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Table of Contents

Note from the Editor: The Direction of Developmental Education

Fellow Educators,

This is both an exciting and challenging time to be involved in developmental education. As demand for developmental education rises, particularly in community college settings, educators must innovate their practices. Examples of teaching innovations can be seen all around the state of New York and the country as a whole, making outlets such as the journal an integral compilation of best practices for the developmental educator. For this reason, I am ecstatic to serve as co-editor of this journal.

One innovation I would like to draw attention to is the accelerated learning program (ALP). ALP is gaining popularity in many developmental education settings, though it can take shape in many different ways. Traditionally, ALP would be implemented where one instructor teaches a class, such as a freshman composition course with half developmental students and half college-level students together; however, the developmental students would also take a support class with the same instructor. Some programs are moving ALP models to hybrid and online formats, as well as changing up the composition of developmental to regular students. I am not saying one of these models is better than another, only research can determine such a phenomenon, I merely want to call attention to all of the innovative practices happening with this base model.

Despite pedagogical innovations, some institutions are moving towards eliminating developmental education programs completely. To many, this may seem counterintuitive given the rising number of underprepared students entering college, but some administrators see developmental education as a high-cost area. Here is how I view developmental education: a key to retention. Developmental education not only teaches a set curriculum, but it also helps students build basic college success skills, such as organization, goal-setting, and wellness strategies. Equipped with these skills, students are more likely to persist through their programs, which ultimately increases the financial viability of educational institutions.

What does all of this mean for the future direction of developmental education? I wish I could answer this question with complete accuracy, but none of this can fully envision the future. I do believe that through continuing pedagogical innovation and an increased research base continuing to link developmental education with increased student retention, developmental education will become a more treasured part of the higher education landscape.

At this critical juncture in the life of developmental education, I am excited to see the body of research expand to help inform future practice. For this reason, I encourage all of you to conduct research and submit your findings to this journal for publication. Happy innovating!

Sincerely,

Jesse M. Redlo, Ed.D. Candidate, M.S.
Co-Editor, Journal of Research and Teaching in Developmental Education

A Note from the Editor: Shifting Gears in the Developmental Education Landscape

We can all agree that the college classroom looks very different than the college classroom of a decade ago. The confines of a brick and mortar space for learning have been transformed into spaces, both virtual and physical, that empowers the student to explore learning in ways that were otherwise unavailable in years prior.

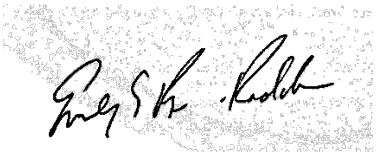
Higher Education is not new to paradigm shifts; however, the fundamentals of developmental education have remained relatively similar throughout many of them. As the access to many institutions has increased, the remnants of traditionalism in Higher Ed has been shirked in favor of opening the doors of the ivory tower while also strengthening the case for transferrable skills in the workplace. In ways, Higher Ed professionals working with students who needed bolstering of skills through developmental courses have always known that true developmental education involves services and opportunities that wrap around the developmental classroom. Professionals such as advisors, mentors, tutoring, social workers, and programs such as summer bridge, just-in-time, supplemental instruction, and accelerated learning transformed from grassroots initiatives to pedagogical canon in the developmental education field.

Of the many advances, technology has brought to the developmental education field, perhaps the first and foremost is that we, as educators and professionals, are not alone. But as we look around at the landscape in developmental education, it would be naïve to dismiss the radical changes in the approach toward meeting the needs of developmental learners. Many institutions have removed developmental courses from their catalog, while others have changed their offerings to center around less content and more successful strategy. Even though we have nearly unlimited access to learning about these changes, it can feel somewhat isolating to witness these changes and wonder how both the students and professionals involved are reacting. NYCSLA, in particular, has been uniting learning skills professionals for decades, and this effort has only been bolstered through the information age.

As we solidify this new chapter in the approach to developmental education, it is only fitting that *Research and Teaching in Developmental Education* also increase access and

community in our field through publishing the journal completely online while maintaining the utmost integrity expected of a peer-reviewed journal. Through *RTDE*, we'll continue the NYCLSA tradition of bringing learning skills professionals together to navigate through, reflect on, and decide the way forward in developmental education.

I'm excited to get started with you,



Emily S. Ryan-Radder

Spelling Counts: The Educational Gatekeeping Role of Grading Rubrics and Spell Check Programs

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Abstract

Failure to adhere to conventional spelling has academic consequences. When encountering spelling errors, instructors can pass critical judgment on students' writing skills, and even on cognitive abilities. Many students turn to spell checkers. However, we find grading rubrics for academic writing assignments to be inconsistent, and judgments about both quantity and quality of errors to be subjective. In addition, spell check programs are inconsistent in flagging misspellings. Supported by our findings, we question the value placed on spelling mastery and its role as an academic gatekeeper, advocating for more exploration of the role of spelling in academic discourse.

Key Words: Spelling, Spell Check Programs, Writing Assignments, Grading Rubrics

Introduction

Past research into the inconsistencies of grammar check programs has questioned the benefits of technology in college students' production of academic discourse (Behrens, Chirinos, Spencer, & Spradley, 2016a). As with standard grammar, conventional spelling also acts as a gatekeeper to academic achievement in higher education. Such a demand is reflected in college grading rubrics for written assignments, which often include statements about spelling.

Many linguists agree that English spelling generally lacks transparency, having lost many of its connections to pronunciation (Burling, 2016). Nonetheless, students must produce conventional English spelling in their academic writing and often turn to spell check programs (Curzan, 2014).

Spelling counts, in several ways. Linguistic research has found readers to be negatively biased against the authors of texts that contain spelling errors (Boland & Queen, 2016; Queen & Boland, 2015). Such attitudes have led teachers to pass critical judgment not only on a student's writing skills but even on his or her cognitive abilities (Figueredo & Varnhagen, 2005; Kreiner, Schnakenberg, Green, Costello, & McClin, 2002). Education thus places a high value on the idiosyncratic English spelling system, a situation that we believe should be investigated.

Our research presented here examined spelling as a component of grading rubrics for written assignments, as well as the reliability of common spell-check programs. Findings allow us to reexamine the issue of a standard set of prescriptive spelling rules as it acts as educational gatekeeper. These investigations can inform professors and students, helping both members of the teaching and learning team to gain a more metalinguistic perspective on the nature of academic discourse (cf. Behrens, 2018). Asking *why* we value something as academic and *why* we penalize deviations from the standard are urgent questions when a student's college success is at stake. This might be especially pertinent to the student already facing barriers: the non-native English speaker, the first-generation college student, and the student in developmental education courses.

This study focused on two aspects of the role of spelling in academic discourse: 1) spelling as it dealt with as a component of grading rubrics in academic writing, contributing to the grade of

academic written assignments; and 2) the accuracy of spell check programs, technology that is available to all college students and has gained prominence over the years (Curzan, 2014). Our research questions were:

- How consistent are grading rubrics in terms of integrating spelling into the evaluation of academic writing?
- How reliable are popular spell checkers?

This work is part of a wider exploration into the relationship between language-oriented technology and the demands of students to master academic English (cf. Behrens et al. 2016a; Behrens, Johnson, Allard, and Carroli, 2016b).

Grading Rubrics

In our investigation, we first looked at grading rubrics for written assignments to see how "spelling counts" in a sampling of rubrics for college-level papers in writing and other courses in institutions across the country.

Methodology: Grading Rubrics

Using a Google search with the term "grading rubric," we found and selected sample rubrics displayed on the Carnegie Mellon University Eberly Center website, (https://www.cmu.edu/teaching/designteach/teach/rubrics.html), the first "hit" on Google. We selected a sample of convenience that reflected rubrics for courses offered in five different colleges across the US, including those that were both associated with a writing course and a non-writing course. See Table 1.

Table 1

Grading Rubrics, by Institution and Course

Institution	Course
1. Saint Mary's College	Writing
2. Roanoke College	Writing
3. California State University, Fresno	Writing
4. California State University, Chico	Business
5. Regis University College for Professional Studies	Criminology

We examined the rubrics in several ways. We first wanted to capture the ways that spelling was framed as contributing to the integrity of the paper, i.e., how deviation from convention detracted from the logic and coherence of the argument being made by the student. To that end, we looked at the name of the category on the rubric under which spelling was listed. We next examined the way spelling errors were considered to negatively affect the paper's overall comprehension by distracting the reader (the paper's "readability"). Here, we looked at both the quantity (number of errors) and quality (degree of severity) of spelling errors described by the rubric, and the corresponding way that deviation from the norm would affect the grade of the paper.

Results and Discussion: Grading Rubrics

Categories

Spelling fell into different categories across rubrics. Two of the five rubrics listed spelling under the category name "Mechanics and Presentation." One rubric listed spelling under "Style and Mechanics." One listed spelling under "Knowledge of Conventions." And one listed spelling under "Grammar, Punctuation, and Spelling." While none of the rubrics stated the percentage that spelling contributed to the final grade, the category that spelling fell under was on average one out of five criteria considered in the final grade or 20%.

Quantity and Quality of Spelling Errors

See Table 2 for a summary of how each of the five grading rubrics rated standard spelling as a component of the paper's final grade.

