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THE EFFECT OF HIGHLY INTERACTIVE ONLINE LEARNING OBJECTS ON STUDENT LEARNING

By

Eric B Karl

A dissertation submitted

in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy in the

Department of Organizational Learning and Performance

Idaho State University

Summer 2016

To the Graduate Faculty:

The members of the committee appointed to examine the dissertation of Eric B Karl find it satisfactory and recommend that it be accepted.

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October 22, 2015

David Coffland
Educational Foundations
MS 8081

RE: regarding study number IRB-FY2016-83: The Effect of Highly Interactive Online Learning Objects on Student Learning

Dear Dr. Coffland:

I agree that this study qualifies as exempt from review under the following guideline: Category 1: Normal educational practices & settings. This letter is your approval, please, keep this document in a safe place.

Notify the HSC of any adverse events. Serious, unexpected adverse events must be reported in writing within 10 business days.

You are granted permission to conduct your study effective immediately. The study is not subject to renewal.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

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September 9, 2015

Dear Eric,

Your request to use human subjects for the study entitled *The Effect of Highly Interactive Online Learning Objects on Student Learning* is approved for 12 months from the date of this letter.

Please notify the IRB if you intend to make any significant modifications to the study's design or implementation.

Good luck with your study.

Regards,

Scott J. Bergstrom, Ph.D.
Chair, BYU-Idaho Institutional Review Board

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ABSTRACT

This study investigated the effect of two different levels of student-content interactivity on three levels of learner capabilities. Additionally, this study investigated whether different levels of student-content interactivity promote learning at different rates.

This study was a quantitative experimental research design consisting of an objective pretest/posttest measuring Remember student learning achievements, six lessons with assessments measuring Apply student learning achievements, and a cumulative assessment measuring Create student learning achievements. The participants were divided into two groups, the first exposed to learning objects with lower levels of interactivity and the second to learning objects exhibiting very high levels of interactivity.

The results of this experiment determined that there were no statistically significant differences in students' learning capabilities between the two levels of interactivity. Additionally, the results for each of these experiments yielded very small effect sizes. Therefore, the results indicated that higher levels of interactivity within an online learning object (which typically cost much more to develop) had very little influence on student assessment scores across the Remember, Apply, and Create levels of the revised Bloom's taxonomy.

This study did determine that there was a statistically significant difference in the rate in which students were able to learn and apply the basic principles of web design and development between the two modes of instruction. The results of this study indicated

that it took the higher interactivity group of students an average of 5.52 hours longer to complete the six lessons than it took the lower interactivity group of students.

The main implications of this research are that care should be taken by practitioners when they are considering using high levels of student-content interactivity in online learning objects. And because higher level interactivity features generally take more time and effort to develop, this research showed that practitioners can use lower levels of interactivity without adversely affecting student learning. Additionally, this research showed that providing high levels of interactivity actually can reduce the efficiency (as measured by the time to complete the lessons) of student learning.

CHAPTER 1

Introduction

The Internet has ushered in new tools for providing instructional resources for education (Larreamendy & Leinhardt, 2006). Increasingly, universities are developing and turning to these online instructional resources to reduce costs and increase the reach of instruction (Allen & Seaman, 2005). These online resources have been used as part of fully online instruction, hybrid (or blended) education, and are even used as supplemental resources within face-to-face learning environments (McGreal, 2004).

One area of extensive research within online education has concerned the effectiveness of online learning objects (McGreal, 2004). This research has included the duration of the learning object (Moreno & Mayer, 2007), the effectiveness of animations within learning objects (Bradley & Boyle, 2004), the use of audio data within learning objects (Cebeci & Tekdal, 2006), and the use of video material within learning objects (McGreal, 2004). Another area of research has been in the effectiveness of user interactivity within online learning environments (Durrington, Berryhill, & Swafford, 2006).

Interactivity has been broadly defined as "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another" (Wagner, 1994). Anderson (2003) built on this definition and identified three types of interactivity that can be used within an online educational environment. These are student-to-student, student-to-teacher, and student-to-content interactivity.

In the research literature, there is a common perception that interactivity increases both the motivation and the success of online education (Wagner, 1994; Scott, 2005; Lou, Bernard, & Abrami, 2006). And while Jung, Choi, Lim, & Leem (2002) reported that student-to-student and student-to-teacher interactivity are important for enhancing learning and also enhancing participation within an online learning environment, there are mixed results in the research literature as to the effectiveness of student-to-content interactivity leading to increased student learning.

To help clarify this, Helfrich and Moulton (2009) researched and developed a meta-analysis of student-to-content interactivity. As part of this meta-analysis, the authors identified nine levels of interactivity for online learning objects. The nine levels of learning object interactivity were broken into three main categories. The following figure illustrates these nine levels and three categories.

