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The Effects of New Materials and Teaching Methodologies on Low-Level Biology Courses

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THE EFFECTS OF NEW MATERIALS AND TEACHING METHODOLOGIES ON LOW-LEVEL BIOLOGY COURSES

A Capstone Experience/Thesis Project

Presented in Partial Fulfillment of the Requirements for

the Degree Bachelor of Science with

Honors College Graduate Distinction at Western Kentucky University

By

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ABSTRACT

A new generation has entered higher education that learns differently from generations before. To meet the changing needs of this generation, Western Kentucky University's Biology Department introduced e-textbooks and e-materials from McGraw Hill™ publishing in the fall of 2013 to most low-level classes. A foreseen product of this shift was a change in the way that some faculty taught and assessed their classes. This study assesses the changes in pedagogical techniques among professors of 100- and 200-level biology classes due to the new e-text and e-materials. Syllabi were collected from these classes pre- and post-implementation and common characteristics were inductively coded and statistically analyzed to identify changes in pedagogy. It was found that biology professors increased their average number of homework assignments by 23%. There was also a 289% increase in the number of courses that offered homework assignments as a means of assessment, indicating a shift from traditional summative assessments to more formative assessments after the implementation of the e-materials. This work provides insight into simple strategies that affect pedagogy in higher education STEM disciplines

Keywords: implementation, pedagogy, pedagogical change, e-textbook and e-materials, biology courses, higher education

Dedicated to my Mother and Father

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First and foremost, I'd like to acknowledge my Savior who gave me this opportunity. I would also like to extend the biggest thank you to my first and second readers, Dr. Kerrie McDaniel and Dr. Jerry Daday, for being by my side during this entire process. Thank you for always being a helping hand and encouraging word. Your guidance never went unnoticed and was appreciated every step of the way. To my third reader, Dr. Michael Stokes, thank you for serving on the committee and providing helpful feedback. I would also like to thank my second coder, Kailey Quiambao, for the many hours of coding.

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VITA

July 21, 1994…………………………………………Born – Lexington, Kentucky

2012…………………………………………………Woodford County High School, Versailles, Kentucky

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FIELDS OF STUDY

Major Field: Health Sciences
Concentration in General Wellness

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CHAPTER 1

INTRODUCTION

1.1 Net Generation

A new generation has entered higher education, a cohort that, as of 2013, has as many as 19 million students enrolled in college courses across the United States (United States Census Bureau, 2013). These students are what Jones, Ramanau, Cross, and Healing refer at as “Net Geners” (Jones et al., 2010). They are a population that learns differently from previous generations, who studied by visiting libraries, reading print material, and who used dial-up internet connections. With the Net Generation comes a “generational shift [that] has consequences for approaches to learning because the new generation requires rapid access and quick rewards, is impatient with linear thinking and displays a novel capacity for multi-tasking” (Jones et al., 2010, pg. 2).

This shift can be seen in all aspects of life, but especially in the way they learn (Palfrey & Gasser, 2008). In the last 15 years, this has proven to be a problem as professors are being forced to teach in a way that they themselves were not taught (Palfrey & Gasser, 2008). These students have grown up in an age where information is only a few internet searches away and now they demand an education that is individualized and autonomous (Barnes et al., 2007; Palfrey & Gasser, 2008). However, the Net Generation’s impatience may leave them incapable of taking the time to critically think and solve problem, two skills required for a more independent education.

Oblinger and Hagner (2005) believe that two of the main methods Net Generation students learn by are 1) by physically doing and 2) interaction. This constant need for stimulation is thought to be responsible for students' short attention spans. Growing up with this generation meant regularly being stimulated by one or more sources of technology at a time (Oblinger & Hagner, 2005). Though this new generation's high standard for learning may seem needy, they are still known to prioritize their education and want to learn (Barnes et al., 2007). To meet the needs of students, professors' pedagogies must adapt to take mere information and turn it into acquirable knowledge in a form that Net Geners use (Barnes et al., 2007).

1.2 Active Learning in STEM Classes

Efforts are being made within science, technology, engineering, and mathematics (STEM) departments to meet these needs. First, there is a call to switch to active learning, which meets the before-mentioned need of learning by physically doing. There is a substantial amount of research exemplifying the restrictions of traditional lecture-based learning and the benefits of modernizing from a passive traditional style to an active modern style in the sciences (Henderson at al., 2010; Handelsman et al., 2004; Andrews et al., 2011; Nelson, 2008). Surveys analyzed by Hake (1998) even showed that college students learn about twice as much when taught with active learning as opposed to passive. Making classes more active can help resolve the monotony that Net Geners report feeling. Active learning can have a wide variety of meanings and is loosely defined by Andrews et al. (2011) as "when an instructor stops lecturing and students work on a question or task designed to help them understand a concept." It is more complex than this though; active learning must be used in a way that is effective in order to benefit Net Geners in the way that they seek (Andrews et al., 2011). For example, professors cannot just replace a five question quiz administered on paper to a quiz administered using clickers and believe it is advancing the students' knowledge (Andrews et al., 2011). Active learning needs to be distributed in a way that requires interaction and forces students to critically think, not just mind-numbingly press a button.

Hake (1998) expands on this by saying interactive engagement (another name for active learning) should "promote conceptual understanding through interactive engagement of students in heads-on (always) and hands-on (usually) activities which yield immediate feedback through discussion with peers and/or instructors." Encouraging critical thinking is the second way STEM courses are evolving in higher education. Science courses have a large amount of content compiled into a single semester's time (Nelson, 2008). With current pedagogical techniques, students are often being conditioned to memorize information and later regurgitate it on a test with little critical thinking required.

Traditionally, the concept of teaching was purely relaying information from instructor to student (Ruben, 1999). A limited number of resources were normally used, including lecture and textbook, meaning the student relied heavily on the professor. The Net Geners however, have a desire for autonomy in their education, which can be met with self-regulated learning (Barnes et al., 2007). Instead of the focus being placed on relaying information from professor to student, Barr and Tagg (1995) explain self-regulated learning as a progression whereby students actively build on what they already know. This form of learning would also force students to take responsibility for and manage their education (Nichol & Macfarlane-Dick, 2006). As far as interaction, self-regulation requires a series of feedback between both student and professor and student and student. This feedback is intended to accelerate performance, not by simply stating what is right or wrong; but by dialogue (Nicol & Macfarlane-Dick, 2006). This dialogue is meant to assist self-regulation by providing an interaction that can answer what the student misunderstood; they then relay this information internally and gain understanding. Plus, if further clarification is needed, they can receive additional feedback (Nichol &Macfarlan-Dick, 2006).

With the majority of experts agreeing that an intervention in higher education needs to take place, it is shocking that these changes are not happening at a faster pace (Handelsman et al., 2004). Active learning and self-regulation are not new ideas; they have just been slow to enter higher education. This may be the product of colleges not requiring professors to complete a formal teacher training program; whereas, teachers of elementary, middle, and high schools are required to complete a formalized program, obtain a college credential, and maintain ongoing professional development for their teaching certificate (Jang, 2008). College professors may know extensive content about their subject, but they may not possess the skills or be aware of the teaching methodologies needed to transfer their knowledge to students and promote student learning and excellence (Jang, 2009). The concept of mixing these ideals results in pedagogical content knowledge (PCK), or as Jang expresses it, “representation of concepts [and] pedagogical techniques…” (2011).

1.3 Active Learning in General Biology

Professors of STEM courses, especially those of biology, have been called to improve their pedagogical content knowledge to develop a new system of teaching to improve education (Brewer & Smith, 2011). A change in pedagogy can be a daunting task, but is necessary to meet the needs of the Net Geners. This change has been recognized as a difficult task, but especially difficult for classes in the sciences (Henderson et al., 2011). The before-mentioned approaches, interactive and active learning, are what the American Association for the Advancement of Science believes is the kind of methodology that biology professors need to develop in undergraduate courses (Brewer & Smith, 2011; Brownell & Tanner, 2012). In biology courses, professors may resist pedagogical change because it is time consuming and "change" comes with the connotation that professors are not teaching effectively (Brewer & Smith, 2011).