Table 2

Grading Rubrics for Written Assignments: Spelling as Component of Grade

	Grade A	Grade B	Grade C	Grade D/F
1	Error free	Minor errors	Frequent errors	Numerous errors
2	Free of error	Occasional errors	Many errors	Frequent errors
3	Nearly error-free	Few insignificant errors, not interfere with comprehension	Few insignificant errors, not interfere with comprehension	Significant errors, interfering with comprehension
4	Spelling correct	Some errors, not impede comprehension	Flaws that impede or distract from readability	Spelling errors that impede readability
5	Virtually free of spelling errors	Occasional errors	Several errors	Frequent spelling errors

Quantity

The number of spelling errors varied from "error-free" for an A paper to "frequent errors" or "many (and severe) errors" for a D or F paper. B and C papers were associated with "occasional errors," "several" or "many errors." Note that "frequent errors" is associated with a grade of C on one rubric and a grade below C on another. For one rubric, a "few insignificant errors" are associated with both a B and C grade. We also noted the subjective aspect of words such as "frequent" and "many"; further, "severe" could be either an assessment of quantity or quality (or both).

Quality

The role that spelling played in final grades was reflected in the phrases "not impede comprehension" (A grade), "impede or distract from readability" (B grade), and "interfere/impede comprehension/readability" (D/F grade). Again, we noted the subjective nature

of these distinctions. Rubrics also did not present an explanation of "comprehension" or "readability."

Spell Check Programs

With spelling contributing to a paper's grade, many students turn to technology to help them in their written assignments (Curzan, 2014). In fact, the default setting for Microsoft Word's Spell Check program is on. Other programs can be easily accessed online, and these companies advertise to students with promises of higher grades when their product is used. We considered five of the most popular spell checkers and tested them with sentences incorporating two types of spelling errors: typical misspellings of common words and reversal of homonyms. (We did not include what Boland and Queen (2016) term "typos" such as *teh* for *the*; nor did we count what Boland and Queen call "hypos," hypercorrections such as *I* instead of *me*.)

Methodology: Spell Check Programs

For a list of commonly misspelled words, we consulted the *Oxford Dictionary* (https://blog.oxforddictionaries.com/2016/08/02/corpus-misspellings/). We chose eight of the site's top ten commonly misspelled words, seen in the list below.

- *Accomodate*
- *Wich**
- *Recieve*
- *Untill*
- *Occured*
- *Separate*
- *Governemnt*
- *Definately*

* Correct spelling has two possibilities, *which* and *witch*.

We also selected three homonyms that are listed on the Purdue Owl website (https://owl.english.purdue.edu/owl/resource/660/01/) as commonly confused with their "look alike" partners. Thus, we worked with a set of 11 words. See the list below.

- *Accept* (confused with *Except*)
- *It's* (confused with *Its*)
- *Lead* (confused with *Led*)

Next, we embedded each word into a sentential context of our own design. (See Table 3.) Note that the appropriate target spelling for *wich* was *which* in our created sentence frame. For the homonyms, the contexts we created called for one of the spellings, and we inserted into the sentence frame the inappropriate form.

Table 3

Words Embedded into Sentences

This room will accomodate up to ten people.
Wich book did you just read?
She hoped to recieve an A in the class.
The library is opened untill midnight.
The incident occured on Main Street.
He and his friend attended seperate colleges.
They are against goverment spending.
You should definately get the flu shot.
Never borrow money accept if it is an emergency.
The dog was protecting it's territory.
The local team lead the division.

We next chose popular spell check programs from the website https://www.bloggertipstricks.com/online-spell-checker-tools.html. We selected the following five programs: Grammarly, Ginger, Small SEO Tools, Spellcheckers, and Microsoft Word Spell Check (2016 version). Each sentence in Table 3, with one of the misspelled words embedded,

was run through each of the five programs. We considered three possible responses from the programs: 1) a word was not flagged as an error, 2) a word was flagged but no changes were made or suggested by the program, and 3) a word was flagged and automatically changed or suggestions made for respelling by the program. (We did not originally intend to separate out autocorrect from suggested changes; see results, below, for further discussion.)

Results and Discussion: Spell Check Programs

Results for our 11 words, run through five spell check programs, are shown in Table 4.

Table 4

Results of Spell Check Programs

	Grammarly	Ginger	Small SEO Tools	Spellcheckers	Microsoft Word
Accomodate	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Autocorrect
Wich	(-)	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested
Recieve	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Autocorrect
Untill	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested
Occured	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Autocorrect
Seperate	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Autocorrect

	Grammarly	Ginger	Small SEO Tools	Spellcheckers	Microsoft Word
Governemnt	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested
Definately	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Suggested	✓ + Autocorrect
Accept	✓ + Suggested	✓	(-)	(-)	(-)
It's	✓ + Suggested	✓	(-)	(-)	✓ + Suggested
lead	✓ + Suggested	✓	(-)	(-)	(-)

Not flagged (-); Flagged but not corrected (✓ **);** Corrected (autocorrect or suggestions) (✓ +**)**

We found the following patterns in the results for our spell checkers as they responded to our 11 stimuli. With the first eight, non-homonym words, the programs were overall consistent in flagging nonstandard English spelling. We noted, however, that only Microsoft Word produced automatically corrected words (autocorrect feature), and then for only five of the eight non-homonym words. When all the other programs flagged an error, they offered a (correct) suggestion but did not automatically change the original spelling.

We looked more closely at the results for the misspelled word *wich*, embedded in a sentence frame that called for the meaning of function word *which* (as opposed to noun *witch*). Grammarly did not flag the error at all. Of the remaining four programs, three suggested the inappropriate *witch* spelling first, and then the correct *which* spelling. Only Ginger offered the appropriate *which* form first. No program responded with autocorrect.

In contrast to our first eight words, the three homonyms we tested were flagged less often by the five programs. Two of the programs, Small SEO and Spellcheckers, failed to detect any errors. Microsoft Word only flagged *it's*, suggesting the appropriate possessive form *its* for that sentence context. Grammarly was the only program that flagged and suggested corrections for all three words.

General Discussion

We found that the grading rubrics we collected and the spell check programs we tested all showed inconsistency and subjectivity in dealing with spelling. In the grading rubrics we sampled, spelling as a component of written assignments fell under different labels. In addition, judgments of both the *quantity* and *quality* of errors seemed to be subjective. Such a loose set of criteria allows for a certain degree of variability from instructor to instructor and thus potential student frustration.

The spell-check programs we examined, tested with eight commonly misspelled words and three easily confused homonyms, varied in their ability to flag nonstandard spelling. When dealing with the non-homonyms, the programs were relatively consistent in flagging misspelled words but not in autocorrecting to the appropriate form. Variability was also seen in how the ambiguous misspelling *wich* was treated by the programs' use of autocorrect versus suggestions for respelling. Furthermore, these programs proved poor in general at detecting homonym errors in sentences.

However, spelling still counts in academic writing. Many linguists agree that English spelling generally lacks transparency, having lost many of its connections to pronunciation (Burling, 2016). Nonetheless, students must produce conventional English spelling in their academic writing (Curzan, 2014). We question the value placed on standard spelling. Rubrics do not seem to differentiate between a misspelled technical term and a common English word, nor do they seem to emphasize spelling more in the writing courses than the content courses. If a misspelled word does not impede comprehension or readability, or if spelling errors can be easily corrected by running a spell check program (or attending to Microsoft Word's built-in, default feature),

why should a paper's grade depend in any way on spelling? Spelling might well be better seen as a formatting issue, such as double-spacing or font size (errors that usually contribute a small amount to a paper's grade).

We hope that such investigations can lead to heightened metalinguistic awareness for both students and educators. Both parties need to understand the demands called for in mastering academic discourse, as well as the accuracy of the technology being employed. Such discussions rarely happen in higher education (Behrens, 2018). We do not claim (or even especially hope) that in the near future spelling will not "count"; we do hope that students and educators can more overtly discuss the demands of academic writing and in more informed ways. Instructors can teach students about the technology and its flaws instead of allowing them to be passive consumers of it, thereby fostering more agency and confidence in students, especially those in developmental courses.

Our research leaves us with further questions. Do students over-rely on technology in their academic writing? Do they fail to develop their own spelling abilities when employing spell check programs? Is a program offering a "suggestion" better than an autocorrect in terms of student mastery of conventional spelling? And an even larger question remains: ultimately, is English spelling (and its assessment) too arbitrary to "count" academically?

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Implication of a Career Essay in a Developmental Algebra Course

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Abstract

This study examined the implication of the Algebra Connection Essay in a developmental algebra course. Undergraduate students (n=18) in four Intermediate Algebra courses were administered a pre-attitudinal survey prior to receiving information on the essay about their chosen or desired program of study. After submitting the essay, the students completed the post attitudinal survey. The prediction was that students would show a positive change in their attitude towards learning algebra for future value in their chosen or desired program of study after completing the essay. A significant difference was shown in five out of six value markers.

Implication of a Career Essay in a Developmental Algebra Course

Studies show that students who understand the value and applicability of learning mathematics are more likely to be successfully engaged. Howard & Whitaker (2011) found that as students began to understand the link between success in mathematics and career opportunities, their motivation to learn was enhanced. According to Martin and Gourley-Delaney (2014), students have difficulty finding applications of mathematics outside of school. Even though algebra books include application problems, those problems do not always relate to the students. Can a short essay based on using algebra in their chosen or desired program of study have a positive impact on students' attitudes towards the value of algebra?

