%	11.3%	41.7%	100%
Quiz participation	530	95.2%	8.4%	41.7%	100%
Previous Math/Stats classes	503	2.35	1	1	9
Academic level	530	2.334	0.599	1	4
Age	530	19.558	1.726	17	43
Structured writing completed	416	78.5%			
Alternative writing completed	29	5.5%			
Male students		55%			
Business/Econ majors		94%			
First year students - Freshman (1)		0.80%			
Second year students - Sophomore (2)		71.10%			
Third year students - Junior (3)		22.10%			
Fourth year students - Senior (4)		6.00%			

Results and Discussion

Evaluating Student Outcomes

To evaluate student outcomes, we use treatment effects estimation (see Figure 1) and regression analysis (see Figure 2) with student exam scores as the dependent variable.

[4] 30 points for the writing assignments are equivalent to 3% of the overall course grade; grading scale is 0,10,20,30.

Figure 1: Impact of the Structured and Alternative Writing Assignments on Grades (Treatment Effects Estimation – 90% CI)

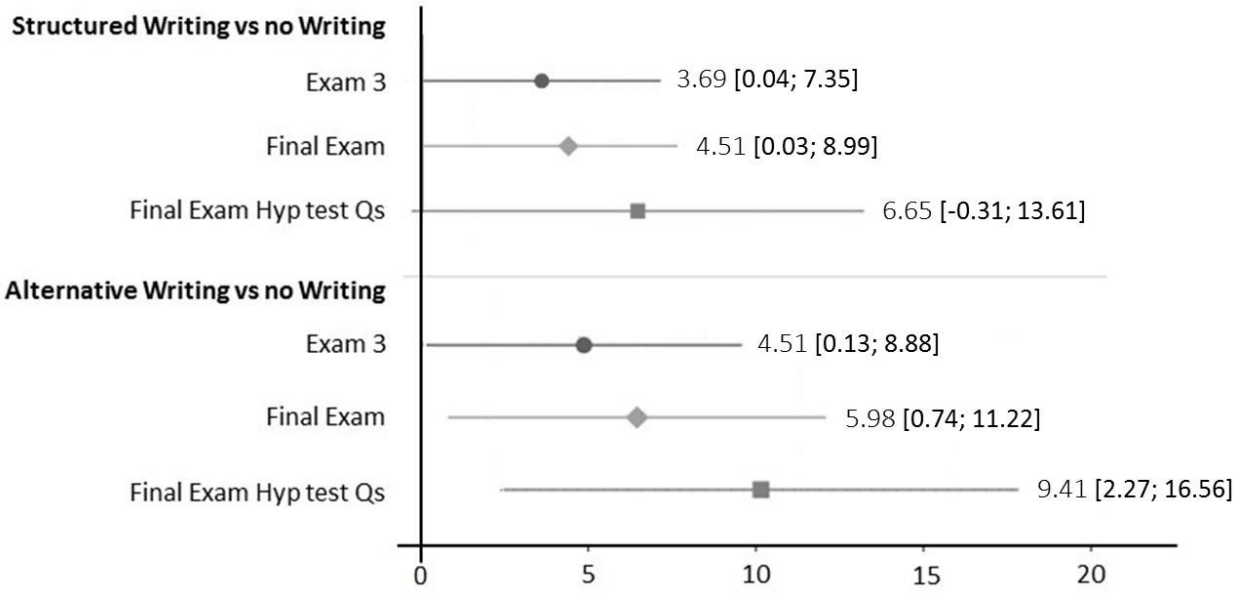


Figure 1 shows the results of a treatment effects estimation and reports average treatment effects on the treated—the difference between those actually treated and their counterfactuals. Relying on available student data, we created these counterfactuals to resolve the difficulty with applying randomization to assign treatment and control groups, which is a typical problem of classroom research. The only way to create such a quasi-experiment scenario for statistical purposes is to use tools such as inverse probability weighting together with a regression adjustment approach. Using this setup, we can account for the possibility that students selected themselves into treatment and control groups based on their personal characteristics. Thus, we can account for the possibility that students who received the treatment of structured writing may be systematically different from students who did the alternative writing assignment and students who did no writing assignment. Using this statistical approach allows us to model the treatment assignment process and also to account for the outcome adjusted for the nonrandom assignment process and self-selection bias. We use the background variables of major, gender, academic level, and residency status together with performance variables of exam 2 scores, enrolled credit hours, and cumulative GPA to model the decision to participate in the writing assignment.