This resistance contributes to what Brownell and Tanner (2011) consider are the three main sources of delay in pedagogical modernization: lack of training, time, and incentives. If biology professors are expected to learn how to teach in a way that they were not taught, it would take consistent feedback and several trials; something they cannot simply learn in a short workshop (Brownell & Tanner, 2011). As far as time goes, not only will the process of change be time consuming, but future planning for each interactive class period is thought to take additional time (Brownell & Tanner, 2011). And incentives could be argued as the biggest impedance of pedagogical change in biological courses. If faculty members dedicate their time to adapting pedagogies and instruction for the Net Geners, they feel they should be compensated or rewarded for their efforts in the form of pay raises, tenure, awards, or lighter teaching loads (Brownell & Tanner, 2011). Most university STEM Departments put a much greater emphasis on research than teaching, leaving little time to devote to the difficult task of pedagogical change (Lederman, 1992). Reward systems are often biased towards productivity in research rather than excellence in teaching.

The American Association for the Advancement of Science notes that some biology courses faculty are making improvements by implementing online assessments. These assessments are to be completed before class and made to engage students in order to create a flipped classroom environment (Brewer & Smith, 2011). Berret (2012) refers to flipping the classroom as an inversion technique that encourages interactive engagement, answering online questions before class that the professor uses to base his teaching off, and students teaching each other. This encourages continual growth and understanding outside of the classroom (Berrett, 2012). After all, as Linn and Eylon (2012) said, "…it is *not* the presence of the resource itself that leads to learning gains, but rather, how the resource is used" (Scalise, 2012, pg. 1136)

Flipping classrooms in STEM courses like biology has recently become more practical than before with new technologies making lectures from all over the world accessible (Berrett, 2012). With class sizes in introductory biology courses reaching close to the thousands, flipping the classroom is a good way to be more efficient with the large student to faculty ratios (Berrett, 2012). Humanities teachers have expected students to read novels outside of class for years and come to class prepared to discuss and clarify; this idea can be duplicated for biology courses (Berrett, 2012). A few disadvantages do exist however; the most notable being the increase of labor required by the professor (Berrett, 2012).

1.4 Pedagogical Change

For years, there has been emphasis placed on creating a better teacher in order to create better teaching for students. However, Heibert and Morris (2012) argue that the approach should be reversed, and instead the aim should be on improving teaching and in return get a better teacher. It is thought that teaching is a cultural movement where each student is raised in the culture that they were taught and then continue to teach in the same manner (Stigler & Hiebert, 2009). Challengingly, the idea of active learning does not match the traditional methods of teaching with which today's professors were taught. This creates what Stigler and Hiebert call "the teaching gap." This happens when experts on teaching create a new teaching method and think that it can be taught to teachers by simply sending out an e-mail and telling them to use these new methods, which is an ineffective system (2009). The United States uses a system that includes learning terms and practicing procedures, a system that requires shallow content knowledge from students (Stigler & Hiebert, 2009). Although attempts have been made to adjust professors' pedagogies, they are merely modifying the same system of learning rather than changing the system itself (Stigler & Hieber, 2009). There does not seem to be a simple approach for making pedagogical changes in university STEM courses that are rooted in traditional methods.

There is an agreement among researchers that the Net Generation is a cohort that learns differently than its predecessors. Some minor changes in teaching methodology to meet these new needs are beginning to emerge, but they are inconsistent and rare. This study evaluates pedagogical change that has occurred in the Biology Department at Western Kentucky University due to the introduction and implementation of e-textbook and e-materials in freshman- and sophomore-level undergraduate courses, specifically the courses 113, 120, 122, 131, 207, 224, and 231, in an attempt to meet the needs of the Net Generation. The study looks further at changes specifically in Human Anatomy and Physiology courses, a subset of the biology courses, which has attempted to modernize a once very traditionally taught course.

This initiative to introduce an e-text for global use in 100 and 200 level courses in the biology department began as an attempt to standardize content across professors, facilitate the transition for professors between courses, and to reduce the price of textbook costs for students. After researching well known textbook companies that had available online materials and e-texts, McGraw Hill™ was selected. McGraw Hill™ offered a variety of online textbooks for low-level courses, showed commitment and extensive support, and offered 24-month access to an online textbook for students, which lowered cost. This study is to evaluate how the pedagogies of professors have changed with the implementation.

CHAPTER 2

MATERIALS AND METHODOLOGY

This research project uses content analysis of course syllabi to examine how faculty members have changed the structure of their courses since the adoption of the new e-text and e-learning materials. Specifically, this research examines the extent of changed structure of these courses by comparing syllabi before the implementation of the e-text and e-learning system to syllabi after the adoption of these new materials. For all of the subsequent analyses, the pre-post implementation comparison will serve as the independent variable, while characteristics identified through the content analyses of syllabi serve as the dependent variables. The central goal of this research was to evaluate if and how pedagogy has changed in general introductory biology courses and anatomy and physiology courses specifically after adopting and implementing e-materials.

The e-text and e-materials were implemented to by the Biology Department in fall of 2013. Syllabi for the low-level biology courses spanning across three years of semesters were collected from topnet.wku.edu. Syllabi were organized into two separate groups, “pre-implementation” and “post-implementation.” Pre-implementation syllabi span from Fall 2011, two years before the implementation, through Summer of 2013, making a total of 150 syllabi pre-implementation. Post-implementation syllabi refer to syllabi spanning from Fall 2013 through Spring 2014, totaling 104 syllabi (Table 2.1). Together, 254 syllabi were collected for the analyses. Syllabi from all professors currently teaching at WKU that have taught low-level biology courses over these three years were included in subsequent analyses. Professors who teach at Western Kentucky University's main campus and south campus extension in Bowling Green, Kentucky, and in an extended campus of WKU in Glasgow, Kentucky were all included this study.

Low-Level Biology Courses' Syllabi Distribution

	Pre Implementation	Post Implementation
Semesters Included	Fall 2011- Summer 2013	Fall 2013 – Fall 2014
Number of Syllabi	150	104

Table 2.1. Low-Level Biology Courses' Syllabi Distribution

After the 254 syllabi were collected from the school's website, Topnet.wku.edu, they were individually numbered so that each syllabus corresponded to a single number and then analyzed for apparent themes. This was an inductive process, where course syllabi were initially read and examined by a single coder for items that would be appropriate for subsequent coding and analysis. This reading and examination of course syllabi by the coder resulted in the development of eight main themes, including:

- Class name and section (ex: 131-001)
- Professor teaching the class

- Semester this class was taught
- Grade distribution of assignments (exams, quizzes, homework, and other)
- Total number of assignments (exams, quizzes, homework, and other)
- Form of text used (e-text vs traditional text)
- Other open education resources (OERs) used

  -This may include a number of online resources that are freely available to faculty and students. (ex: modules, software, etc.)
- Type of tests, quizzes, and homework (online vs. traditional)

These themes were expanded upon as coder made the code sheets which totaled 27 total items that were collected from each syllabus. To guide the coder, a codebook was made to specify rules on how the items in the syllabi should be coded. The codebook allowed for the further extraction of specific information from each of the 254 course syllabi. The coder read and examined each of the 254 course syllabi identified for this study, and entered relevant information on a corresponding coding sheet, each numbered to match the number assigned to each syllabus. A single coding sheet was generated for each course syllabus. A simplified coding sheet is shown in Table 2.2:

Coding Sheet	
1. Class Name	### (Class) - ### (Section)
2. Professor	# (Corresponding with a professor)
3. Semester	Semester, Year
4. Percent of Total Grade in Tests	Calculated numerical value
5. Percent of Total Grade in Quizzes	Calculated numerical value
6. Percent of Total Grade in Homework	Calculated numerical value
7. Percent of Total Grade in Discussion	Calculated numerical value
8. Percent of Total Grade in Other	Calculated numerical value
9. Total Number of Tests	Numerical value
10. Total Number of Quizzes	Numerical value
11. Total Number of Homework	Numerical value
12. Total Number of Other	Numerical value
13. Use of e-text	Absent = 0, Present = 1, Unclear = 2
14. Use of e-text from McGraw Hill™	Absent = 0, Present = 1, Unclear = 2
15. Use of e-text from other	Absent = 0, Present = 1, Unclear = 2
16. Use of traditional text	Absent = 0, Present = 1, Unclear = 2
17. Use of a general video to teach	Absent = 0, Present = 1, Unclear = 2
18. Use of a Tegrity™ video to teach	Absent = 0, Present = 1, Unclear = 2
19. Use of a class website	Absent = 0, Present = 1, Unclear = 2
20. Use of other OERs	Absent = 0, Present = 1, Unclear = 2
21. Use of Blackboard™	Absent = 0, Present = 1, Unclear = 2
22. Use of online homework	Absent = 0, Present = 1, Unclear = 2
23. Use of online homework from McGraw Hill™	Absent = 0, Present = 1, Unclear = 2
24. Use of online homework from other	Absent = 0, Present = 1, Unclear = 2
25. Use of online quizzes	Absent = 0, Present = 1, Unclear = 2
26. Use of online tests	Absent = 0, Present = 1, Unclear = 2
27. Use of extra credit	Absent = 0, Present = 1, Unclear = 2

Table 2.2. Coding Sheet

Additionally, a codebook was created to minimize the level of subjectivity in the extraction of information from the course syllabi by standardizing rules for completing the coding sheets. For example, item 2 on the coding sheet (Table 2.2) asks for the professor that was teaching the course from which that individual syllabus came. Instead of placing the name of the professor, there is a coordinating number assigned to each of the professors in the codebook, and that number should be placed in item 2.