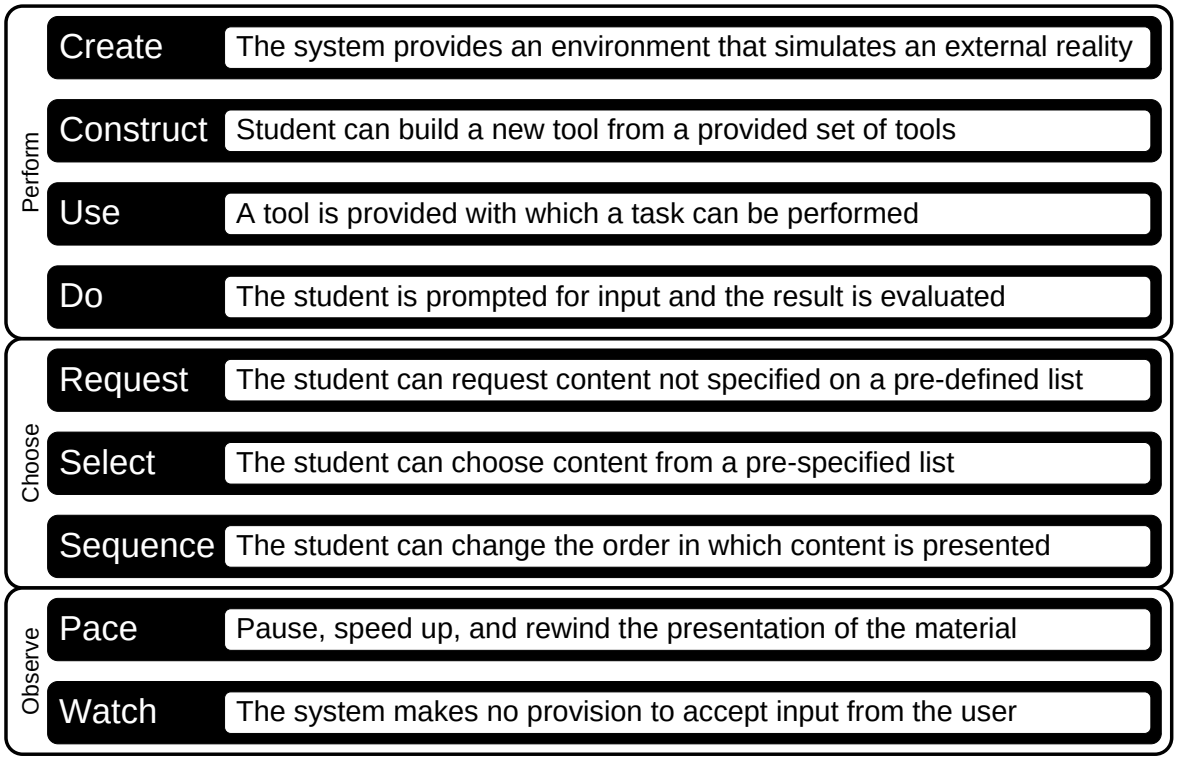

Figure 1. Nine Levels of Student to Content Interactivity (Helfrich & Moulton, 2009)

In further research, Helfrich built on this meta-analysis and conducted a study on the effect of two of these levels of interactivity on student achievement (Helfrich, 2011). In this research, he provided two groups with different levels of interactivity (Watch interactivity and Select/Do interactivity) within an online learning environment and measured the learning achievements of each group. Helfrich tested the level of interactivity for an effect on student achievement within three of Gagne's learner capabilities: verbal, defined concept and rule/problem solving learning capabilities. The result of his research did not indicate any statistically significant learning differences between the two groups.

This study builds on this previous research and explores the influence of higher levels of interactive online learning objects (Perform level interactivity, consisting of Do, Use, and Construct levels of interactivity) on student learning in comparison to lower levels of interactive online learning objects (Observe level interactivity, consisting of Watch and Pace levels of interactivity). In addition, this research broadens the learner capabilities that were tested to include the three areas of student achievement of Remember, Apply, and Create as defined by Krathwohl (2002).

Purpose of the Study

The purpose of this study was to determine the effect of highly interactive learning objects on student learning, specifically the three areas of student achievement of Remember, Apply, and Create as defined by Krathwohl (2002). These learning achievements were investigated in relation to Perform levels of interactivity (Do, Use, and Construct levels of interactivity) within an online learning object in contrast to Observe levels of interactivity within a learning object (Watch and Pace levels of

interactivity). Additionally, this study investigated the difference in the time required to complete each lesson for the two levels of interactivity. For each of the three areas of student achievement, there were separate assessments to measure student learning. These interactions were explored in the context of university students in a beginning web design and development course.