A theory that promoted this research is the Social Cognitive Career Theory (SCCT). SCCT asserts that learning experiences are indirectly related to career choice goals through other personal cognitive variables such as self-efficacy and outcome expectations (Lent, Brown, Hackett, 2002). Hackett (1985) mentions that one of the variables affecting students' self-efficacy is the perceived usefulness of mathematics. Garriott, Fores, and Martens (2013) conducted a study on predicting math/science career goals of low-income prospective first-generation college students. The study findings imply that students from less privileged social backgrounds could benefit from targeted learning experiences designed to enhance self-efficacy for math/science-oriented careers.

Past experiences in mathematics usually dictate student opinions concerning career choices for which mathematics is the basis of the curriculum. Champion, Parker, Mendoza-Spencer, and Wheeler (2010) explored students' attitudes towards the value of course components for their potential career while Antonio and Tuffley (2105) noted the need for relevance in students' university experience and career aspirations. Both studies uncovered the need for future research in determining if the relevant course components encouraged students to pursue or rethink their chosen career path.

Staats and Batteen (2009) state that little research exists on students' reactions to learning math in context. Of the research reviewed involving writing in algebra, most focus on explaining algebra concepts. Meier and Rishel (1998) point out that writing assignments must be carefully designed. Therefore, the current study helps determine if a career essay in a developmental algebra course improves students' attitudes towards the value of algebra.

Method

Participants

This study occurred at a four-year public institution in the northeastern United States. This institution is part of a state system of higher education consisting of 14 institutions. According to 2016-17 admissions data, 33.6% of undergraduates are first-generation freshmen and 21.9% are underrepresented minority freshmen. The department where the study occurred is a centralized department of developmental instruction that oversees coursework and other programs. The coursework is intended to prepare students for the range of introductory credit-bearing courses they will need to satisfy either the general education program or their major requirements for graduation. Entry into the developmental mathematics courses is determined by a placement exam or SAT scores. However, students can self-select courses if they feel the need.

Participants were enrolled in four sections of a three-credit Intermediate Algebra course over an academic year with the same instructor, who is the researcher. All 96 students were required to complete the essay, but three students did not. The students had the option to participate in the study and complete the pre/post attitudinal surveys. The pre-attitudinal survey was completed by 35 students and 31 students completed the post attitudinal survey. The data results are based on 18 students who completed both the pre/post attitudinal surveys.

Materials

The Algebra Connection Essay (Appendix A) is a 600 to 800-word paper in which students respond to statements involving algebra in their chosen or desired program of study. Students were provided the grading rubric with the essay information. The students submitted their essays in the course learning management system and the instructor provided feedback on the essays after the post attitudinal survey was completed.

The pre/post attitudinal surveys (Appendix B) were based on the Survey of Attitudes Towards Statistics (SATS) 36 developed by Candace Schau (Schau, 2003a). The SATS 36 is a survey to understand student attitudes toward statistics in their statistics course and for research into students' statistics attitudes. The survey uses a Likert scale of 7 measurements from strongly agree to strongly disagree. The survey was adapted, with permission granted by Candace Schau on February 4, 2016, to focus on developmental algebra. The focus for this study was on the

value component of the SATS 36 Survey which evaluated students' attitudes about the usefulness, relevance, and worth of algebra in personal and professional life.

Procedure

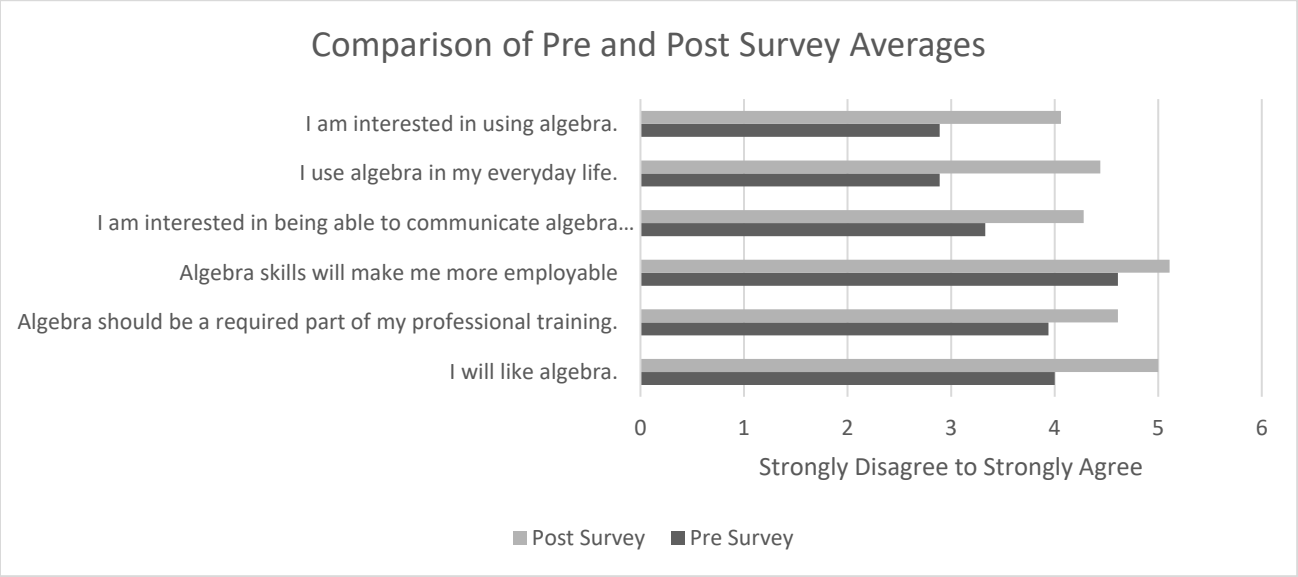
Informed consent was distributed to the students in the third class meeting by a colleague and kept confidential since the researcher was also the course instructor. All informed consent forms were placed in a sealed envelope and not opened until final grades were assigned and submitted for each semester. The pre-attitudinal survey was administered in Qualtrics prior to the students receiving the essay requirements. The post attitudinal survey was administered in Qualtrics immediately after students submitted their final essay and prior to receiving feedback. Students were given one week to complete each survey.

Results

From a total enrollment of 101 (88 freshmen, 6 sophomores, and 7 junior status), 18 students chose to participate (16 female, 2 male). All the participants (n=18) were an academic level freshman. There were 10 undeclared students and 8 declared students. Out of the undeclared students, five students identified as being part of the ACT 101 Program with none of the declared students identifying as ACT 101. The ACT 101 Program is a state-funded program that allocates funds for post-secondary schools to provide services for academically and financially disadvantaged students. The ethnicity of the participants was self-reported as "Hispanic or Latino" (n=1), "White" (n=10), "Black or African American" (n=4), "Multiracial" (n=2), "Asian/Pacific Islander" (n=1), "Prefer not to disclose" (n=0). Seven undeclared students and one declared student identified as a minority.

A paired-samples t-test was conducted to compare students' attitudes towards the value of algebra in their chosen or desired program with a pre-survey to post-survey. There was a significant difference in the overall scores for pre-survey ($m = 3.61$, $SD = 0.689$) and post-survey ($m = 4.58$, $SD = 0.409$) conditions; $t(5) = -6.7548$, $p = 0.00108$. These results suggest that the essay does have an effect. Specifically, the results suggest that when students complete the Algebra Connection Essay, there is a positive increase in their attitude towards future value in their chosen or desired program of study. All six value statements reported a positive increase between pre/post attitudinal surveys (see Figure 1).

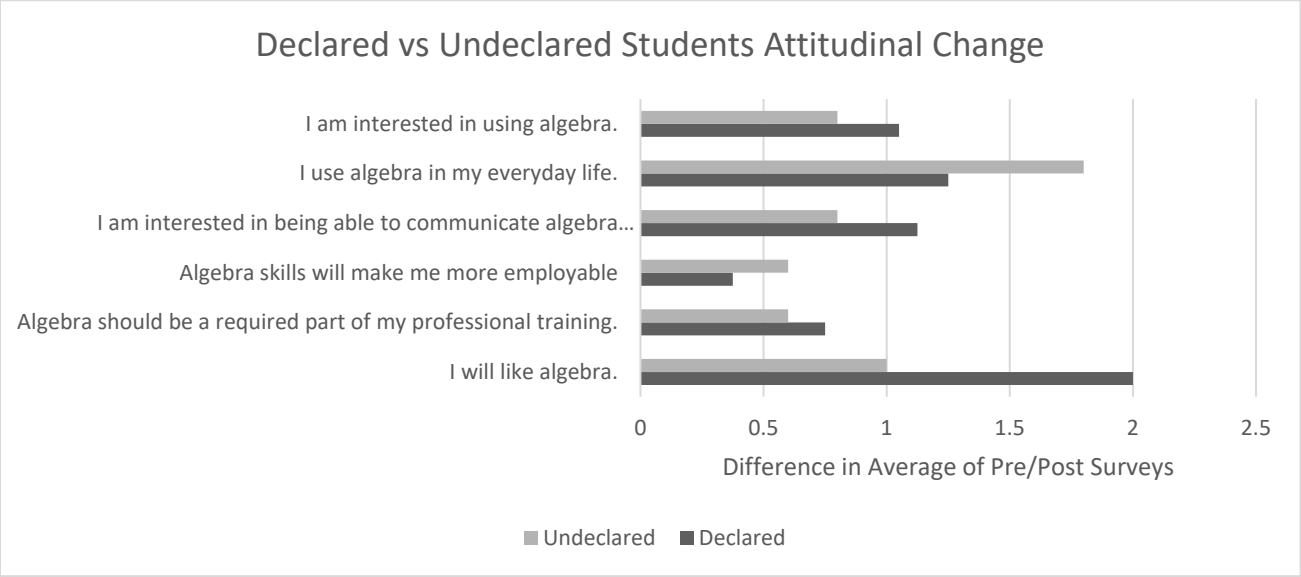
Figure 1.