For items 4-8 in the coding sheet, percentages represent how much of the total grade for a single course was allotted to different forms of assessments, including: tests, quizzes, homework, discussion, and other. The codebook clarifies this by explaining percentages are to be calculated by dividing the points from a single form of assessment (ex: tests alone) by the total number of points available in the course, then multiplied by one hundred, and rounded to the nearest whole number.

<u>Example of Percentage:</u>

If tests account for 755 of a total 1000 points available:

755 / 1000 = 0.755

0.755 x 100 = 75.5%

Rounded to 76%

Items 13-27 in the coding sheet are common characteristics or resources that were seen thematically throughout the syllabi. These characteristics are accounted for on the coding sheet as “present” or “absent” for each syllabus, which is clarified in the following Table 2.3:

Description of Characteristics

in the Coding Sheet

#	Characteristic	Description
13	E-Text	Includes the general use of any online textbook
14	E-text from McGraw Hill™	when item is present in syllabi, it is counted in both the general e-text category and here
15	Other E-text	when item is present in syllabi, it is counted in both the general e-text category and here
16	Paper Text	any traditional textbook, can be offered alongside of e-text
17	General Video	videos made by someone other than the professor
18	Tegrity Videos	videos professors have made of themselves teaching for students to access
19	Class Website	an additional website made specifically for the students in the course
20	Other OER	Open Educational Resource
21	Blackboard	an online learning management system which both professors and students can access to post content, grades, assignments, etc.
22	Online Homework	any general homework to be completed online
23	Online Homework from Learnsmart™	when item is present in syllabi, it is counted in both general online homework category and here
24	Other Online Homework	when item is present in syllabi, it is counted in both the general e-text category and here
25	Online Quizzes	quizzes completed on a computer, whether in class or a testing center
26	Online Tests	tests completed on a computer, whether in class or a testing center
27	Extra Credit	can be a variety of options, has to be specifically stated as an extra credit option

Table 2.3. Description of Characteristics in the Coding Sheet

After the coding sheet and codebook were created, all syllabi were each coded separately by two coders to ensure inter-coder reliability, represented by coders “A” and “B.” Their findings were then compared to find the amount of error between the coders. Both sets of data (one from each coder) were analyzed in a computer software program, STATA, to generate a corresponding percentage of agreement and a kappa value for each characteristic that could be quantified numerically (seen in Table 2.5). The kappa value can range from 0.0 to 1.0; the closer the kappa value is to 1.0, the higher the relationship is between the two sets of data. Landis and Koch (1977, p165) further clarify the possible kappa values by dividing them into 5 categories (Table 2.4).

Landis and Koch’s Kappa Value Interpretations

Kappa Value	Interpretations
0.00-0.20	Slight
0.21-0.40	Fair
0.41-0.60	Moderate
0.61-0.80	Substantial
0.81-1.00	Almost Perfect

Table 2.4. Landia and Koch’s Kappa Value Interpretations

These interpretations are listed next to the percent agreement and kappa value for each characteristic from the syllabi in Table 2.5.

Inter-Coder Reliability			
Characteristic	**Agreement**	**Kappa**	**Interpretations**
Class	98.02%	0.9774	Almost Perfect
Professor	100.00%	1.0000	Almost Perfect
Semester	99.60%	0.9956	Almost Perfect
Test Percentage	95.59%	0.9552	Almost Perfect
Quiz Percentage	98.95%	0.9887	Almost Perfect
Homework Percentage	94.85%	0.9447	Almost Perfect
Discussion Percentage	89.19%	0.8738	Almost Perfect
Other Percentage	91.30%	0.9081	Almost Perfect
Number of Tests	97.29%	0.9594	Almost Perfect
Number of Quizzes	97.85%	0.9761	Almost Perfect
Number of Homework Assign.	100.00%	1.0000	Almost Perfect
Number of Other Assign.	91.30%	0.8978	Almost Perfect
E-Text	98.03%	0.9606	Almost Perfect
Paper Text	97.64%	0.9527	Almost Perfect
E-Text from McGraw Hill™	98.82%	0.9751	Almost Perfect
E-Text from Other Source	99.21%	0.9540	Almost Perfect
General Video	97.64%	0.8001	Almost Perfect
Tegrity Video	98.82%	0.9388	Almost Perfect
Class Website	98.43%	0.7697	Almost Perfect
Blackboard	98.43%	0.9606	Almost Perfect
Other OER	99.21%	0.9556	Almost Perfect
Online Homework	98.82%	0.9754	Almost Perfect
Learnsmart™ Online Homework	99.21%	0.9814	Almost Perfect
Online Homework from Other Source	100.00%	1.0000	Almost Perfect
Online Quizzes	98.42%	0.9582	Almost Perfect
Online Tests	97.22%	0.9369	Almost Perfect
Extra Credit	99.60%	0.9789	Almost Perfect

Table 2.5. Inter-Coder Reliability

All of the kappa values for this experiment fell into the “almost perfect” category, meaning that the data was very similar from both coders. This is likely due to the coding sheet and coding manual being thorough and allowing little grey area of data.

Data were entered into a Microsoft Excel spreadsheet and analyzed with IBM SPSS using two main statistical procedures, crosstabs and t-tests. Crosstabs were used to compare the presence or absence of course characteristics for syllabi pre-implementation and post-implementation. Whether the syllabi being analyzed were pre- or post-implementation served as the independent variable and each individual course characteristic served as a dependent-variable. Each crosstab shows the percentage of syllabi that have a specific course characteristic pre- and post-implementation along with a Pearson chi-square statistic to test for significant differences between these two groups. An alpha of $p < .05$ (See Appendix) was used to determine if there was a significant difference in the percentages of course syllabi possessing certain course attributes pre- and post-implementation (Fig. 3.1).

T-tests were conducted to compare the average number of assignments pre- and post-implementation (items 9-12 in Table 2.2) and to compare the grade distribution based on percentages pre- and post-implementation (items 4-8 in Table 2.2). Given the continuous nature of these variables, t-tests were employed to compare these course attributes pre- and post-implementation rather than cross-tabs. The total number of a single characteristic across all syllabi pre-implementation and across all syllabi post-implementation was summed. This gives us a sample number (N). The presence of a single characteristic was also averaged pre- and post-implementation ($\bar{X}$). For example, if 2 syllabi pre-implementation used quizzes as a means of assessment, then N=2. If these two syllabi accounted for a class with 4 quizzes and a class with 2 quizzes and were averaged, then $\bar{X} = 3$.

Pre and post implementation totals and averages of each characteristic were compared to establish significance using an independent sample t-test. Levene's Test for Equality of Variances is first used to determine if there is a significant difference in the variances of each group with $p < .05$ used as the threshold for significance. If the alpha for the Levene's test is greater than or equal to .05, equal variances are assumed and the two-tailed test listed in the first row of the IBM SPSS output is used to determine significance. However, if the Levene's test has an alpha of less than .05, equal variances are not assumed between the pre- and post-implementation groups for each course characteristic, and the two-tailed test listed in the second row of the IBM SPSS output is used to determined significance.

When both the cross tabs and t-tests were completed, it was noticed that syllabi from two specific general biology courses, Anatomy and Physiology 1&2, had exaggerated results compared to the rest of the syllabi. To address this, the two procedures were repeated a second time, but only with the data extracted from the syllabi for Anatomy and Physiology (A&P) courses. These syllabi include both their lectures and labs, making a total of 99 syllabi, 57 pre-implementation and 42 post-implementation (Table 2.6). Figure 3.5 shows the results from the A&P crosstabs and Figures 3.6, 3.7, and 3.8 show the results of the t-test analyses.