Research Questions

This study investigated the effect of higher levels of student-to-content interactivity on student learning. Specifically, this study attempted to determine whether students perform better when they were given Perform levels of control (Do, Use, and Construct levels of interactivity) within an online learning object in comparison to being given Observe levels of control over the learning object (Watch and Pace levels of interactivity). In addition, this study attempted to determine the difference in the time required for students to complete each lesson for each level of interactivity.

Because it was anticipated that the level of interactivity might influence the specific learning capability being taught, three research questions were explored. These three questions covered three levels of Krathwohl's (2002) Learner Capabilities (Remember, Apply and Create). A fourth research question explored the difference in the time required for students to complete each lesson for the two modes of interactivity.

The first Krathwohl Learner Capability (Remember) research question for this study was: RQ1: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Remember Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

H_1: There is a difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

The second Krathwohl Learner Capability (Apply) research question for this study was: RQ2: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Apply Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

The third Krathwohl Learner Capability (Create) research question for this study was: RQ3: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Create Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

The fourth research question for this study was: RQ4: Does the degree of interactivity in online learning objects influence the relative efficiency in student learning? The null and alternative hypotheses for this research question are:

H_0: There is no difference in the mean time to perform assignments between the two groups.

H_1: There is a difference in the mean time to perform assignments between the two groups.

Definition of Terms

- Analyze: The fourth level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to break material in to its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose. (Krathwohl, 2002).
- Apply: The third level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to carry out a procedure or use a procedure in a given situation (Krathwohl, 2002).
- Bloom's Taxonomy: A framework for classifying statements of what students are expected to learn as a result of instruction (Bloom, 1956)
- Create: The sixth level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to put elements together to form a novel coherent whole or make an original product (Krathwohl, 2002).

- CSS: CSS is an acronym for Cascading Style Sheets. This is a style sheet language used for describing the look and formatting of a document written in the HTML language. (Anderson, 2010, p. 154)
- Efficiency: For the purpose of this study, efficiency is defined as the time that was required for students to complete each of the Apply lessons.
- Evaluate: The fifth level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to make judgments based on criteria and standards (Krathwohl, 2002).
- HTML: HTML is an acronym standing for Hypertext Markup Language. This is the primary markup language used for coding web pages. (Anderson, 2010, p. 171)
- Interaction: Interaction is denoted as reciprocal action, effect or influence between two objects. (Anderson, 2003)
- Interactivity: Interactivity is generally defined as "reciprocal events that require at least two objects and two actions" (Anderson, 2003).
- Learning Management System (LMS): An LMS is a web-based tool that integrates a wide range of pedagogical and course administrative tools. It is used to effectively organize and present learning material to students (Coates, James, & Baldwin, 2005).
- Learning Object: A learning object is an independent entity that may be used for learning. It contains an objective, a learning activity, and an assessment. (Polsani, 2003).

- Levels of Interactivity: The levels of interactivity from highest to lowest are present in figure one above (Helfrich & Moulton, 2009).
    - Perform Category
        - Create: The system provides an environment that simulates an external reality.
        - Construct: Students can build a new tool from a provided set of tools
        - Use: A tool is provided with which a task can be performed
        - Do: The student is prompted for input and the results are evaluated
    - Choose Category
        - Request: The student asks for content not specified on a pre-defined list
        - Select: The student can choose content from a pre-specified list
        - Sequence: The student can change the order in which content is presented
    - Observe Category
        - Pace: Pause, speed up, and rewind the presentation of the material
        - Watch: the system makes no provision to accept input from the user
- Observe Interactivity: As defined in this study, Observe Interactivity refers to the learning objects that allow Pace and Watch level interactive features (Helfrich & Moulton, 2009).

- Perform Interactivity: As defined in this study, Perform Interactivity refers to the learning objects that allow Do, Use, and Construct level interactive features (Helfrich & Moulton, 2009).
- Remember: The first level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to retrieve relevant knowledge from long term memory (Krathwohl, 2002).
- Revision of Bloom's Taxonomy: A framework based on Bloom's Taxonomy used for classifying learning outcomes (Anderson & Krathwohl, 2001).
- Understand: The second level of learning outcomes as defined in the revision of Bloom's Taxonomy. It refers to the ability of students to determine the meaning of instructional messages, including oral, written, and graphic communication (Krathwohl, 2002).
- W3C: W3C is an acronym standing for World Wide Web Consortium. The World Wide Web Consortium is an international community that develops open standards for the World Wide Web (Anderson, 2010, p. 428).
- W3Schools: W3Schools is the largest web developer reference site on the World Wide Web (Alexia, 2015).