There was a difference, but not a significant difference in the statement 'Algebra skills will make me more employable.' The scores for pre-survey ($m = 4.61$, $SD = 1.684$) and post-survey ($m = 5.11$, $SD = 1.278$) conditions; $t(17) = -1.256$, $p = 0.2261$. These results suggest that students already understand the value of knowing algebra.

A further breakdown between declared (n=8) and undeclared (n=10) students suggested that the essay had a positive impact on both sets of students (see Figure 2). The undeclared students showed a significant difference in the overall scores for pre-survey ($m = 3.55$, $SD = 0.638$) and post survey ($m = 4.483$, $SD = 0.588$) conditions; $t(5) = -5.0783$, $p = 0.00384$. The declared students showed a significant difference in the overall scores for pre-survey ($m = 3.52$, $SD = 0.853$) and post survey ($m = 4.613$, $SD = 0.59$) conditions; $t(5) = -4.9094$, $p = 0.00444$. Half of the undeclared students reported being ACT 101 students. The undeclared students had a higher significant difference then the declared students. With half the undeclared students self-identified as ACT 101 students, this supports Garriott, Fores, and Martens 2013 study of low-income college students benefiting from targeted learning experiences.

Figure 2.



Discussion

Finding ways to increase students' self-efficacy in mathematics is not easy. However, educators need to continue to find ways to enhance students' learning experiences and have a positive impact on increasing students' self-efficacy. The findings of this study support Howard and Whitaker (2011) that students who find a link between success in mathematics and career opportunities enhance their motivation to learn.

The statement 'Algebra skills will make me more employable' was the only statement that did not show a significant difference in students' attitudes towards the value of algebra. This is an interesting finding as students had to provide detailed examples of using algebra in their chosen or desired program of study. Wanbach, Brothen, and Dikel (2000) reported students to become discouraged if they do not take college-level courses consistent with their goals. This opens an opportunity for further research on the need for studying algebra in college for today's careers.

The comparison between declared and undeclared students is interesting in a number of statements. The undeclared students showed a bigger difference between pre/post surveys in the statement 'I use algebra in my everyday life' while the declared students showed a bigger difference in 'Algebra being a required part of my professional training.' This difference may be attributed to declared students encountering algebra in their major courses; whereas, the undeclared students are associating algebra to their daily lives. Even though there was little

difference for undeclared students in seeing the need for algebra as part of their professional training, they had the bigger difference in the need for algebra to make them more employable than their declared counterparts. Further research between declared and undeclared students' attributes and learning strategies may guide the discrepancies in these value statements.

Limitations

The results and limitations are limited to a small sample size and by a cross-sectional design that does not allow for claims of causation (Frankfort-Nachmias & Nachmias, 2000). The sample size was too small to have confidence in the statistical significance of the findings and cautions generalization to broader contexts. This study cannot account for the possible effect of the instructor's teaching style and course objectives covered between the pre/post attitudinal surveys. Another limitation of the study may be due to the students' attitude towards being in a developmental algebra course. It is important to note that the intention of this study was to determine if the essay was an effective and worthwhile assignment for the students to complete.

Suggestions for Future Research

More studies on the effectiveness of the Algebra Connection Essay need to be conducted, possibly correlating interview data from students. This would afford a deeper understanding of the ways in which the essay affects students' perception of algebra in a field of study. Increasing the sample size would allow for the opportunity to interpret results for first-generation college students and underrepresented minorities. Research on students' attitudes towards algebra could continue in several directions. Research has shown that students needing remediation in mathematics tend not to seek majors in mathematics (Benken, Ramirez, Li, and Wetendorf, 2015). Therefore, students could be tracked to see if those who declared a major prior to the essay change their major to or from a mathematics focused curriculum. Undeclared students could be tracked to see if they select majors involving higher-level math. Most of the research in writing in mathematics focuses on explaining problems. This is a unique approach for students to discover ways in which algebra is used in careers. This coincides with Benken, Ramirez, Li, and Wetendorf's findings to include student outcomes that focus on attitudes about mathematics. They recommend inclusion of parallel assignments that promote student investigations and reflections that are interesting to the student (2015).

Conclusion

The purpose of this research study was to investigate if the Algebra Connection Essay positively changed students' attitudes of the value of algebra. The statistically significant difference observed between the pre/post attitudinal surveys indicate that students' attitudes can be changed. The effect size for this improved attitude is small, but it does demonstrate that a simple treatment can have a positive result. The small number of participants in this study should be considered when interpreting findings and planning future studies.

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Appendix A

Algebra Connection Essay

The Algebra Connection is a writing assignment to discover how math is used in your chosen or desired program of study. The paper must include:

- Discuss your math goal for this year
- Discuss ways in which math is used in your chosen or desired program of study (interview with someone or research online in that field)
- Provide at least 2 detailed examples of math problems used in your chosen or desired program of study
- Conclude with how you envision yourself using math in 5 years

Paper Specifications

- Include bibliography page for references used
- Minimum 600 words; Maximum 800 words
- Type: 12-point font, single-spaced, 1-inch margins
- Save as .doc, .docx, or .pdf
- Submit to the **Algebra Connection Essay** Assignment in BOLT by due date
- Visit the Writing and Literacy Engagement Studio (WALES) (http://intranet.bloomu.edu/wales)

Points	Description
Excellent **45-50**	The paper demonstrates well-developed reading comprehension and/or listening skills and ability to analyze a topic. • All parts of the prompt are fully addressed • Ideas are logically organized • Statements are well supported or explained through detailed references • The response demonstrates a well-developed command of the English language (spelling, capitalization, punctuation, sentence structure)
Strong **40-44**	The paper demonstrates solid reading comprehension and/or listening skills and ability to analyze a topic. • Most parts of the prompt are fully addressed or all parts of the prompt are adequately addressed

Points	Description
	• Most ideas are logically organized • Most statements are supported or explained through references • The response demonstrates a solid command of the English language (spelling, capitalization, punctuation, sentence structure)
Acceptable **35-39**	The paper demonstrates some reading comprehension and/or listening skills and ability to analyze a topic. • Some parts of the prompt are fully addressed or all parts of the prompt are adequately addressed • Some ideas are logically organized • Some statements are supported or explained through references • The response demonstrates a solid command of the English language (spelling, capitalization, punctuation, sentence structure)
Needs Improvement **0-34**	The paper demonstrates little or no skill in reading comprehension and/or listening skills and ability to analyze a topic. • The paper is off topic or ignores significant aspects of the prompt • Ideas are not logically organized • Statements are not supported or explained through references • The response demonstrates little or no command of the English language (spelling, capitalization, punctuation, sentence structure)

Appendix B

Pre-Survey of Attitudes Toward Algebra

Adapted from

DIRECTIONS: The statements below are designed to identify your attitudes about algebra. Each item has 7 possible responses. The responses range from 1 (strongly disagree) through 4 (neither disagree nor agree) to 7 (strongly agree). If you have no opinion, choose response 4. Please read each statement. Mark the one response that most clearly represents your degree of agreement or disagreement with that statement. Try not to think too deeply about each response. Record your answer and move quickly to the next item. Please respond to all of the statements.

Student ID: _____

	Strongly disagree			Neither disagree nor agree			Strongly agree
I will like algebra.	1	2	3	4	5	6	7
Algebra should be a required part of my professional training.	1	2	3	4	5	6	7
Algebra skills will make me more employable.	1	2	3	4	5	6	7
I am interested in being able to communicate algebra information to others.	1	2	3	4	5	6	7
I use algebra in my everyday life.	1	2	3	4	5	6	7
I am interested in using algebra.	1	2	3	4	5	6	7

DIRECTIONS: For each of the following statements mark the one best response. Notice that the response scale changes on each item.
Are you an ACT 101 student? _____Yes _____ No

Is your major declared or undecided? _____Declared _____Undecided
I identify my race/ethnicity as ___White ____Hispanic or Latino ___ Black or African American ___Native American or American Indian __Asian/Pacific Islander ____Multiracial ___Not Listed ___Prefer not to disclose
I identify my gender as: ____Male ____Female ___Transgender _____ Prefer not to disclose
THANKS FOR YOUR HELP!

Post-Survey of Attitudes Toward Algebra

Adapted from

© Schau, 1992, 2003

DIRECTIONS: The statements below are designed to identify your attitudes about algebra. Each item has 7 possible responses. The responses range from 1 (strongly disagree) through 4 (neither disagree nor agree) to 7 (strongly agree). If you have no opinion, choose response 4. Please read each statement. Mark the <u>one</u> response that most clearly represents your degree of agreement or disagreement with that statement. Try not to think too deeply about each response. Record your answer and move quickly to the next item. Please respond to all of the statements.