Anatomy and Physiology Courses' Syllabi Distribution

	Pre Implementation	Post Implementation
Semesters Included	Fall 2011- Summer 2013	Fall 2013 – Fall 2014
Number of Syllabi	57	42

Table 2.6. Anatomy and Physiology Courses' Syllabi Distribution

CHAPTER 3

RESULTS

Through inductive coding of course syllabi, fifteen characteristics were identified and coded. These characteristics were compared pre- and post-implementation using cross-tabs to determine percentages and level of significance across both groups. The results are presented graphically in double bar graphs. Each characteristic was dichotomous, being either present or absent in the pre- and post-implementation groups.

Additionally, t-tests were used to analyze the percentage of courses that utilize each form of assessment (tests, quizzes, homework, and other) pre- and post-implementation, average number of each assessment per syllabi, and the amount of the total grade allotted to each assessment. The characteristics marked with an asterisk (*) in the figures symbolize a significant result with an alpha of $p<0.05$. This process and tests were completed first for all general biology courses (Figures 3.1-3.4) and then repeated for findings specifically related to anatomy and physiology courses as a sub-set sample (Figures 3.5-3.8).

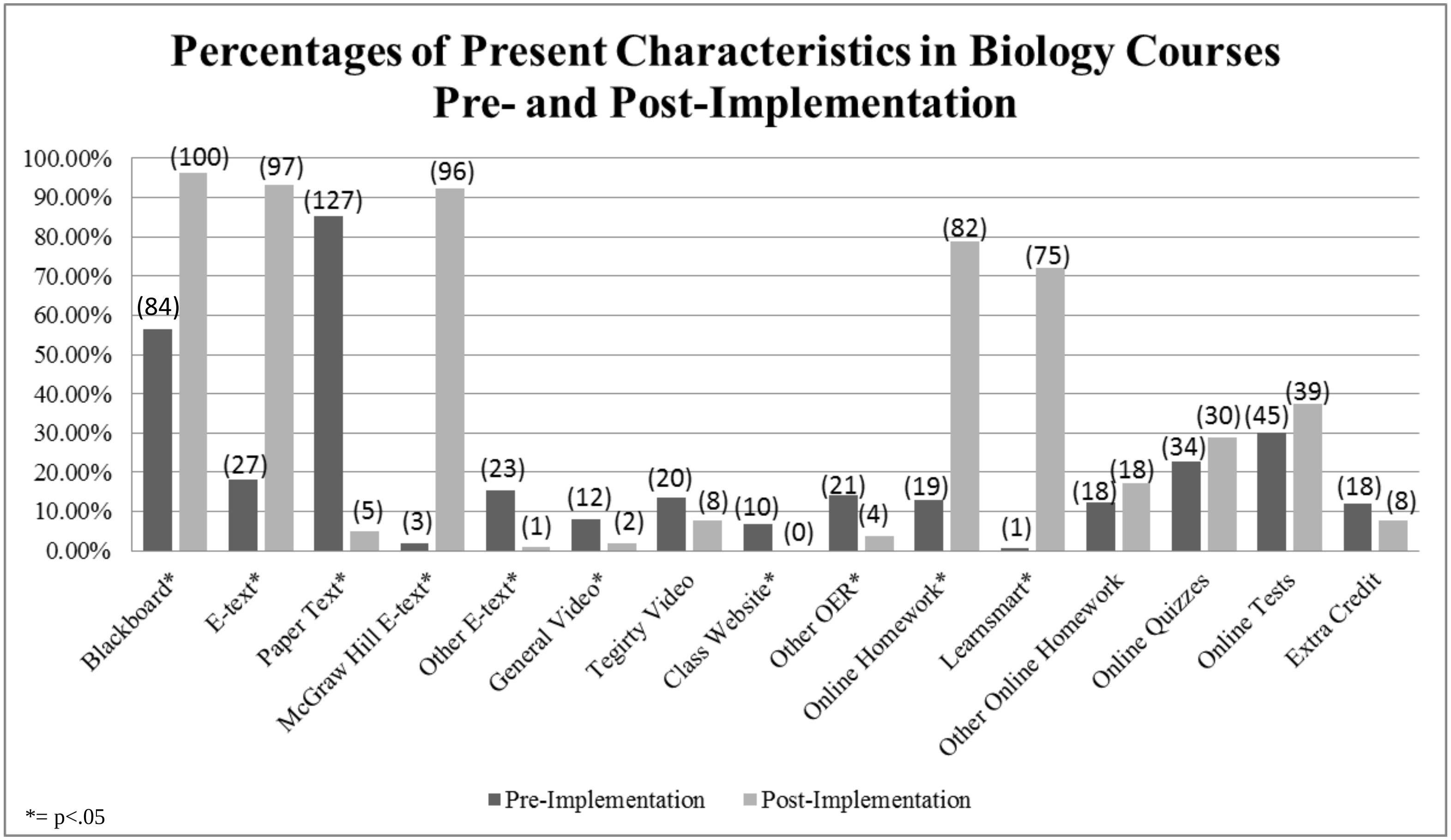

Figure 3.1. Percentages of Present Characteristics in Biology Courses Pre- and Post-Implementation

The percentages in Figure 3.1 show the presence of each characteristic on course syllabi pre- and post-implementation. The darker bars represent the percentage of course syllabi pre-implementation of e-text and e-material (before Fall 2013) and the lighter bars represent the percentage of course syllabi after the implementation (Fall 2013 and after). If a course characteristic is significantly different pre- and post-implementation, an asterisk (*) is listed next the attribute in Figure 3.1. The value above each bar is the raw score of the syllabi with the present characteristic. The raw score is especially interesting because the total number of syllabi pre-implementation (150) was much larger than the total number of syllabi post-implementation (104). Most notable from Figure 3.1 is the change in total number of syllabi that use general online homework, specifically, Learnsmart™. Before the implementation of the e-learning system, only 19 syllabi showed any use of online homework, while post-implementation that had increased to 82 syllabi. The presence of Learnsmart™ also increases drastically in syllabi, from 1 to 75.

As noted in the discussion above, an asterisk is used in the following figures and discussion to indicate when there is a significant difference in course attributes pre- and post-intervention, with $p < .05$ used as the threshold for determining a significant relationship. For example, the number of syllabi that included use of blackboard before the implementation was at 56.4% and increased to 96.2% and had a $p=0.000$, a statistically significant relationship. Prior to the implementation of the McGraw Hill™ e-text, 18.1% of syllabi were coded for use of their materials, and as expected, that percentage significantly increased to 93.3%.

As presence of e-text increased, paper text significantly decreased from 85.2% to 4.8%. The syllabi listing use of e-text other than from McGraw Hill™ significantly decreased from 15.4% to 1% after the implementation. Use of general videos and tegrity videos both decreased in syllabi, general video from 8.1% to 1.9% and the tegrity videos from 13.4% to 7.7%, but only general videos saw a significant relationship. Syllabi reporting use of class websites also significantly decreased from 6.7% to 0% and syllabi including other open education resources (OERs) from 14.1% implementation to 3.8% post implementation. For online homework, all three areas saw an increase with the new implementations, including online homework in general, online homework through Learnsmart™, and other online homework assignments. General online homework significantly increased in presence from 12.8% to 78.8%. Also, online homework specifically from Learnsmart™ significantly increased from 0.7% pre- to 72.1% post-, and other online homework included in syllabi from 12.2% to 17.3%. Many of the other online homework assignments came from professors posting additional homework on blackboard, rather than a separate source. Online quizzes also saw change, though insignificant, and increased from 22.8% pre- to 28.8% post-. Online tests were also affected in their presence in syllabi increasing from 30.2% to 37.5%.