Limitations

The target population of this study consisted of students enrolled in a freshmen level university course called "WDD 100 - Introduction to Web Design and Development." In this study, students were randomly assigned into one of the two treatment groups (Perform level of interactivity or Observe level of interactivity). This random assignment as well as the relatively short six-week duration of this experiment

minimized many of the threats to internal validity (Cook & Campbell, 1986). Even with this, there were six possible threats to internal validity. These includes:

1) Pretest Sensitization: For research question RQ1, the same objective assessment instrument was used for both the pretest and the posttest assessment. There was a possibility that student scores on the posttest would be influenced by the pretest. To minimize this effect, the order of the questions as well as the order of the distractors were randomized on the posttest. In addition, after the students took the pretest, they were not given access to those questions until after they completed the entire experiment (six weeks later). Chapter 3 contains a complete discussion of this assessment instrument.
2) Differential Mortality: The two treatment groups had different learning environments with respect to interactivity. This difference in interactivity may have had an effect on the overall motivation to participate and complete the entire experiment. Therefore there is a possibility that this study suffered from differential mortality. The relatively short duration of this experiment should have helped to reduce this threat.
3) Compensatory Rivalry: The Observe interactivity group had a less interactive learning environment than the Perform interactivity group. If students within the Observe group had become aware of the differences in instruction, there is the possibility that students could have been motivated to work harder to overcome those differences. This threat was minimized due to the relatively short duration of this experiment.

4) Resentful Demoralization: The Observe group had a less interactive learning environment than the Perform group. If students within the Observe group became aware of the differences in instruction, there is the possibility that students would have been less motivated to perform their best. This effect was also minimized due to the relatively short duration of this experiment.
5) History: Due to the abundance of web development instruction available on the web, there was a possibility for students to gain knowledge and experience in their basic knowledge of HTML and CSS outside of the instruction given within the learning objects. The relatively short time frame of this experiment should have helped reduce this threat.
6) Diffusion of Treatment: To minimize differences in instruction between the two groups, the instructor answered all student questions in the discussion boards so that all students had access to the same level of instruction. To minimize this threat to internal validity, the instructor ensured that the answers given to the students were void of any reference to the differing levels of interactivity.

Delimitations

For this study, the sample population was students enrolled in a freshmen level university course called "WDD 100 - Introduction to Web Design and Development." This course was taught at a large private university in the Intermountain West.

Even though the course was a freshmen level course, students from all four academic years (i.e. freshmen, sophomore, junior and senior) enrolled in this course. In addition, the students who enrolled in this course came from a wide variety of majors (e.g. Computer Science, Web Design and Development, Art, English, Communication,

Biology, Business Management, International Studies, etc.). The potential effects of academic standing (i.e. freshmen, sophomores, etc.) and major were not included in this study.

Because of the subject of this course, the students who enrolled in this class generally had a greater fluency and interest in computers and technology than the general population. And because of the online nature of the instruction, the results of this experiment may not be generalizable to the overall population (who may not have as much fluency in computers and technology).

In addition, the racial demographics of the students at Brigham Young University-Idaho are not as diverse as at other universities or the population in general. This may limit the generalizability of this study to populations less diverse. A detailed description of student demographics is included in chapter three.

As defined by Anderson (2003), there are three types of interactivity: student-content, student-teacher, and student-student interactivity. This research only considered student-content interactivity. This study does not include student-teacher nor student-student interactivity.

While there have been numerous taxonomies of learner capabilities that have been defined (e.g. Bloom (1956), Anderson and Krathwohl (2001), Gagne (1985), Fink (2003)), this study used Krathwohl's Learning Capabilities as defined by Anderson and Krathwohl (2001) as the standard for comparison. No other learning taxonomies were studied nor were any comparisons made to other learning taxonomies. In addition, this study focused on the development of Krathwohl's Remember, Apply, and Create Learner

Capabilities. The three other learner capabilities as described by Krathwohl (Understanding, Analyzing, and Evaluating) were not studied.

This study only focused on a subset of the types of interactivity as defined by Helfrich and Moulton (2009). Specifically, this study focused on the Watch, Pace, Do, Use and Construct levels of user interactivity. The other four types of interactivity (Sequence, Select, Request, Create) were not studied. In addition, this study treated the Watch and Pace levels of interactivity as a single group (rather than separately) called the Observe level of interactivity. Similarly, this research treated the Do, Use, and Construct levels of interactivity as a single group called the Perform level of interactivity. There was no effort made to distinguish between the individual interactivity level effects within the category.

This study used the Codecademy tool (www.codecademy.com) available on the web for the high interactivity learning objects (Perform level of interactivity). This tool was professionally developed and is of high quality. Every effort was made to make the Observe level of interactivity learning objects (instructional videos) equivalent in content, look and feel.

The instruction for this study spanned a total of six weeks in duration. There was a possibility that no effect would be observed due to the relatively short duration of the treatment. Further, the instruction for this study was in the content area of web design and development. If this study were done in a different content area, the study results may be different.

Even though the objectives of both treatments were the same, it is possible that either or both treatments suffered from either good or bad instructional effects. If either

or both treatments were substandard, scores would be low and there is a possibility that no treatment effect would be observed. Likewise, if either or both treatments were of really high quality, a ceiling effect would occur and again, there is a possibility that no treatment effect would be observed.