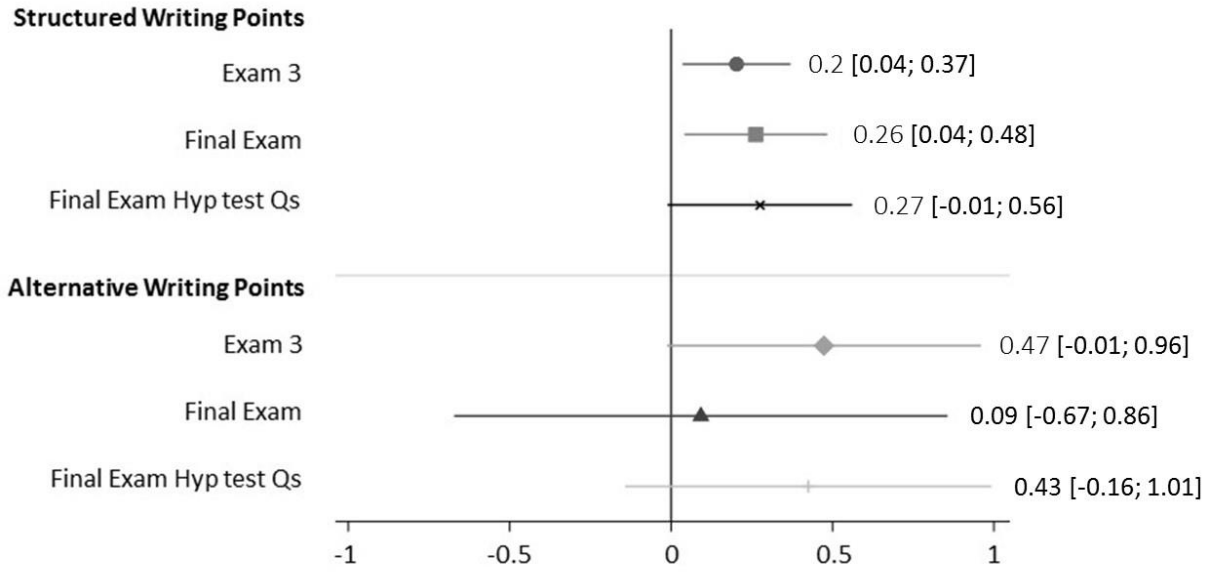
Using no writing and an alternative writing assignment as the control groups we find some evidence that (1) both the structured writing and the alternative writing assignments improved exam outcomes; (2)

although the alternative writing assignment resulted in a larger improvement, the improvement after the structured writing assignment was comparable (see Figure 1 and for more details Table 4 online at). On average students who complete the structured writing assignment have between 3.7 (p-value: 0.090) and 6.7 (p-value: 0.116) percentage point higher exam scores compared to the students who do no writing. The average impact of the alternative writing assignment for the average treatment effect on the treated is between 4.5 (p-value: 0.096) and 9.4 (p-value: 0.030) percentage points. Since the participation in the final exam is not mandatory, exam 3 results provide more reliable results because they show a more complete distribution of all student ability levels.

In addition to analyzing the effects of completing the structured or the alternative writing assignment on the exam scores, we were also interested in learning whether how well the students completed either of the two writing assignments had an impact on the exam scores. For this purpose, we use a regression setup that includes the scores the students received on each of the writing assignments as the key explanatory variable along with several other control variables.

For students who completed the structured writing assignment, we find that on average each 10-point improvement (graded on 0,10,20,30 scale) increased exam scores by 2 percentage points (p-value: 0.046) on exam 3 and 2.6 percentage points (p-value: 0.051) on the final exam (see Figure 2 and for more details Table 5 online at). Thus, we see that on average higher quality of the structured writing assignment as measured through an improved score on the assignment leads to better exam scores. We do not find evidence of such an effect for the alternative writing assignment.