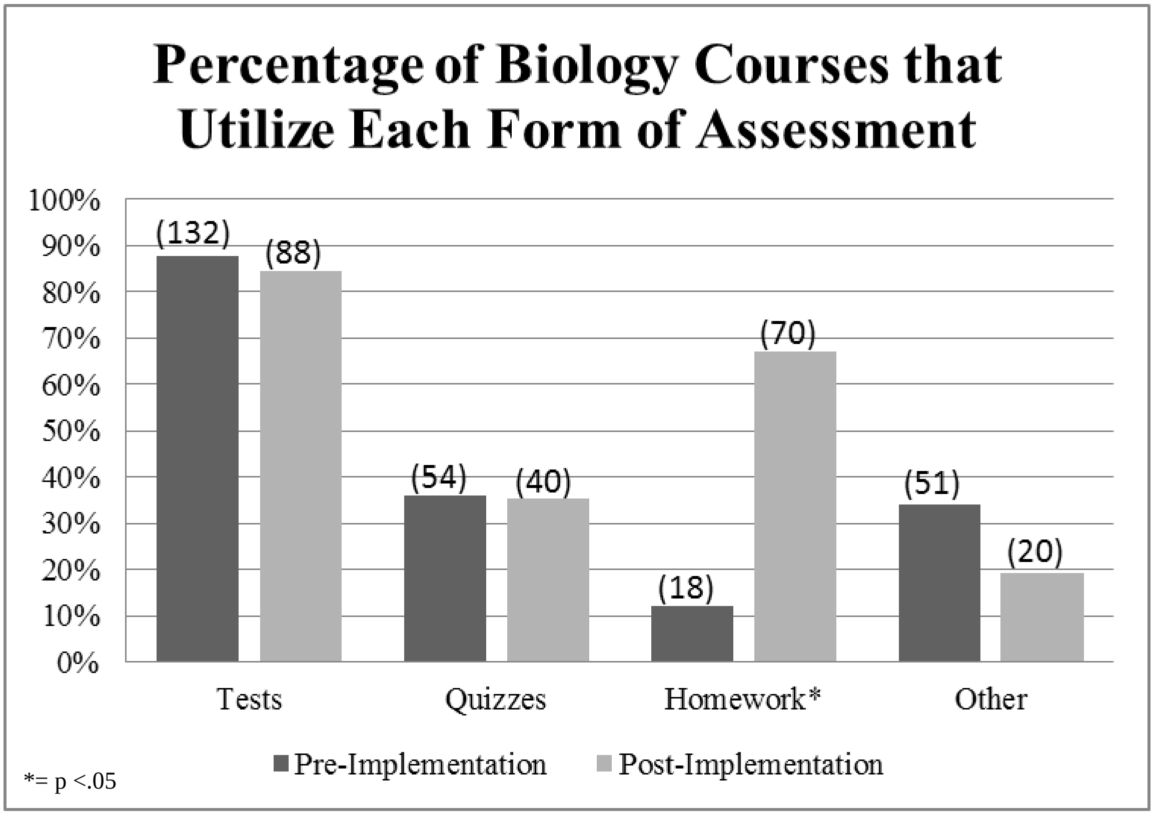

Figure 3.2. Percentage of Biology Courses that Utilize Each Form of Assessment

The percentage of syllabi that included tests, quizzes, homework, and other assignments pre- and post-implementation are shown in Figure 3.2. Biology courses that listed homework as a means of assessment significantly increased by 289% from 12% pre- to 67.3% post-implementation. Pre-implementation, 88% of the syllabi from general biology courses included tests as a means of assessment and this decreased to 85%. The percent of syllabi that used quizzes stayed constant from 36% pre- to 35% post-. Presence of other assessments in syllabi decreased from 34% to 19%, a 43% decrease.

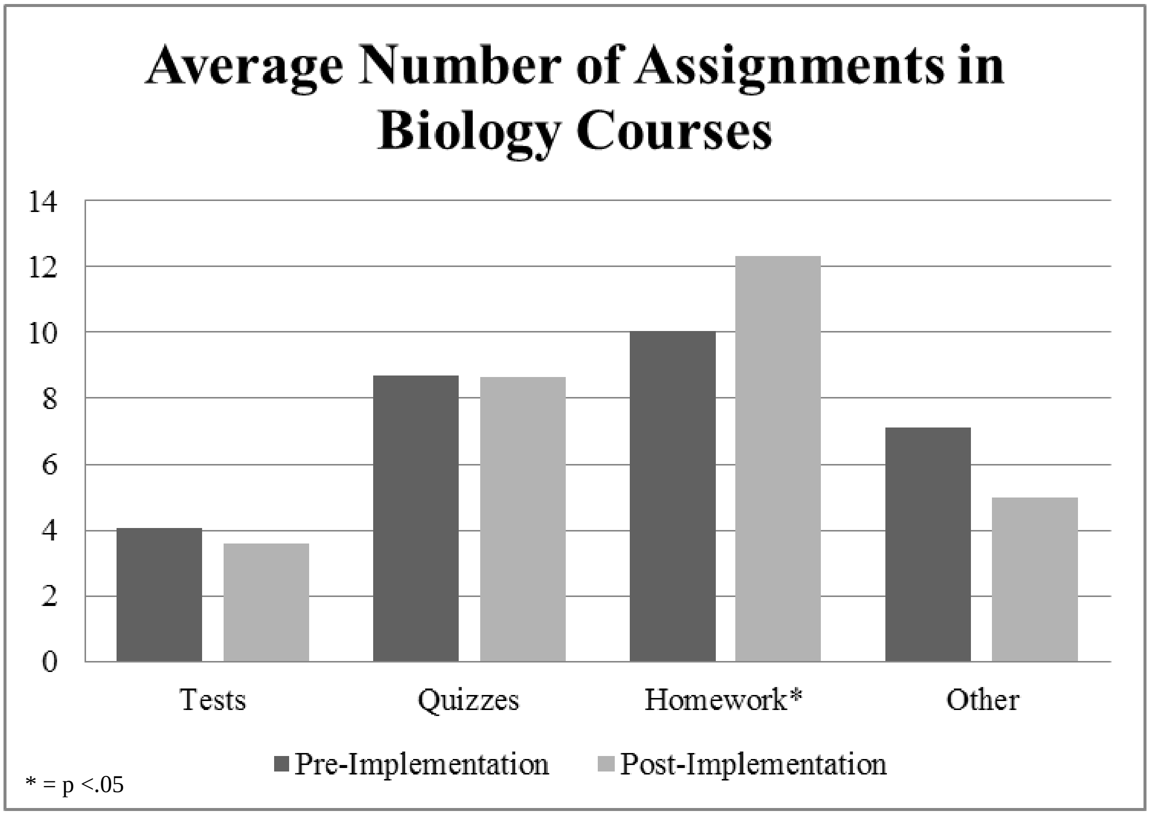

Figure 3.3. Average Number of Assignments in Biology Courses

Figure 3.3 shows the average number of assignments that were listed in the syllabi pre- and post-implementation. The average is a better representation of grade distribution because the uneven numbers of syllabi pre- vs post-implementation (seen in Table 2.1) are not biasing data. The only significant finding was in the average number of homework assignments in a single syllabus, which increased from 10.06 to 12.33. Average number of tests decreased from 4.03 pre- to 3.6 post-implementation; the average number of quizzes stayed almost constant with 8.72 to 8.65; and other assignments average decreased from 7.1 to 5 per general biology course.

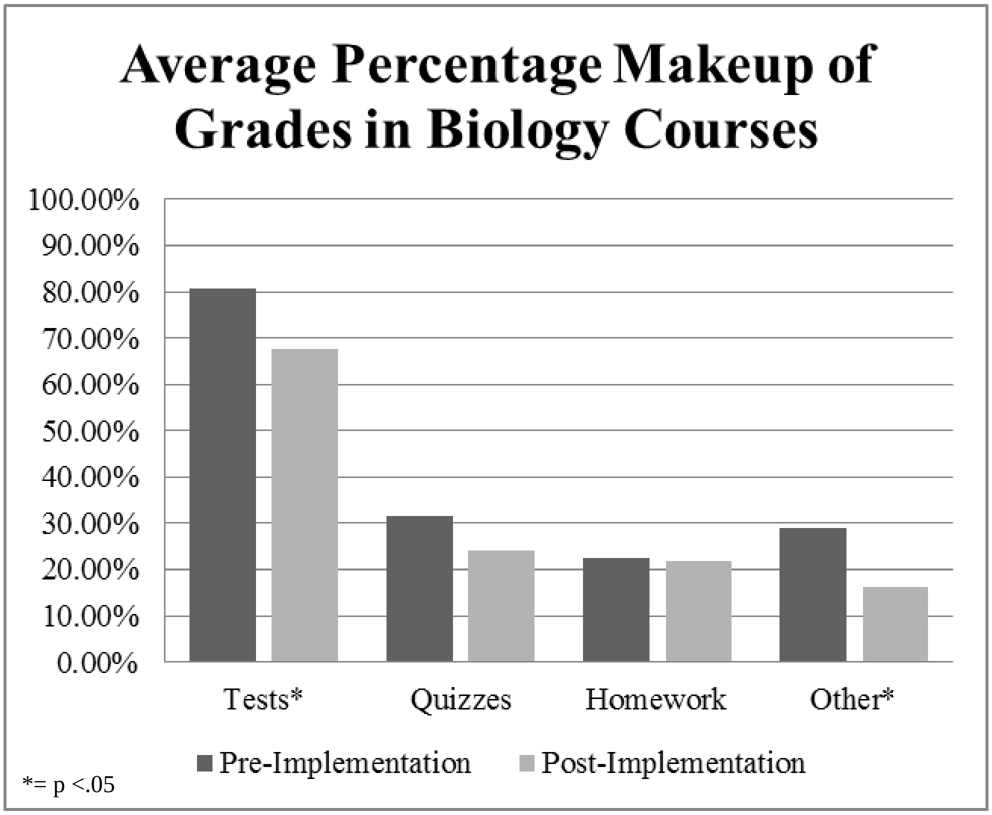

Figure 3.4. Average Percentage Makeup of Grades in Biology Courses

Figure 3.4 shows how professors, on average, distributed their grades as reflected on their course syllabi. Before the implementation, larger percentages of grades relied on tests, significantly decreasing from 80.56% to 67.72%. Percentage of total grade in other assignments also significantly decreased from 28.8% to 16.35%. Percentage placed in quizzes, on average, also decreased from 31.65% to 24.05%. Percent in homework stayed almost completely the same from 22.4% to 21.8%.