The high interactivity treatments included immediate feedback and timely guided practice. The lower interactivity treatments did not include these instructional effects. This study was not be able to specifically determine whether these specific instructional factors may be directly responsible for any observed differences between the groups.

Research Design

This study was a pretest/posttest, two-treatment group, quantitative research study measuring student achievement over a total of six online lessons spanning six weeks of instruction. The study compared the learning achievements of two groups of students who were enrolled in a beginning web design and development course.

The students enrolled in the course were randomly divided into two groups (Observe and Perform interactivity groups). The first group (the Observe group) was given six online instructional videos covering topics in the basics of HTML and CSS. These students were given Observe (Watch and Pace) level control over those instructional videos. These students had the opportunity to pause, speed up and rewind the online instructional material. The second group (the Perform group) was given Perform levels of interactive control over online simulations covering the same topics as the Observe group. These Perform level controls included the Construct, Use, and Do levels of interactivity. Aside from the degree of interactivity, all aspects of the instructional content were similar. This is further discussed in Chapter 3.

This study measured student achievement on three areas of Krathwohl's Learner Capabilities. Specifically, this study focused on the development of Remember, Apply, and Create learner capabilities. This study used a multiple choice pretest/posttest format to gauge students' learning gains in the Remember Learner Capability. It also used six rubric assessment instruments to measure the Apply Learner Capability. These six rubric instruments were used to assess how well each student performed after each online lesson. And finally, this study used another rubric assessment instrument to measure the Create learner capability at the completion of the six weeks of online lessons.

This study also attempted to measure the effectiveness of each treatment. This was accomplished by requiring students to self-report the amount of time that is required to finish each homework assignment.

Significance of Study

The research literature is mixed as to the effectiveness of interactivity in promoting learning. Some studies have shown that interactive online learning environments promote increased learning (Mayer & Chandler, 2001; Schwan & Riempp, 2004; Tung & Deng, 2006). Other studies have reported little to no gains in student learning relative to different levels of interactivity (Helfrich, 2011; Moreno & Mayer, 2005). And other studies have even reported some drawbacks to adding interactivity to online learning objects (Moreno & Valdez, 2005).

This study built on this previous work and investigated learning gains when students were given the highest levels of user interactivity within online learning objects. Specifically this study investigated the effect of giving students Perform (Construct, Use,

and Do) levels of interactivity over a learning object compared to students who were given Observe (Watch and Pace) levels of interactivity over a learning object.

This study investigated whether these different levels of interactivity promote different learner capabilities. Specifically, this study attempted to determine whether there is a relationship between different levels of interactivity and the Remember, Apply, and Create learner capabilities as defined by Krathwohl (2002). Additionally, this study investigated whether different levels of interactivity promote learning at different rates. It is anticipated that the results of this study will help to inform educators on the benefits of providing the highest levels of user interactivity in online learning objects.

CHAPTER 2

Literature Review

The purpose of this study was to investigate the relationship between different levels of interactive online learning objects on student learning. To support this goal, this chapter reviews the relevant literature in the areas of online education, online learning objects, interactivity, online simulations and learning capabilities. In addition, this chapter discusses the theoretical rational for this study including some of the conflicting results of previous research studies.

Online Education

With the advent of the Internet, many new tools and instructional resources for education have been developed (Larreamendy & Leinhardt, 2006). The United States Department of Education (2009) reported that these educational resources have been incorporated by all major education providers, including institutions of higher education, K-12 school systems, and corporate training programs.

In the K-12 domain, the National Center for Education estimated that 37 percent of K-12 school districts had students taking technology-supported distance education courses during school year 2004–05 (Zandberg & Lewis, 2008). Two K-12 school district surveys (Picciano & Seaman 2007; 2008) estimated that approximately 700,000 K–12 public school students took online courses in 2005–2006 and over a million students did so in the 2007–2008 school year (a 43 percent increase). Most of these courses were at the high school level or in combination elementary-secondary schools (Zandberg & Lewis 2008).

Increasingly, universities are also developing and turning to these online instructional resources to reduce costs and increase the reach of instruction (Allen &

Seaman, 2005). These newly developed online educational resources have been used as part of fully online instruction, hybrid (or blended) education, and are even used as supplemental educational resources within face-to-face learning environments (McGreal, 2004). According to the Babson Survey Research Group (2014), it is estimated that over 7,000,000 college and university students took at least one online course in 2012.

The growth in online education has been facilitated by the rapid pace of technology advancement (U.S. Department of Education, 2009). And over the last decade, online education has become more prevalent and the majority of higher educational institutions (66%) report that online education is critical to their long-term strategy (Babson, 2014). In addition, it is estimated that online education will continue to advance and become even more prevalent in higher education (Babson, 2014).