Figure 2: Impact of Writing Quality on Exam Scores (Regression Estimates – 90% CI)



In addition to learning about exam scores, we were also interested in examining students' opinions about the structured writing assignment. We analyzed the results of a survey, which students completed after the writing assignment and in which they evaluated the assignment. The survey was available through Qualtrics (an online survey platform) and consisted of eight questions. As part of the survey students were asked about the amount of time they spent on the assignment, whether the assignment encouraged them to consider material beyond the classroom material, the helpfulness of the assignment, comparison to other assignments, and suggestions for improvement; in addition, students provided open-ended feedback. 408 students completed the survey and their responses were anonymous.

Overall, the response of students to the structured writing assignment was positive (see Table 3).

Table 3: Student Survey Results

Question Number	Question text	Results
1	Which writing assignment did you choose?	*[Students chose between the two options]*
2	How much time did you spend on the writing assignment?	On average 30 – 60 minutes
3	Did the assignment lead you to study material for the writing assignment that you otherwise would not have looked at?	85% of students reported that they reviewed material for the assignment they otherwise would not have.
4	Do you think doing the assignment helped you prepare better for the topic on the exam relative to just having a regular homework?	75% of students thought that the structured writing assignment prepared them better for an exam than a regular homework assignment.
5	How easy was the assignment compared to a regular homework assignment?	54% of students reported that the structured writing assignment was easier.
6	How helpful was the assignment compared to a regular homework assignment?	96% of students reported that the assignment was more helpful.
7	What did the assignment help you with?	55% of the students reported that the structured writing assignment improved their understanding of the material.
8	Is there anything you would change about the assignment?	65% of students reported that they would not change anything about the assignment; the most common complaint (5% of all students) was to increase the word count for the assignment.

Comments by students in the open-ended question of the survey showed that they gained a deeper understanding of the topic through the structured writing assignment. Below are the two most representative comments:

> "It helped me actually understand the concept of a hypothesis test. I used to think of it more mathematically whereas now I think of it more conceptually."
>
> "It helped me to simplify my own understanding of what a hypothesis test is. Also, pretending to teach material is very helpful for solidifying a concept."

Based on student feedback we conclude that the structured writing assignment is a very suitable alternative to traditional writing-to-learn assignments.

Evaluating Instructor Outcomes

To evaluate instructor outcomes (feasibility of implementing the structured writing assignment in high-enrollment classes), we measured how long it took the instructor of the class to grade the writing assignments.

One statistics instructor graded 416 structured writing assignments and 29 alternative writing assignments based on the rubric provided online at [website address]. Students' submissions could be automatically downloaded from Qualtrics[5] in a spreadsheet format. The spreadsheet format aided the grading by removing the necessity of opening a new document for each student but rather displaying all student submissions side by side. Grading each structured writing assignment was faster: it took 30-60 seconds per student versus 2-3 minutes for the alternative assignment (this is observational data based on grading 445 submissions in Fall 2017).

In addition, grading of the structured writing assignment got progressively faster with the number of graded assignments, while the grading of the alternative writing assignment got slower. We suspect that this is due to the initial learning curve for grading the structured writing assignment, which, however, is then counteracted by the tiredness levels resulting from grading of the unstructured writing assignment. Therefore, with an even number of structured and unstructured writing assignments, the grading time difference would likely be even larger.

Conclusions, Limitations, and Suggestions for Future Research

In this article, we offer a new writing-to-learn assignment format for high-enrollment statistics classes that helps overcome the grading burden. The new format is based on the concept of structured writing from technical communication. We find some evidence that on average our assignment format improves students' understanding of course concepts (e.g., hypothesis testing) and that it is fast to grade for instructors and well-liked by students.

One possible limitation of the data analysis in the study is that the data suffer from omission bias. Internal analysis at the host institution of the study showed that exam scores were significantly higher for students who provided consent to participate in the study. Thus, the grade distribution is truncated, and it was not possible to measure the impact on student populations at the lower end of the grade

[5] Having the student submissions available in a spreadsheet format is a feature of the survey platform, Qualtrics, which was used for submissions.

distribution who were of particular concern. Missing students at the lower end of the grade distribution can also limit the ability to find evidence for the impact of the assignment on exam scores. In addition, since the final exam was not mandatory, students who were happy with their grade before the final exam chose not to take it. Dropping the final exam can bias the results upward since very likely only students at the middle and lower end of the grade distribution took the final exam, which could lead to overestimating the effect of the writing assignments on the exam scores. However, there is also a potential downward bias from students who benefited the most from the writing assignment not participating in the final exam.