As shown in Figures 3.1-3.4, ALL low-level biology courses were analyzed using t-tests and crosstabs, including syllabi for Anatomy and Physiology 1&2 (A&P) as they are 100- and 200-level courses. Figures 3.5-3.8 represent data that were drawn ONLY from A&P courses. Because these courses were very traditionally taught pre-implementation and the entire grade for the lecture and lab was made of a few tests and quizzes and very little online material was used, the implementation had made a more radical change within A&P specifically. To assess this, A&P courses' syllabi were extracted from the previous data set and analyzed separately as a sub-sample. Crosstabs and t-tests were completed again in IBM SPSS specifically with A&P course syllabi and these results can be seen in Figures 3.5 – 3.8.

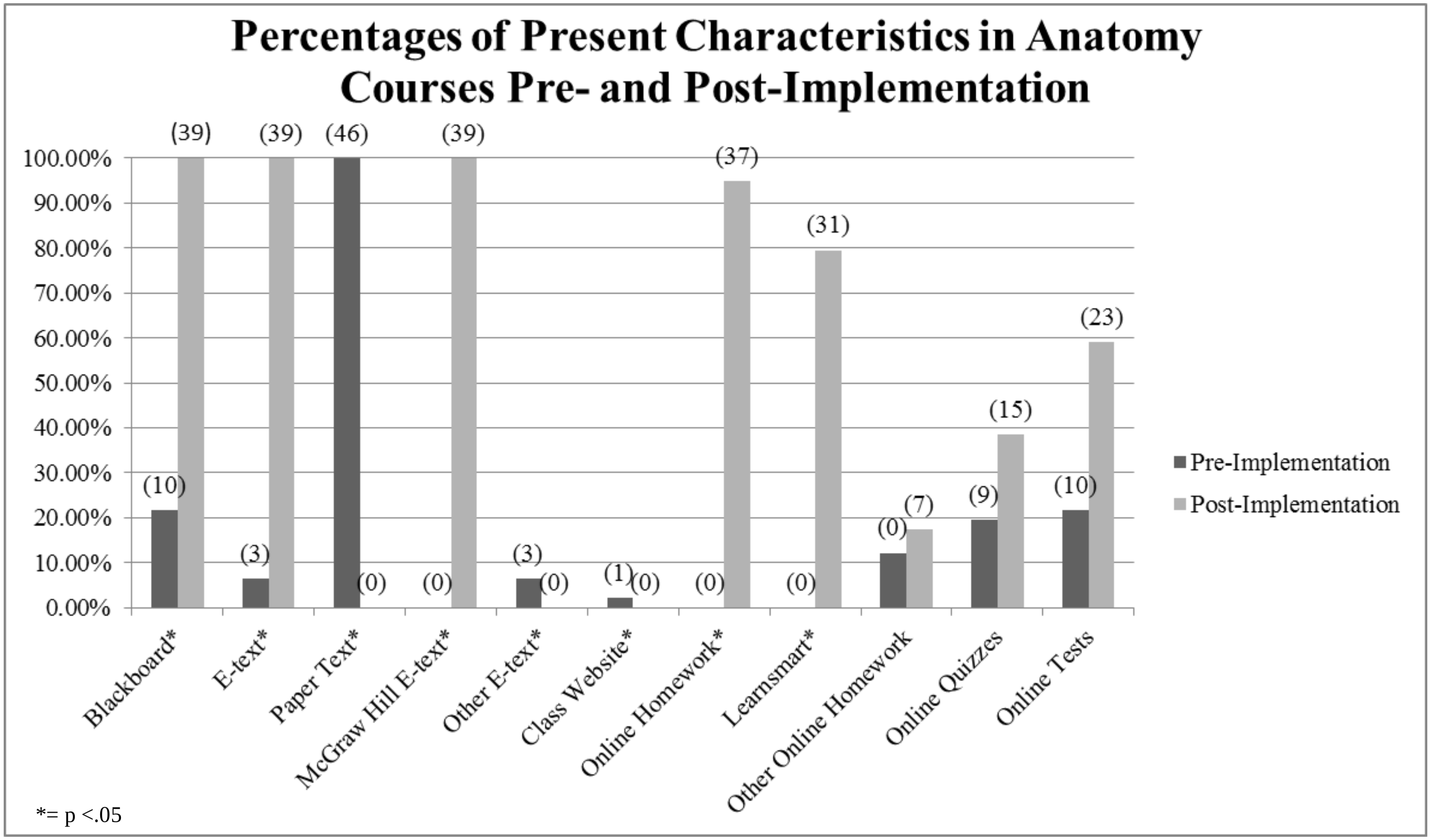

Figure 3.5. Percentages of Present Characteristics in Anatomy Courses Pre- and Post-Implementation

The percentages in Figure 3.5 show the presence of each characteristic in Anatomy and Physiology (A&P) syllabi pre- and post-intervention. Once again, the darker bars represent the percentage of course syllabi pre-implementation of e-text and e-material (before Fall 2013) and the lighter bars represent the percentage of course syllabi after the implementation (Fall 2013 and after).Also, if the characteristic's presence statistically changed pre- and post-implementation, an asterisk (*) is listed next the characteristic in Figure 3.5. The value above each bar is the raw score of the syllabi with the present characteristic. General online homework remained a prominent feature of the implementation within A&P courses with the total number of syllabi including online homework assignments significantly increasing from 0 pre- to 37 post-. This is even more interesting as the total number of syllabi pre-implementation is larger at 46 syllabi than post- at 39 total syllabi. The percentage of A&P syllabi that include online homework significantly increased from 0% to 95%. Presence of online homework specifically from Learnsmart™ saw a meaningful increase as well from 0% pre- to 80% post-implementation.

Blackboard's presence in A&P syllabi also increased post-implementation from 22% to 100%, a 355%, significant increase. Presence of general e-text also significantly increased from 7% to 100%, and presence of e-text specifically from McGraw Hill™ significantly increased from 0% to 100%. Paper-text and other e-text use experienced a significant decrease from 100% to 0% and 6.5% to 0%. The presence of syllabi accounting for the use of a class-website also decreased from 2% to 0%. Syllabi that included the use of online homework assignments increased from 12% pre-implementation to 17% post-implementation, online quizzes increased from 20% to 39%, and online tests increased from 22% to 59%.