One of the reasons for the growth of online education is that there seems to be some inherent advantages of online education (Chumley-Jones et al, 2002). In a meta-analysis conducted concerning online education, Chumley-Jones el al. (2002) found that adding online learning content to a course usually (but not always) improved knowledge. They also found that online learning can be more efficient for most learners and is generally well received by learners. In addition they found that learners especially liked interactive online features.

Learning Objects

One area of extensive research for online educational materials, has been on the effectiveness of online learning objects (McGreal, 2004). The term "learning object" was first used in 1994 as part of the title to a working group called "Learning Architectures, API's, and Learning Objects" (Polsani, 2003). But even before the term was used, the concepts embodied by learning objects were used in various forms. And while there have

been many definitions offered, Polsani (2003) defined it as "an independent entity that may be used for learning. It contains an objective, a learning activity, and an assessment." This is the fundamental definition that is used in this study.

There has been extensive research on various aspects of online learning objects. This research has included the duration of the learning object (Moreno & Mayer, 2007), the effectiveness of animations within learning objects (Bradley & Boyle, 2004; Boucheix & Schneider, 2009; Mayer & Chandler, 2001), the use of audio data within learning objects (Cebeci & Tekdal, 2006), and the use of video material within learning objects (McGreal, 2004). Another area of research has been in the effectiveness of user interactivity within an online learning environment (Durrington, Berryhill, & Swafford, 2006).

Animations within learning objects have been studied extensively by many different researchers (Boucheix & Schneider, 2009; Mayer & Chandler, 2001; Betrancourt & Tversky, 2000; Kriz & Hegarty, 2004). This research has yielded mixed results as to the educational effectiveness of these animations (Betrancourt & Tversky, 2000). Lowe (2003) found that animations were not always superior to static text. He found that "selective processing of the animation that involved perceptually driven dynamic effects … raise questions about the widely assumed intrinsic superiority of animations over static graphics as resources for learning" (Lowe, 2003). In addition, Austin (2009) showed that the position of textual material and even "motion distraction" led to the inferiority of certain multimedia presentations.

In computer based education, human-computer based interactivity is considered as one of the most promising technology features for use within an educational

environment (Domagk, Schwartz & Plass, 2010). This idea results directly from constructivist theory. In the constructivist theory of education, the learner is assumed to be the responsible active agent in the process of knowledge creation (Piaget, 1969). Hannafin and Peck (1988) further stated, "perhaps the greatest advantage of computerized instruction over linear media is the potential for interaction during a lesson" (p.17). These ideas are supported by research that shows that active learning much more effective than passive learning pedagogies (Freeman et al, 2014).

Constructivism actually has several different related perspectives (Schunk, p.238). In computer-based education, one extension of constructivism that has been proposed by Mayer and Moreno (2002) is called the cognitive theory of multimedia leaning (CTML). This extension of draws on the dual coding theory, the cognitive load theory, and constructiveness learning theory. The dual coding theory hypothesizes that teaching students using both verbal (i.e. verbal description or in printed words) and nonverbal codes (i.e. graphics or images) will result in stronger encoding than when teaching with verbal or nonverbal codes alone (Moreno & Valdez, 2005). Another extension of constructivism that has been proposed by Moreno and Valdez (2005) is the interactivity hypothesis. This hypothesis states that having students actively organize materials on their own rather than having students study pre-organized materials is more engaging and hence promotes deeper learning (Moreno & Valdez, 2005).

Interactivity

Interactivity has been broadly defined as "reciprocal events that require at least two objects and two actions. Interactions occur when these objects and events mutually influence one another" (Wagner, 1994).

Anderson (2003) defined 3 types of interactivity within an instructional setting. The first type consists of interactivity between the learner and the content (student-content). The second type consists of the interactivity between the learner and the teacher (student-teacher). And the last type consists of interactivity between the students within the class (student-student). Student-student and student-teacher interactions have been shown to facilitate deep learning (Price & Rogers, 2004). Price and Rogers (2004) also demonstrated how adding student-content interactions (along with student-teacher and student-student interactions) using an online learning object provides an even deeper level of active learning environment for students.

Student-content interactivity has several different connotations and meanings in different contexts (Sedig & Sumner, 2006). Patwardhan and Murthy (2015) explained that student-content interactivity in computer based learning environments occurs "when some response is elicited from the learner and in turn, the visualization is able to respond to the learner's input. The quality of such interactions has been referred to as interactivity." Bernard et al. (2009) described student-content interaction as "student-content interaction refers to students interacting with the subject matter under study to construct meaning, relate it to personal knowledge, and apply it to problem solving."