Student ID: _____

	Strongly disagree			Neither disagree nor agree			Strongly agree
I like algebra.	1	2	3	4	5	6	7
Algebra should be a required part of my professional training.	1	2	3	4	5	6	7
Algebra skills will make me more employable.	1	2	3	4	5	6	7

I am interested in being able to communicate algebra information to others.	1	2	3	4	5	6	7
I use algebra in my everyday life.	1	2	3	4	5	6	7
I am interested in using algebra.	1	2	3	4	5	6	7

Meaningful Teaching and Learning: MyStatLab and StatCrunch
The Value of MyStatLab to Faculty and Student

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Abstract

Institutions of higher learning increasingly identify different forms of technology to remain competitive. Thus, these efforts have accompanied a paradigm shift in teaching and learning. The struggle between comprehension and effective teaching
methods raise numerous interrelated concerns for faculty and students as on-line learning software becomes an integral feature of teaching and learning in higher education. Despite the increased acceptance of technology within society, faculty remain relatively distant to the full incorporation of online materials and software in their courses. The challenge remains as to how faculty can reconstruct pedagogies of engagement in the classroom that will draw student interest from disconnected spaces whilst simultaneously reconnecting learning. This paper reflects upon the challenges, advantages, and drawbacks that emerge as faculty attempt to utilize electronic software (such as MyStatLab and StatCrunch) in meaningful ways to teach and engage the digital learner.

Keywords: Teaching, science, mathematics, and technology learning.

Introduction

The pressure on institutions of higher learning to remain competitive has accompanied a paradigm shift in teaching and learning. The struggle between student comprehension and effective teaching methods raises numerous interrelated concerns for faculty and students, as institutions intentionally shift towards increased on-line or open educational resources.

Additionally, alternative delivery methods continue to be used in response to the changing student demographics as a pathway for creating greater connection of theory with practice. This increase in e-learning has also impacted the use of electronic resources and software in face-to-face classroom instruction. Electronic software and online teaching tools have become an integral feature of teaching and learning for face-to-face instruction in institutions of higher learning.

In a culture of instant gratification and constant interaction through a range of hand-held electronic devices, it is no longer unsettling or even surprising to raise the question of whether traditional environments of learning should integrate more technology in teaching. Today, cyberspace is a part of where we live. It is integrated into our sense of identity and value, whether we fully accept it or not. It is a place in which we all have become naturalized digital citizens authorized through the purchase of an electronic device and access to the internet. Even faculty today, have constructed their cyber identities and legitimated their online presence through continued membership and activity as cyber citizens who religiously contribute to the web (Correa, 2017).

Yet, despite the increased acceptance of technology within society, faculty remain relatively distant to the full incorporation of online materials and software in the teaching of their courses. The challenge remains as to how faculty can reconstruct pedagogies of engagement in the classroom that will draw student interest from disconnected spaces whilst simultaneously reconnecting learning. In this paper, the challenges, advantages, and drawbacks that emerge as faculty attempt to utilize electronic software (such as MyStatLab and StatCrunch) in meaningful ways to teach and engage the digital learner are discussed.

Brief Literature Review of Technology in Teaching

Researchers have identified a variety of ways for how faculty can integrate Information and Communication Technology (ICT) into their teaching practices (Kozma & Anderson, 2002; Jimoyiannis & Komis, 2008). In the past decade, several studies related to the promotion of ICT as a learning and teaching tool in education have focused on enhancing student learning outcomes (Hakkarainen et al., 2000; Hopson, Simms & Knezek, 2002; Keengwa, 2007; and Cox

& Marshall, 2007). In 2012, Peeraer & Petegem developed instruments for the measurement of the frequency of teachers' usage of ICT for teaching and learning. These instruments incorporated the 21st-century skills that were based on the UNESCO (2003) ICT competencies framework. The study results concluded that the majority of teachers occasionally used ICT to replace their existing teaching practice or to enhance student learning. Interestingly, the innovative use of ICT in support of student learning was still very scarce. These results reflect the need for a more meaningful integration of ICT in student learning.

As evidenced in the current research literature, the conceptualization of ICT integration can foster the development of 21st-century skills of students (Pedersen & Yerrick, 2000; Law 2009; Wang, Hsu, Reeves, & Coster, 2014). Thus, teachers have a critical role in promoting learning with ICT in the classroom context by developing new curricula and new pedagogies (UNESCO, 2011). The International Computer and Information Literacy Study 2013 (ICILS 2013) indicated that teachers most frequently used ICT in their classes for simple tasks such as word-processing, presentations, and information resources (e.g. websites, wikis, and encyclopedias) as noted by Frailllon, et.al, (2014). Teachers were more inclined to use ICT for more complex tasks only when they felt more confident in their own ICT skills. In terms of teaching mathematics, and specifically statistics, Thomson (1992) indicated that a relationship between what teachers' beliefs are in terms of teaching about mathematics, and their understanding of how to teach the subject, determine their attitudes and the way they will teach. Since many teachers indicate having little exposure to the use of technology in their own learning of mathematics, the expectation that teachers will stray from what they have learned and know would seem unlikely (Ertmer, 2005). Teachers are expected to reproduce the type of teaching pedagogies that they have learned and consequently feel both familiar and comfortable replicating. Thus, it can be anticipated that teacher beliefs and practices in utilizing technology in teaching mathematics will be based on their own internalized beliefs and past experiences.

While the use of technology has been found to be an effective means to produce growth in students' understanding of mathematics content (Cradler, McNabb, Freeman, 2002), research findings indicate that technology is not being used widely by classroom teachers (Huang & Waxman, 1996; Milou, 1999). The training that newly graduated teachers have received in their

pre-service programs, may also contribute to the reluctance of teachers to fully utilize technology in the classroom. Without appropriate discipline-specific training, many teachers may leave university not knowing how to appropriately use technology in their classrooms. For the university instructor, who is to serve as the subject matter content expert, the reliance and use of technology in teaching may simply be a matter of teaching preferences. As research evidence suggests, limited technology usage in the classroom can be equated to the teachers' beliefs about the nature of mathematics and the goals of mathematics education (Fleener, 1995; Norton, McRobbie, & Cooper, 2000).

Technology and Pedagogical Practices

There are many different ways of integrating ICT in the classroom. Teachers use technology for different instructional purposes such as e-mail, creating quizzes and tests, as well as preparing lessons. Additionally, teachers ask students to perform several tasks with ICT, for example, writing a paper and using spreadsheets or creating Web pages (Russell, Bebell, O'Dwyer, & O'Connor, 2003). Ironically, teachers seem to rely on technology for instructional purposes in terms of the preparatory aspects of teaching, rather than in the delivery of academic content. Technology as a tool for enhancing pedagogical practices requires that instructors feel comfortable with technology and recognize the value of integrating technology into various forms of teaching and student learning.

Recently, one area in which there has been an expansion of technology use is in homework and the use of e-textbooks. There is a growing body of literature that credits online homework with improving student achievement on tests, final exams, and final grades in courses (e.g., Folami & Simons, 2012; Grinder, 2014; Jones, 2008; King & Mo, 2013; Lusher, Huber, & Valencia, 2012; Titard, DeFranceschi, & Knight, 2014). Online homework platforms provide students with immediate feedback on their work while also reducing instructors' workload.

The financial considerations that align with increasing tuition fees for students in addition to rising textbook costs have contributed to the demand for more open educational resources (OER) and e-textbooks to reduce the price tag of higher education. It is widely accepted that engagement in the classroom begins with students' reading of the content material, however,

there is increasing evidence that indicates that most undergraduate students are not choosing to purchase their books due to the high costs of textbooks (Dawkins, 2006, p. 30). An obvious benefit of open educational resources (OER) is that they are free and easily accessible to students. Several universities have initiated zero course material costs (ZCCM) or open educational resources (OER) to entice students to their institutions by offering courses with lower overall costs. The movement towards reducing textbook costs seems to be an adequate 'digital solution' for the current millennial student generation.

The use of open educational resources (OER) however extends beyond textbooks to online homework. Often online homework is aligned or integrated with the course textbook. This is significant, as integration can provide encouragement for students to more fully engage in the learning experience by reading and digesting the textbook material using multiple points of entry and a variety of learning tools. Online homework platforms that are bundled with the textbook can play a major role in encouraging textbook purchase/use and, therefore, encourage greater engagement (Maxwell, P., Smokert, K., Stites-Doe, S., 2018). Some studies have reported no differences using either an online homework platform or the traditional pen and paper format in terms of student learning for accounting or math courses (Bonham, Beichner, & Deardorff, 2001; Hahn, Fairchild, & Dowis, 2013; Williams, 2012). Bonham et al. suggest that it is the underlying pedagogy that makes the difference in student learning. They acknowledge that the use of online homework provides instructors with more time to explore other topics, and they believe that this freedom may enable the integration of other kinds of more valuable assignments than may be otherwise possible with paper-and-pencil exercises. Fatemi, Marquis, and Wasan (2014) research findings revealed the benefits of written format assignments over online homework formats based on the type of assessments used. Fatemi, et.al. (2014) found an important distinction in learning outcomes when comparing two different sections of the same course with one section utilizing online homework while the other section retained written format for homework assignments. The students who used the online homework platform performed significantly better-completing problems, but they performed significantly worse on the multiple-choice questions designed to assess whether the students had mastered a deeper understanding of the course material. The authors concluded that, while the online homework platform helped students better grasp the mechanics for completing problems, the written

assignments helped students gain a better understanding of conceptual issues and encouraged students to think more critically.