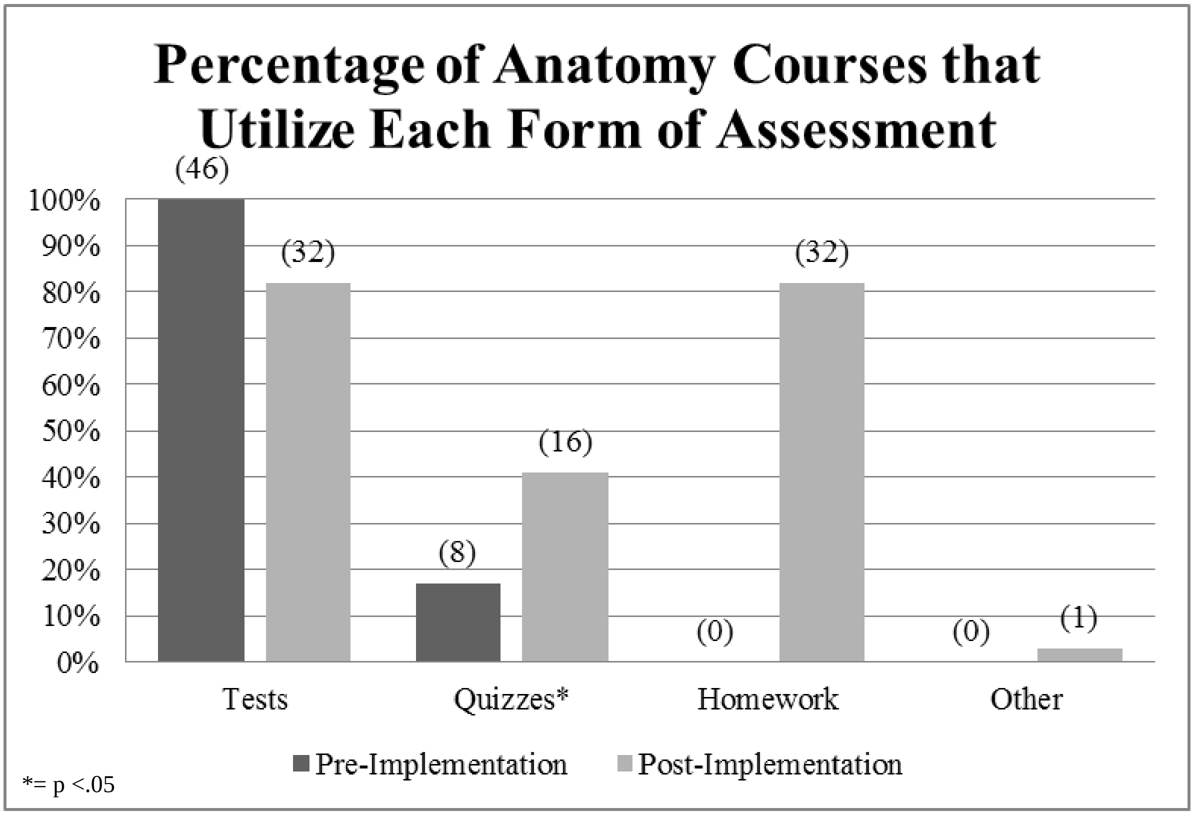

Figure 3.6. Percentage of Anatomy Courses that Utilize Each Form of Assessment

In Figure 3.6, the percent of A&P course syllabi that use each type of assessment (tests, quizzes, homework, and other) and their raw score are displayed. A&P syllabi that use tests decreased from 100% pre-implementation to 82% post-implementation. Presence of quizzes significantly increased from 17% to 41%. Use of homework increased the most, from 0% to 82%, while significance could not be calculated because there were no syllabi pre-implementation that has any homework assignments, the total number of A&P course syllabi that used homework increased from 0 to 32. Other assessments slightly increased from 0% to 3%.

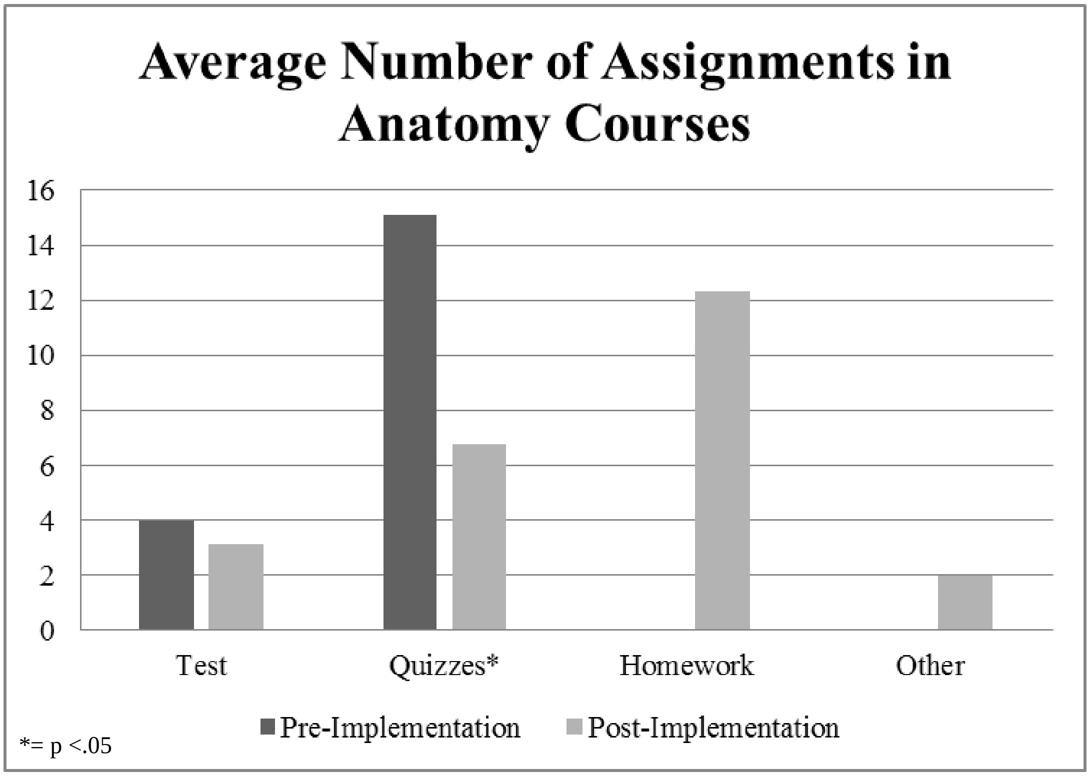

Figure 3.7. Average Number of Assignments in Anatomy Courses

Figure 3.7 displays the average number of assignments in both levels of anatomy and physiology pre- and post-implementation. This more clearly displays the average number of each assignment given in A&P courses and is not skewed by an uneven raw score like Figure 3.6. Results show a statistically significant decrease after the implementation in the average number of quizzes in A&P courses from 15.13 to 6.75. The average number of tests remained close to the same with an average of 3.98 tests pre-implementation to 3.13 post-implementation. The average number of homework and other assignments both increased from a pre-implementation average of 0 to 12.35 homework assignments and 2 other assignments. Because data was none existent in the homework and other assignment sections pre-implementation, their significance could not be computed.

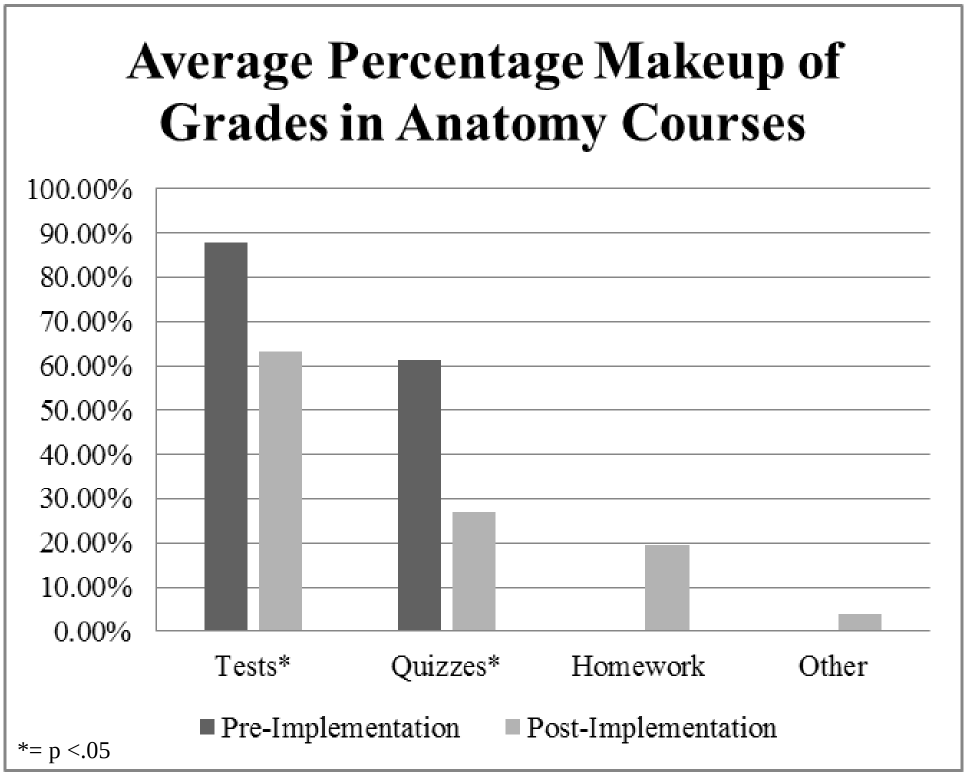

Figure 3.8. Average Percentage Makeup of Grades in Anatomy Courses

In Figure 3.8, the average percentage allotted to each assignment in anatomy and physiology courses is shown. As mentioned before, these courses did not have homework or other assignments besides tests and quizzes prior to the implementation, making it impossible to calculate the significance of change. However, the average percent of grade for tests did see a statistically significant decrease from 88.02% to 63.18%. The average percentage of total grade determined by quizzes also saw a significant decrease from 61.22% pre-implementation to 27.06% post-implementation. The average percent of total grade allotted to homework assignments increased from 0% pre- to 19.45% post-. The presence of other assignments increased from 0% to 4%. While statistical significance could not be calculated, there is a meaningful increase in the percentage of grade accounted for in homework assignments.