In the research literature there is a common perception that interactivity will increase both the motivation and the success of online education (Wagner, 1994; Scott, 2005; Lou, Bernard, & Abrami, 2006). And while Jung, Choi, Lim, & Leem (2002) reported that student-student and student-teacher interactivity were important for enhancing learning and also enhancing participation within an online learning environment, there is mixed results in the research literature as to the effectiveness of

student-to-content in student learning. Even though the literature is mixed as to the learning effectiveness of student-content interactivity, Salajan et al (2009) showed that students perceived highly interactive learning objects as superior to the lower interactive learning objects. And this leads to the conclusion that the students were more engaged with those learning objects (Salajan, et al., 2009).

To help clarify the effects of interactivity, Helfrich and Moulton researched and developed a meta-analysis of student-to-content interactivity (Helfrich & Moulton, 2009). As part of this meta-analysis, Helfrich and Moulton identified nine levels of interactivity for online learning objects. These nine levels of learning object interactivity are broken up into three main categories. The following figure illustrates these nine levels and three categories.

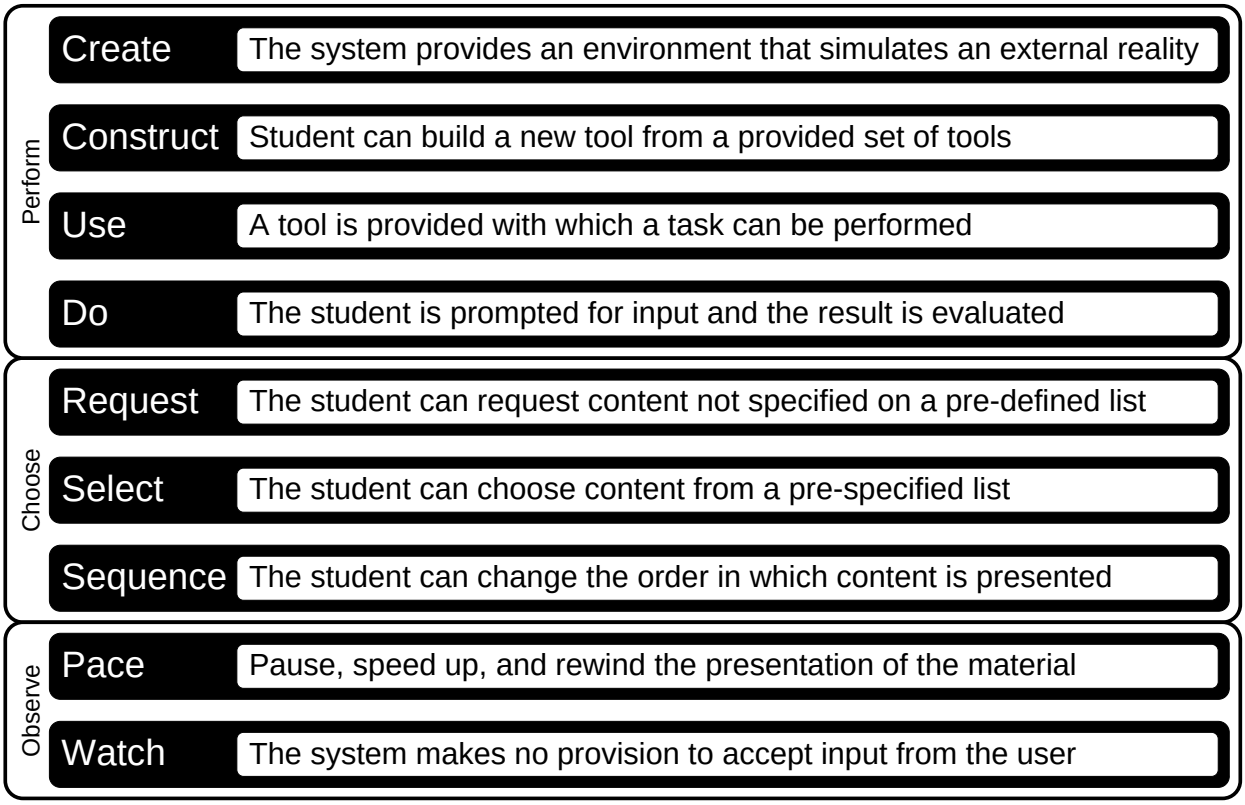

Figure 2. Nine Levels of Student to Content Interactivity (Helfrich & Moulton, 2009)

The lowest interactivity levels (Pace and Watch) are in the Observe Category. These levels only allow a minimal amount of learner control over the learning object. In the Watch level, the learning object does not allow any real interaction with the learning material. The user is able to "watch" or view the learning material, but is not allowed any interactivity with the material. In the Pace level, the user is allowed minimal control over the presentation of the learning material. The control includes the ability to Pause, Speed Up, and Rewind the presentation of the material.

The second interactivity category is called the Choose Category. In this category, there are 3 specific levels of interactivity defined. These include the Sequence, Select, and Request levels of interactivity. These levels allow a student more interactivity such that they can select which material to learn, choose the sequence of material to learn, and even request additional content.