Future iterations of this project should include grading of the same assignments by multiple additional faculty to independently verify the accuracy of the estimated grading time. Furthermore, future research should expand the topics beyond just hypothesis testing. We plan to develop a rubric for designing similar assignments on different topics. Another helpful strategy would be to include an audience persona into the template: an archetype of a specific audience group with needs, expectations, goals, and values. Research shows that personas help writers focus on people they write for and make better writing decisions (e.g., Personas; Goodwin, 2011).

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Supplementary Online Information

Structured Writing Assignment Prompt

Provide a *simple* explanation of hypothesis testing. Your explanation needs to be so simple that a fifth grader can understand it. Make sure your explanation does not include any statistical jargon. Your explanation must be age-appropriate and not use any words that would be beyond the abilities of a fifth grader.

Use the following template that (you will fill in the blank sections) researchers have found successful in explaining complex concepts to children.

Your submission should consist of four items (follow the prompts):

- Definition: What is a hypothesis test? Explain in one short sentence.
- Long example/Personal experience: How would a fifth grader relate to a hypothesis test? What experiences in their life can be related to this concept?
- Compare/Contrast: Is there anything that a hypothesis test can easily be confused with? What is it NOT? Remember that your fifth grader still needs to be able to relate to these examples.
- Short example(s)/Application: Are there any other areas that could make hypothesis tests a useful concept for fifth graders? You can also push their limits and provide examples of how people in different professions use this concept.

How your writing will be evaluated (your submission should consist of 250-500 words total):

- 30 points: each section of the template is filled, explanation and information are sufficient for a fifth grader, there is no jargon.
- 20 points: each section of the template is filled, but information is insufficient, there is no jargon
- 10 point: all sections of the template are filled, but information is insufficient, there is some jargon
- 0 points: some sections of the template are unfilled, there is much jargon

Alternative Writing Assignment Prompt (Fall 2017)

Pick a news item and describe how the use of hypothesis testing could have improved the coverage of the news item. Include the hypothesis statements in your essay, describe the hypothesis statements, and justify your decision. Include the complete reference for your news items in your submission.

How your writing will be evaluated (your submission should consist of 250-500 words total):

- 30 points: Well explained how news item can be improved using hypothesis testing
- 20 points: Good explanation of how news item relates to the hypothesis testing but some use of statistical terminology is incomplete
- 10 point: explanation is incomplete and some statistical terminology is used incorrectly
- 0 points: poor explanation, wrong use of statistical terminology

Sample Structure Writing Assignment (Standard Deviation)

Definition: The standard deviation tells us something about how spread out a group of numbers are relative to the middle of the numbers.

Long example/personal experience: It is one week after Halloween trick-or-treating and you want your favorite ice-cream. Your parent is worried, however, that you have eaten too much candy this week. They count the remaining candy in your pumpkin bucket and say: "You have eaten 28 pieces of candy this week – that is only 4 pieces of candy per day! Very good, let us go and get you some ice-cream."

But did you actually eat only 4 pieces of candy each day this past week? Oh, no ☺. Now is a good time to talk about standard deviation.

The standard deviation of the number of pieces of candy eaten per day tells us something about how consistent we were in our daily candy eating.

A large standard deviation would mean that you had 22 pieces of candy the day after Halloween, then you got worried that your parent would notice and get upset (and may be your stomach was hurting) and so you then had only 1 piece of candy each day for the rest of the week. You see how the numbers 1, 1, 1, 1, 1, 1, are far from the number 22? That large spread in the numbers makes for a large standard deviation.

A small standard deviation would mean that you decided to have about the same number of pieces of candy every day, for example having 7 the day after Halloween, then 2 the day after that, then 3, then 5, then 4, then 6, then 1. You see how numbers 1,2,3,4,5,6,7 are close together? That small spread in the numbers makes for a small standard deviation.

Compare/Contrast: So, is standard deviation simply the distance between the smallest and the largest number? Oh, no. What grown-ups measure with the standard deviation is the difference between how many pieces of candy you ate each day and the number of pieces of candy you ate on average each day. And the standard deviation would be very small, 0, if you really ate 4 pieces of candy every day.