A key question for faculty to consider is whether web-based learning tools will enhance students' learning experiences and engagement in a course. Is there a significant difference in learning engagement and academic achievement between students using online homework versus students submitting written homework? There are several studies that have explored the potential role that learning styles play in student engagement, learning, and academic achievement (Robotham, 1999; Rinaldi & Gurung, 2008). Researchers continue to explore learning styles and their potential role in developing educational best practices. For example, Engel (2015) explored the learning styles of students and teachers in an introductory accounting course at a community college, proposing that "[a] better understanding of learning styles could help students become more aware of their own learning style and help teachers become more aware of their own approach to teaching" (p. 290). Engel (2015) found that over one-third of the accounting students reported having an interactive learning style while 22% reported a multimodal learning style (p. 291). In a related study, Pardakhtchi and Saidee (2012) examined learning styles in the context of student satisfaction, finding that student satisfaction is high when students' learning styles match the instructor's self-reported teaching style thus aligning the instructor's teaching with the student's learning.

More research is needed to understand whether it is the homework format itself that increases engagement, or the influence of other factors such as student and instructor attitudes, learning style preferences, GPA, age, or gender. As online homework platforms become increasingly prevalent, faculty who teach elementary statistics must not only be prepared to integrate the teaching of statistical concepts, but also apply real-world examples for students to comprehend and grasp. Furthermore, an understanding of these concepts requires working with large data to make inferences. Prior to the days when computer statistical courses were taught using simple numbers, fabricated examples, and hand computations, today, computers are changing the way faculty teach statistics: since instructors today can automate calculations and graphics, making the inferential more accurate and pertinent to real-life situations.

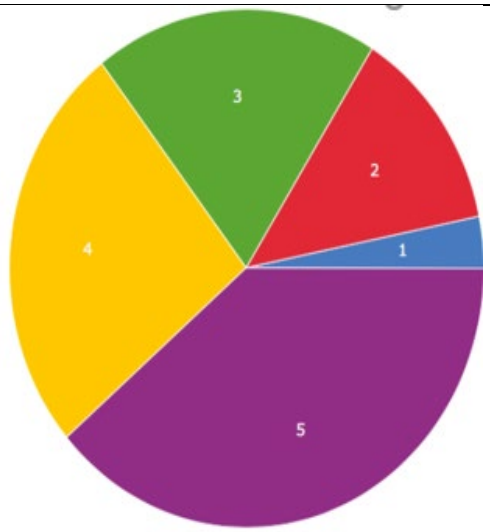
In certain cases what faculty teach in statistics is modeled by what faculty can compute. Today, how statistics is taught, is influenced by the presence of computers in the classroom which provides the professor with some freedom to focus on the inferential and interpretations of the concepts as well as the statistical concepts. Using statistical software is a must in today's academy since students should be able to use and manipulate large data by means of statistical software. Furthermore, students should be familiar with statistical software since most likely they will be expected to use it in their future careers. The use of such software can potentially help the students to better understand and apply the statistical concepts. Furthermore, students may be able to understand and make pertinent conclusions about real-life statistical problems when using online statistical programs.

Pedagogical Value of Statistical Software

In our pilot study, instructors believed that they might be able to improve student engagement by using online homework systems. In an undergraduate statistical course, 30 students were surveyed for their responses to the use of online statistical software. The online system offered by the Pearson publishing company, entitled "MyStatLab" is a statistical package to be used with a companion statistical software called "StatCrunch." For instructors teaching an elementary statistics course, the use of an online homework system was anticipated to be helpful for encouraging increased student engagement as well as the completion of homework assignments. In Figure #1, 64.5% of students surveyed indicated that the online homework system helped them with the understanding of the statistical concepts. Less than a third of the students, 16.13% indicated that the online system did not help them, while 19.35 % were neutral.

Figure # 1 - The Value of the Online Homework System for Learning

Question: The Online HW system helped me with the understanding of the mathematical concepts.

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSE
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	1, 1, 3.23% 2, 4, 12.9% 3, 6, 19.35% 4, 8, 25.81% 5, 12, 38.71%

Some of the benefits that emerge from the online homework systems align with the functionality embedded within these systems. For example, the online homework system consists of many different tools that are easily accessible and effectively integrated into the program. Students can utilize these tools to help them understand the practical application of the statistical concepts that they are studying. Furthermore, students have the opportunity to practice the exact concept that they need to master by using the array of features that have been designed to provide multiple forms of help to assist the learner. For example, videos and tutoring, are available in the StatCrunch software. As indicated in Figure #2, the range of comments by students identify the ease of moving back and forth from one question to the next, checking their understanding, and using the 'hint' feature for incorrect answers. Several students appreciated the option to use their phones to work on their assignments.

Figure # 2 – Comments about the Use of Online Homework

Question: What did you like most about the Online Homework?

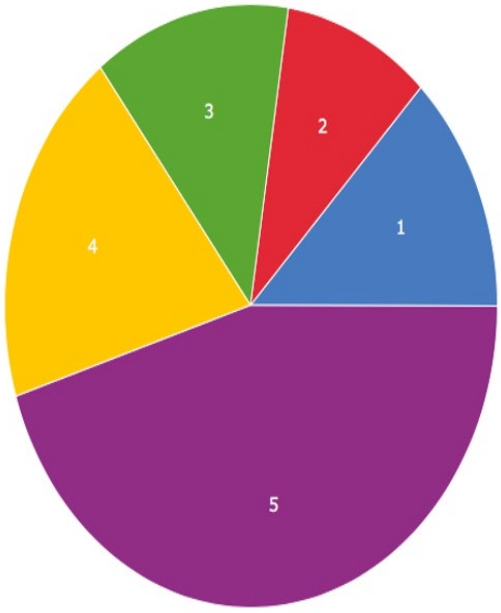
	Student Comments
1.	I liked that if you answered incorrectly first, MyStatLab would give you a hit to allow you to get it correct the next time.
2.	Being able to see if I did a question correctly or not before turning it in.
3.	If I didn't understand why my answer was wrong, I could use the 'Help me solve this' tab.
4.	That it helped you with the answers
5.	The help section
6.	If I didn't know how to do a problem, I would click "view example" which would explain how to do that specific problem. This helped me understand each of the questions which in return helped me on the quizzes and tests.
7.	It was easy to access and I could do it whenever is convenient for me
8.	Personally, I like that I could do the question again if I got it incorrect as I was able to learn the proper way to do the question right then and there.
9.	How you can choose multiple answers before it doesn't let you answer no more
10.	It was easier to get help when you needed it right away
11.	You get multiple attempts on questions.
12.	I was able to better understand the concepts and formulas better and was better able to apply the formulas to the problems.
13.	I liked that it was easy to get onto the site and that I could do it from my phone
14.	I liked that you could view examples and it helped you if needed.
15.	Somewhat helped to learn the material
16.	The ability to use statcrunch
17.	Having StatCrunch there and the options to have help and be walked through a similar Example
18.	It was easy to access
19.	The examples
20.	Examples that are available
21.	It's more practice and if you need help you can just it view example.

22.	That it gives examples and help and can answer question more than once
23.	Online

The benefits of online homework systems extend beyond the students in addressing the needs of the faculty as well. The online homework system has practical value for faculty in terms of instructional time. During the class session, the instructor can focus attention on the exact concept that requires repetition for improvement. In essence, the software is organized in such a manner that the specific needs of students can be identified and focused upon during classroom instruction. This feature can help to provide improvement in student learning and understanding. The online system can be used to identify areas of weakness as well. For those students who may be struggling with or not fully comprehending the material, more time can be allocated by the instructor to review specific concepts. The identification of information about the exact mistake students have made, and the concepts they continue to experience trouble mastering can ensure that valuable class time is dedicated to these specific areas of need. Additionally, the instructor can focus on group work and projects that integrate the specific concepts that require more time for comprehension into the type of activities that are assigned to the students. Take, for example, Figure #3 were, overwhelmingly, students identified the opportunity to move at their own pace and check for comprehension as a feature of the homework system that they felt was beneficial to their learning.

Figure #3 – Preference for Online Homework

Question: I prefer MyStatLab online Homework, to Paper Homework.

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	1, 4, 12.9% 2, 3, 9.68% 3, 4, 12.9% 4, 6, 19.35% 5, 14, 45.16%

Communities of Practice for Learning

There are also pedagogical benefits for students that extend beyond learning the concepts for the sole purpose of testing. Students enjoy working together and using the data that they have collected in order to practice the statistical concepts that they are learning. If the students can share their findings from these projects with their classmates, their confidence can potentially increase and therefore their engagement during the class period should also improve significantly. The fact that these data sets are representing real-life situations is a real benefit of the online homework programs. The students feel that statistical concepts are not abstract, especially when they can apply what they are learning to their own lives. The connection of theory with practice has the potential to increase student engagement levels since the students are open and more receptive to concepts that are not abstract.

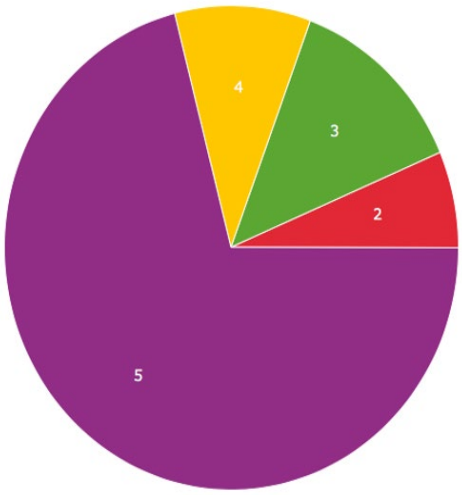
Rather than working with small data sets and computing the information by hand, all of the data analyses that are completed through the online homework system enable students to use large

data sets from the online community with the StatCrunch software. The StatCrunch software can be used by students to perform analyses, share data sets and generate reports on their data. The possibility for students to share their findings with an online community from all over the world is potentially empowering for students. Students may demonstrate increased confidence that may transfer in the ways that they will communicate and engage during the lesson.