CHAPTER 4

DISCUSSION

Biology Conclusion

Research has shown that many faculty members have changed pedagogy in the Biology Department of Western Kentucky University as the new e-text and e-material are being utilized at a much higher degree than before fall of 2013. Changes were measured in fifteen characteristics coded from course syllabi, including use of: Blackboard, e-text, e-text from McGraw Hill™, online homework, online homework from Learnsmart™, other online homework, online quizzes, and online tests (Figure 3.1). Some of the totals for present characteristics can be misleading as a greater total number of syllabi were collected before the implementation than prior (Figure 3.1, Table 2.1).

A decrease in the use of educational resources outside of Learnsmart™ and e-text, such as videos, websites, and other open education resources was observed. This decrease can be explained by faculty exploiting the many features of McGraw Hill™'s online system rather than outside resources or by lack of inclusion of this material in the syllabi. The ease and access of these materials reduced the need to search for other materials to use for classes. Other resources that did not show up on the syllabi but were noted during interviews were online modules, videos, case studies, or even programs where students respond to online questions in class using their phones and laptops.

The increase in professors' utilization of Learnsmart™, a series of adaptive learning questions administered online before class, leads to the assumption that students are now learning or at least becoming familiar with and working with the content before they come to class (Figure 3.1 & 3.2). When students are more prepared for class there is more class time for professors to build on these basic ideas and answer questions rather than use time covering simple information (Berret, 2012). The publisher-generated online learning resources also reduces grading time because most assignments are computer-graded and the students' scores are automatically transferred to Blackboard (or other learning platform), addressing the main impedance of pedagogical change, lack of time. Giving students more assignments with quick feedback provides the formative assessments students need to self-adjust their learning (Biggs & Tang, 2011). Learnsmart™ and other online homework have not only changed the way professors evaluate their students with more formative assessments but produced students who come to class more prepared and ready to learn.

While the percentage of the overall grade earned from homework remained mostly constant, the average number of homework assignments increased (Figure 3.3 & 3.4). This is likely because professors reported using a Learnsmart™ assignment from most chapters they covered in the e-textbook, with each assignment accounting for only a few points. Although the point value is not significant, the learning value of these assignments is high. Learnsmart™ is an adaptive learning environment that requires students to answer questions about reading material from the parallel e-text. If a student misses a question in the Learnsmart™ homework assignment, he/she has the opportunity to return to the e-text to review the section that was missed. A student who answers the questions correctly moves on to the next objectives in the text; while, a student who does not answer correctly the questions reviews the content with another similar question that Learnsmart™ generates. In this way, a student who has mastered a section of content does not spend additional time on content he understands, but a student who has not mastered the content can go back and review. This adaptive system gives students the immediate feedback that Nichol and Macfarlane-Dick say Net Generation students need (2006). Formative assessments, not just summative, are important to student learning at the university level (Nicol & Macfarlane-Dick, 2006; Biggs and Tang, 2011). Learnsmart™ provides the necessary formative assessments to guide students but does not demand faculty time. Immediate feedback and remediation are part of the formative assessment model. In addition, Learnsmart™ asks the students how confident they are about each question before allowing them to answer. It shows the students that they often have a false sense of how well they understand material. This attribute of Learnsmart™ helps the student realize what they are have not mastered content they think they know. Self-awareness of content mastery is an important part of the learning process.

Aside from online homework, the average percentage of general biology courses that use online quizzes and tests have increased (Figure 3.2). Some of these online quizzes and tests are done on students' own computers, in a testing center, or even on iPads provided by faculty to complete online quizzes or tests. The Net Geners have grown accustomed to and are quite savvy with technology, making online tests and quizzes similar to what students have used during childhood. These online assessments are also entered into the gradebook more quickly, seen as an advantage by both professors and Net Geners who receive immediate feedback.

Anatomy Conclusion

Anatomy and physiology (A&P) courses showed much more exaggerated results than general biology courses. Because A&P courses at WKU had traditionally been assessed by high-stakes tests, few quizzes, and few to no homework assignments, the implementation was a big transition for both professors and students. Figures 3.1 and 3.5 compare the results of the characteristics between general biology courses and A&P courses. Because there were no A&P syllabi pre- or post-implementation accounting for certain characteristics like extra credit, fewer total characteristics are accounted for in A&P courses syllabi, as seen across the x-axis in Figure 3.5.

Large increases in the characteristics that were analyzed are noted in Figure 3.5. This includes the presence of blackboard, e-text, and online homework, which was expected as these courses were very traditionally taught pre-implementation. Pre-implementation A&P courses used primarily printed textbook and paper assessments. The increase in online quiz presence in A&P syllabi by 49% and online tests by 63% are worth noting as the course adapts to modern educational methods which include more technology in the classroom.

One data value that should be mentioned is the percentage of classes that reported using tests as a means of assessment (Figure 3.6). Post-implementation the syllabi report that only 82% of classes used tests, as opposed to 100% pre-implementation. This is due to the lack of reporting tests as a means of assessment in syllabi though professors reported in interviews using them. This number would likely be 100% post-implementation if the syllabi had been a true representation of the class.

A&P courses saw much more drastic changes in pedagogy as measured by the percent of A&P courses that offered different types of assessment, average number of assessments, and average percentage makeup of grades. Though the average number of tests remained close within A&P syllabi, the average number of quizzes decreased by nearly 50% and homework increased from an average of 0 homework assignments to just over 12 per syllabus (Figure 3.7). Professors are now incorporating more ways of evaluating student knowledge rather than relying solely from on tests, and they are introducing opportunities for formative assessment. Most homework assignments were administered online using Learnsmart™, again requiring student participation before the class starts to ensure preparation. Before modernization and the implementation of the e-texts, anatomy and physiology courses were purely evaluated by tests and quizzes, with pre-implementation courses relying on tests for nearly 90% of the grade. Total grade distribution became more spread out across tests, quizzes, homework, and other assignments breaking down content into smaller learning segments and creating a lower stress environment by removing a single high-stakes test.

Though the system has advantages, no system is perfect. Learnsmart™ is indeed done out of class, but this raises the question if of whether students are really looking over material or cheating the system with internet searches or getting answers from classmates. Simply answering questions to earn points without being mentally aware of the material defeats the purpose. This is a concern presented by several professors as recorded during personal interviews. Also, in the opinion of professors, attendance dropped drastically when no in-class incentives were presented. Some professors did not view lack of attendance as a problem. If students learn the material, these professors felt they have done their job. Others find lack of attendance disrespectful and would prefer students come to class. Lastly, some professors reported not feeling confident enough in their content knowledge to answer students' questions on the spot. A flipped classroom involves unplanned student-teacher interaction, which can put stress on the instructors.

While pedagogical change is hard and slow at the university level, especially in STEM disciplines, introduction of e-text has changed pedagogy among many professors in the Department of Biology at WKU. Making students more accountable for being prepared for class via on-line homework assignments such as Learnsmart™, increasing formative assessment opportunities and decreasing high-stakes testing as the sole method of assessment are ways that e-text implementation has altered teaching methods. Modernizing pedagogy by increasing technology in the classroom should help meet the learning needs of Net Geners and provide a simple intervention for higher education, especially STEM disciplines.

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APPENDIX

The crosstabs tests compare the pre- and post-implementation totals and percentages to determine significance with a Pearson chi square test. Under the "Asymp. Sig (2 sided)" column, a value is computed. If this value is <0.05, the result is significant; if it is >0.05, the result is not significant. The value is "p," or the probability of being wrong if the null hypothesis (H0) is rejected and the alternate hypothesis (HA) is accepted (H0=no relationship is present, HA=present relationship). If a result is stated to be significant in this study, it will be based on a p<0.05 (or a 5% chance of the HA being wrong).