Short Example/Application: One application of the standard deviation would be in planning for a birthday party. Let us pretend that we always have 20 people (cousins, friends, and relatives) at our birthday party, but not all might eat a piece of cake. Should we have a cake that serves 20 people or will a smaller cake work? If the standard deviation of pieces of cake eaten is large, then it would be hard to determine how many will eat cake at the next party, so we better have a cake that serves 20 people. If the standard deviation of pieces of cake eaten is small, then we can prepare a cake that will serve close to the average number of pieces of cake eaten, say 12, and be reasonably certain that we will have enough cake.

Appendix Estimation Results

Table 4: Treatment Effect Estimation			
	Fall 2017		
	Exam 3	Final Exam	Final Exam Hypothesis Testing Q
ATET (S) vs (0)	0.0369*	0.0451*	0.0665
St. Err.	0.0222	0.0319	0.0423
ATET (A) vs (0)	0.0450*	0.0597*	0.0941**
St. Err.	0.0267	0.0272	0.0434
ATE (S) vs (0)	0.0194	0.0116	0.0378
St. Err.	0.0142	0.0189	0.0268
ATE (A) vs (0)	0.0118	0.1052***	0.1585***
St. Err.	0.0231	0.0292	0.0269
Treated (S)	0.6938	0.7047	0.7223
St. Err.	0.0068	0.0080	0.0112
Treated (A)	0.6862	0.7983	0.8429
St. Err.	0.0202	0.0237	0.0096
Control (0)	0.6744	0.6931	0.6844
St. Err.	0.0139	0.0179	0.0253
N	514	369	369
ATET = average treatment effect on the treated, ATE = average treatment effect, * p<0.10, ** p<0.05, *** p<0.01, robust standard errors reported; S = structured writing assignment, A = alternative writing assignment, results generated with stata teffects ipwra			

Table 5: Regression Analysis						
	Exam 3		Final Exam		Final Exam Hypothesis Q	
Structured writing=S Alternative writing=A	S	A	S	A	S	A
writing score	0.0020**	0.0047	0.0026*	0.0009	0.0027	0.0043
	(0.0010)	(0.0028)	(0.0013)	(0.0041)	(0.0017)	(0.0031)
Homework score	-0.0388	-0.2564	0.0916	0.7012*	0.1090	0.8506**
	(0.0620)	(0.1659)	(0.0855)	(0.3212)	(0.1148)	(0.3120)
Business/Econ Major	-0.0501*	0.2163***	-0.0598*	0.4208***	-0.0571	0.2280***
	(0.0273)	(0.0295)	(0.0357)	(0.0551)	(0.0547)	(0.0492)
Academic Level	0.0303***	0.0110	0.0183	0.0894	0.0353*	0.3542***
	(0.0112)	(0.0781)	(0.0133)	(0.1046)	(0.0204)	(0.0548)
Score Exam 2	0.1616***	0.0123	0.1137*	-0.0253	0.0585	-0.0660
	(0.0515)	(0.1371)	(0.0630)	(0.1906)	(0.0869)	(0.1529)
Enrolled credit hours	-0.0046	-0.0243	0.0009	-0.0749**	-0.0029	-0.1083***
	(0.0037)	(0.0151)	(0.0044)	(0.0313)	(0.0069)	(0.0251)
Residence	-0.0195*	0.0338	0.0182	-0.0805	-0.0105	0.0265
	(0.0117)	(0.0460)	(0.0143)	(0.0672)	(0.0215)	(0.0444)
Previous Math/Stats classes (#)	-0.0085	0.0124	0.0005	-0.0494	-0.0095	0.0621*
	(0.0064)	(0.0222)	(0.0087)	(0.0499)	(0.0130)	(0.0289)
Cumulative GPA prior semester	0.1681***	0.3149***	0.1513***	-0.0624	0.1721***	-0.0009
	(0.0189)	(0.0676)	(0.0226)	(0.0999)	(0.0341)	(0.1231)
Constant	0.0935	-0.1755	-0.0511	1.1970	0.0047	0.6721
	(0.0996)	(0.3153)	(0.1166)	(0.6828)	(0.1836)	(0.6538)
R2	0.356	0.725	0.258	0.847	0.156	0.903
N	405	29	299	18	299	18
F	27.347	.	13.756	.	6.651	.
* p<0.10, ** p<0.05, *** p<0.01, heteroscedasticity corrected standard errors in parenthesis						