Perhaps what is the most compelling factor is that StatCrunch is 'user-friendly.' Students have expressed the ease by which they have navigated the online homework system using StatCrunch. The fact that students do not have to complete graphs by hand and use complicated and laborious formulas and computations is another benefit that underscores the value of online homework systems for increasing student learning and increasing student success. Additionally, students may have more free time to work on examples during the class period which may result in their confidence increases as they become comfortable with statistics and realize that computation of statistics is not as complicated as they initially imagined. This shift in thinking could potentially encourage more students to move towards careers in science, technology, and mathematics when they experience success in learning statistics. In Figure #4, students overwhelming identify their appreciation of the help feature (70.97%) as a valuable component of the Online Homework system.

Figure #4 - Value of the Help Feature for Online Homework

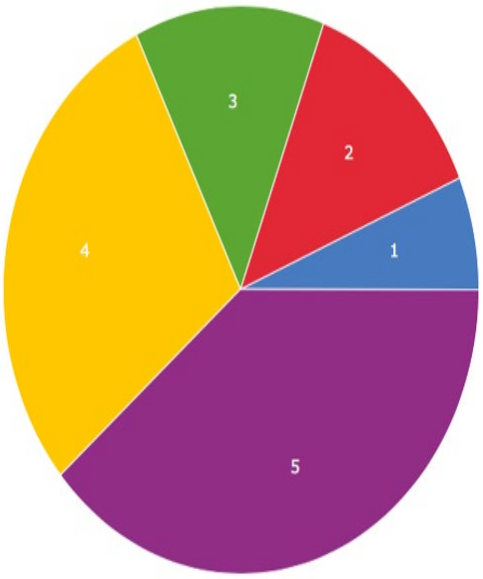
Question: I liked the help feature in MyStatLab Online Homework

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	2, 2, 6.45% 3, 4, 12.9% 4, 3, 9.68% 5, 22, 70.97%

In Figure #5, students overwhelming identify their appreciation of the online homework system.

Figure #5 - Liked MyStatLab Online Homework

Question: Overall, I liked the MyStatLab Online Homework

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	1, 2, 6.45% 2, 4, 12.9% 3, 4, 12.9% 4, 9, 29.03% 5, 12, 38.71%

History & Practical Use of Software

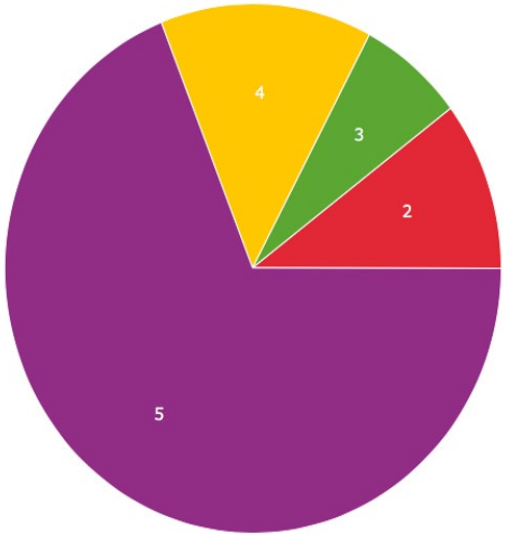
The digital revolution has impacted how faculty teach as well as the delivery format for content materials that are used in the classroom. MyMathLab is an online Homework system that is available for teaching math, specifically statistics. MyMathLab can be supported by a number of different electronic textbooks that students can access electronically. For students to have access to their course materials, they must purchase a code. The code enables students to access their electronic books as well as the homework statistical software, StatCrunch. The price of these materials is by far less expensive than the price of the traditional textbook. For some e-books each section or chapter has accompanying online videos that students can watch to reinforce their learning. Students can listen to an instructor presenting the lesson in class and then watch how an instructor explains some of the examples that may require more in-depth review.

The homework in the MyMathLab system can be created in different ways. For example, the instructor can choose the problems from a pool of questions that are similar to the questions from the textbook, or the instructor can create his/her own questions/problems to be incorporated in the MyMathLab homework. Each question has a toolbox that provides an example similar to the question that the students are solving. Students can work on additional examples of a given problem to ensure comprehension. A helpful feature in the design of the electronic textbook is that students can return directly to the pertinent page in the textbook where information about the question is provided. If the student continues to experience problems, the student can send an email to the instructor, or the student can ask a tutor from Pearson for assistance. All of this information is provided on the same page with the question that the student has to solve.

In some cases, a selected group of questions from the e-book and the homework can have the data sets sent directly to StatCrunch so the students do not have to input all the data by hand in order to perform their statistical analysis. The instructor can also see how much time each student spends on each question. Furthermore, the instructor can easily identify the concepts the students do not understand. StatCrunch is statistical software, similar to SPSS, or Excel, the difference between StatCrunch and the other statistical software is that the StatCrunch is more student-friendly. Figure #6 provides the feedback from the pilot study in which 68.97% of students indicated that they liked using the StatCrunch software statistical package.

Figure #6 - Student Preferences on StatCrunch Software

Question: Overall, I liked the StatCrunch Software

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	2, 3, 10.34% 3, 2, 6.9% 4, 4, 13.79% 5, 20, 68.97%

StatCrunch contains a database with large data sets, and the utilization of this software can be shared by students for their assignments, and projects. This component of StatCrunch is really helpful for students because they have access to a large library of data and they can share their projects and statistical findings with their peers.

Benefits of StatCrunch Software

In the pilot study, the instructor identified the benefits of StatCrunch Software for teaching undergraduate students in the Math Program. The instructor noted that StatCrunch was a helpful statistical tool for teaching statistical courses. The students were able to input their own data or they could use the data sets provided by the StatCrunch community. Students were able to perform basic statistical tests, and computations, as well as produce graphs. The instructor indicated that the data from the Homework was transferred instantly into the StatCrunch software, and the students could use this software to perform their statistical operations.

The instructor stated:

> "*I find it really useful especially when I introduce the normal and standard normal distribution concepts. The students save some time by using this software instead of looking in the z-values tables for example. The StatCrunch software gives the area under the normal curve, the x value, and the bell shape graph, all in one window with one click. This software frees a lot of time that can be used towards reviewing more examples with students or discussing the interpretation of the results. The software is useful also when the confidence intervals and the t-tests are introduced*."

The student feedback addressed a number of benefits of using StatCrunch. Several students were pleased with the "*multiple opportunities to answer the questions*", as hints were provided to assist students with solving the problem correctly. The MyMathLab "*offers students hints as they move through the assignments.*" Additionally, the students are able "*to see what they did correctly before they submitted their answers."* The students also indicated that if they did not see their mistake, the '*help me solve this'* tab *"could be used to guide them and identify the mistake."* Students also identified that the '*view an example*' tab was also helpful if they had "*no clue how to solve a questio*n," as the system provides a "*step by step*" guide for how to solve a problem.

The students also recognized the speed of response time to questions when they needed help. The students mentioned that they were able to better understand the concepts and formulas because of the immediate help feature that enabled students to apply responses to the problems they were trying to solve. What was perhaps the most appreciated feature of the software was the compatibility feature for students to access the system on their phones. Many of the other statistical software packages that have been used in the past were strictly accessible on the university computers. Thus, students were often expected to come to the university in order to complete their homework assignments. The practical application of access on any device was an important distinction and feature that the students significantly appreciated. Finally, the students mentioned the options embedded in the software such as being "able to go back and review the

questions" and the ease of accessibility in terms of "user-friendliness," as some of the dimensions of the software that were helpful to their needs.

While the overall response to StatCrunch was positive, there were some comments from students who did not like the software package for their learning. Some of the students indicated that they did not like that their answers had to be provided in a specific format, as one extra decimal and their answers would be marked wrong. Also, students indicated that they did not like that the homework contained more problems than the paper homework. A few students stated that at times it was difficult to see all the parts of the questions and therefore could not complete their homework on time. Figure #8 provides a breakdown of the individual comments that were identified to the question of *"What did you dislike most about the Online Homework?"* For the most part, 1.4% of respondents indicated that the specific issues of concern that were identified focused more on minor technical aspects rather than larger issues with the actual software access and ease of operation.

Figure #7 Student Concerns with StatCrunch

Question: What did you dislike most about the online homework system?

1.	They required specific answers with no margin of error (needed exact number and if off by even one digit at the end, it was wrong)
2.	Sometimes the answers would be roughly the same, maybe an extra decimal, but would be considered wrong.
3.	Quizzes
4.	the length
5.	It took a long time, especially with more than 10 questions, but overall it was worth it because it really helped me understand the material.
6.	That sometimes it wouldn't let me login
7.	There really wasn't anything I truly disliked about the online homework.
8.	the amount of questions
9.	It is sometimes hard to focus when the homework is online
10.	It didn't show you how to do questions well enough sometimes.
11.	Even if I had the correct answer, mystatlab would mark them wrong because it wasn't in the exact same order as what mystatlab had.

12.	I hate that it wouldn't always download all parts of the questions and that it is so picky with the answers. Also, it never helped me to understand the material and sometimes would take a long time to complete
13.	I do not have any major dislikes.
14.	My star lab was very picky
15.	Nothing
16.	It did not show me the correct way to do the problem I was on after I got it wrong
18.	The online component, i'd much rather have a hard copy
19.	answers are marked incorrect if you are even 0.01 number off.
20.	Glitched
21.	The amount of tries you have
22.	That the assignments can be closed by the professor.

Faculty Advantages of Using StatCrunch Software and Electronic Textbook

The instructional value of using online homework software from the perspective of faculty was the time that was saved and could be utilized to illustrate other examples or to stress the importance of the statistical analysis. The use of software also provides more time for faculty to focus on the understanding of concepts, instead of students wasting time on tedious computations. For example, from the pilot study, the instructor indicated that time could be spent on "*transforming an x-value into a z-value, rather than using the regular tables to find the area under the normal curve which would take 5-10 minutes".* With the use of StatCrunch, students would be able to see the graph of the normal curve and the z value together with the probability within 3 minutes. Additionally, students were able to visualize the data sets and use real-life situations when solving the problems. For students this type of learning would enable greater understanding of the statistical concepts that were discussed.

On a practical level, students are exposed to different tools in the digital era. They are apt to learn more and understand greater material that can be covered in an academic term. Since the instructor can spend less time on the computational aspect, there is more time for real-life applications with the use of the software, as well as increased comprehension in understanding how statistics work, in relation to the concepts and not simply only the theories. Furthermore,

since the software is compatible with several devices and user-friendly, the time required for learning how to use the tool is limited. Overall, the advantages identified by instructors are also reflected in the experiences of students given the usefulness of the online system and software to their learning opportunities. Figure #8 highlights the advantages identified by instructors but these advantages are also reflected in the responses of students.

Figure #8 - Advantages of On-line Textbook by Students

Question: What did you like most about the use of the Electronic Textbook?

1.	I liked not having to carry around the textbook even though I have it.
2.	I could view it on my phone
3.	That I could go straight to the section I was looking for
4.	Don't have to carry it around
5.	Ease
6.	I honestly bought the book, because I find it really hard to concentrate when I read material online. But that is just my personal opinion.
7.	I prefer the physical textbook
8.	I was able to reference the exact section without having to leaf through pages.
9.	easier way to search for what I wan
10.	Statcrunch is extremely helpful
11.	Able to transfer data needed right over to StatCrunch.
12.	You can search what you want to look up rather than flipping threw pages
13.	It was easy to get to when I needed it, if I needed it.
14.	I didn't really use it
15.	It's was easily accessible
16.	Being able to open the problems in StatCrunch
17.	it didnt use paper
18.	You can access it at anytime
19.	You can access it anywhere
20.	It was useful when needed.
21.	I didn't I like the book in hand.

22.	It helped fill in gaps that were needed in completed in assignments but I wished it were used more frequently for assignments.

Drawbacks of Using StatCrunch Software and/or E-textbook

Some of the drawbacks that were identified resonate with the need for connection to the internet in order to use the online software system. Students who were not connected to the internet would not be able to access the software. For a few students, the small size of the screen devices on phones is problematic as a full view of the material can be difficult to see on a small screen. As previously noted, the answers to the questions needed to be documented in a specific way. The narrow structure of this component of the software design could potentially be frustrating for students and possibly discourage them from pursuing the homework questions to completion. Finally, there is a learning curve with any new program. A paradigm shift is needed for those students who are less inclined to be receptive to new ways of learning. Some students may prefer traditional formats for learning because they are already familiar with these formats, and thus may perceive the old way of completing their assignments as easier.

Figure #9- Drawbacks of On-line Textbook by Students

Question: What did you dislike most about the use of the Electronic Textbook?

1.	I don't have any complaints about it.
2.	Nothing
3.	I don't think it helped that much
4.	It is more difficult to look through than a paper book.
5.	That you have to go online
6.	I did not know how to use it unless it was explained
7.	I did not use it once. I only used my book copy.
8.	I learn better from the textbook
9.	Electronic texts can get confusing to navigate at times
10.	too difficult
11.	it did not always work
12.	Sometimes difficult to find specific content.
13.	I didn't really use it.

1.	I don't have any complaints about it.
14.	That it was electronic and difficult for me to move through on a mac
15.	online and e learn better from hardcopies
16.	Didn't dislike anything.
17.	Nothing.
18.	that its online.
19.	nothing

Traditional Pen and Paper versus Technology Software- Next Steps

The students appeared to recognize the usefulness of the online homework system, although there were some students that indicated a preference for the paper homework format. As this was a pilot study, the feedback from students indicates that the online system was a good start for enhancing the teaching and learning of statistics for undergraduate students. In the next phase of this research study, more evidence is needed to provide some conclusive findings from the data that is collected. The following graphs indicate the preferences of students for both the traditional pen and paper format versus the software option.

Figure #10 – Preference for Electronic Textbook over Physical Copy

Question: I prefer the Electronic Textbook Over the physical Textbook

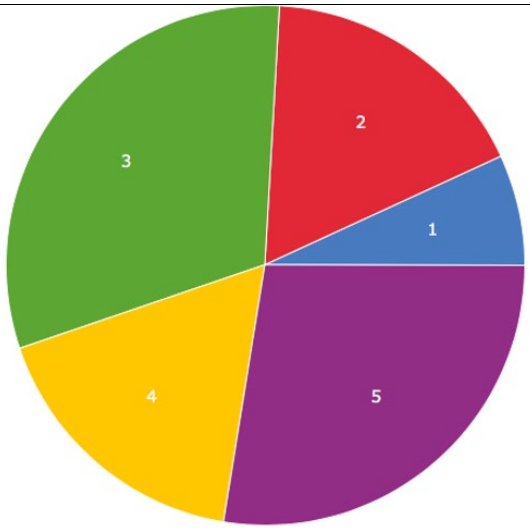
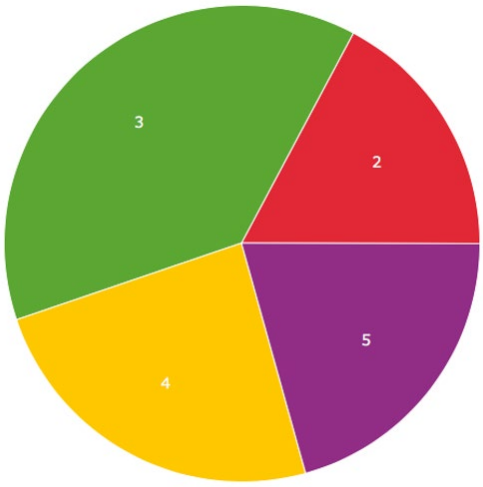
RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	1, 2, 6.9% 2, 5, 17.24% 3, 9, 31.03% 4, 5, 17.24% 5, 8, 27.59%

Figure #11 – The Value of Using Electronic Textbook to Student Learning

Question: I think that the e-textbook help me with understanding mathematical concepts

RESPONSE GRAPH	SCALE	SCALE to STUDENT RESPONSES
	1 - Strongly Disagree 2 - Disagree 3 - Neutral 4 - Agree 5 - Strongly Agree	2, 5, 17.24% 3, 11, 37.93% 4, 7, 24.14% 5, 6, 20.69%

As students are cognizant of the increasing costs associated with learning, the use of StatCrunch while similar to SPSS, is substantially cheaper for students and more user-friendly. The open-source software is another option that could be considered, such as R, but this software is more appropriate for research types of statistical problems. In some cases, R may be used for teaching upper-level statistics courses.

Conclusion

Statistical software and the use of online learning systems (textbooks, homework) are generally helpful for student learning. It is something that faculty need to adjust to in response to the digital learning needs of students. In this pilot study, sufficient data was not found to conclude that one system is better than the other, or what statistical software is more pertinent for elementary or developmental courses compared to upper-level courses. Over the next two years, surveys will be administered to collect more data in order to make a conclusive decision as to which system is best.

Given the ever-changing technology marketplace, it is difficult to project whether StatCrunch will continue to dominate the market in a few years. There may be other equally helpful software packages available for teaching statistics. What can be anticipated is that faculty must be prepared to move forward with the various supplemental packages that are available to assist students to learn. In a digital age, one should be prepared to expect that this is the life cycle of technology.

Teachers in higher education should incorporate some type of online learning system into their teaching practices. The needs of our students should not be ignored, and the way they would like to learn should also be considered. The apparent benefits of online homework systems and statistical packages appear to outweigh the drawbacks as noted in the pilot study feedback. Students and the instructors wanted to embrace the software because of greater flexibility provided with technology during the lecture. The use of software would permit more time for focusing on topics that needed more attention. Additionally, for certain topics, scaffolding of student learning was possible as instructors could use different types of activities such as simulations which enable the merging of theories with practice. Finally, the software is valuable for interpreting the problems quickly so that the instructor has more time to explain the results and why these findings matter.

As institutions of higher learning increasingly identify different forms of technology to remain competitive, it is imperative that faculty continue to remain abreast of both the learning needs and technological options that are available for teaching ‘digital learners’. Faculty must be prepared to reconstruct pedagogies of engagement in the classroom that will draw student interest from disconnected spaces whilst simultaneously reconnecting learning. In this way, meaningful teaching and learning can have a significant impact on student success.

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