The highest levels of interactivity are in the Perform Category. In this category, the student is allowed the most flexibility to interact with the learning object. In this level, a student can answer questions, use different tools, construct new tools from existing building blocks, and even create new tools.

Helfrich conducted research on the effect of two of these levels of interactivity on student achievement (Helfrich, 2011). In his research, Helfrich provided two groups with different levels of interactivity (Watch interactivity and Select/Do interactivity) within an online learning environment and measured the learning achievements of each group. The result of his research did not indicate any statistically significant learning differences between the two groups.

Boucheix and Schneider (2009) studied observe level interactivity within a dynamic mechanical systems learning object. They found that giving students observe level interactivity was only effective for students with low spatial and mechanical reasoning ability. They found that for students who had a higher level of spatial reasoning ability, the interactivity of the learning object did not have any effect on their learning gains (Boucheix & Schneider, 2009).

In another study by Boucheix and Guignard (2005), it was demonstrated that giving a learner basic first level user control (stop, rewind, restart, slowdown, and change direction) over a presentation yielded a positive effect on comprehension for children learning about lightning formation.

Lowe (2004) performed a similar study and he observed that care needs to be taken when allowing interactivity within an animation to ensure that the content and the complexity of the learning object is suitable to the cognitive level of the learner. His study concluded that novices can actually become cognitively overwhelmed if too much interactivity is given to them. Specifically he stated, "It seems that it is not sufficient to offer learners who are novices in a domain an accurate, comprehensive dynamic depiction of a dynamic referent situation and expect them to be able to interrogate it productively on their own" (Lowe, 2004).

The benefits of interactive animation were further supported by research from Schwan and Riempp (2004). In their study, learning gains from interactive videos were compared to non-interactive videos for students engaged in learning to tie nautical knots. The results of the study indicated similar learning gains between both modes of instruction. While both groups were equally successful in completing the objectives of

the instruction, the results did indicate an advantage for the interactive videos. The students using the interactive videos "proceeded in a far more efficient manner" than students who used the non-interactive videos.

In other research, Kriz and Hegarty (2007) examined the influence of interactive controls in animations and found no advances in learning compared to non-interactive animations. In addition this research reached the conclusion that the interactive controls did not facilitate better mental models (Kriz & Hegarty, 2007).

Schnotz and Rasch (2005) investigated the effect of animations on cognitive load. It was determined that there was a distinct difference with respect to the prerequisite knowledge of the learners. For those with higher prerequisite knowledge, providing them interactive features helps facilitate learning. For those with lower prerequisite knowledge, just presenting the salient concepts was more effective (Schnotz and Rasch, 2005).

In follow on research, Meyer, Rasch, and Schnotz (2010) investigated the effect of user selectable speed of presentation of an animated presentation. Their research (Meyer, et. el, 2010) indicated that "The higher the mean weighted presentation speed, the more macro-events comprehension was achieved compared to the participant's total comprehension score that included both macro- and micro-events comprehension scores."

Moreno and Valdez (2005) also researched the effect of cognitive load and interactivity on student learning and found an interesting result. In their research, student performance actually decreased when students were given higher levels of interactivity. Further research indicated that this lower performance was actually due to the type of feedback presented. Their conclusion indicated that, "deep learning is not promoted

unless careful consideration is given to the effects of different feedback strategies. This is particularly important for the case of novice learners, who may lack the necessary schemas to guide them in the process of meaning making" (Moreno and Valdez, 2005).

Further, Cairncross and Mannion (2001) state that interactivity has a great potential to create high quality learning environments, however the "the very richness and complexity of interactive multimedia can lead to problems if the needs of the learner are not given careful consideration". When not done well, common problems such as cognitive overload, divided attention and disorientation can occur (Caircross & Mannion, 2001). One of the criteria for the effective use of interactive features is the ability of the user to manage his/her own learning needs (Boucheix & Schneider, 2009). Care must be taken to ensure the interactive controls provided to the learner must match their cognitive abilities at the time of instruction (Boucheix, 2008). In fact, it may not be appropriate to give lower prior-knowledge learners complete interactive control over their learning environment (Boucheix & Schneider, 2009).

Moreno and Mayer (2000) performed an experiment where two levels of learning were tested based on interactive and non-interactive features. The results indicated that students with interactivity scored better on both retention tests and problem-solving tests than students without interactive features (Moreno & Mayer, 2000). They concluded "Students who were encouraged to see themselves as interacting with a pedagogical agent in a shared computer-based environment remembered more and used what they learned to solve new problems better than students who were not addressed" (Moreno & Mayer, 2000).

Wang et al. (2011) performed research on varying levels of interactive features in an online learning object. They compared four groups of students with different levels of interactivity in an introductory statistics course. They compared these interactivity levels to four levels of learning capabilities: remembering, understanding, lower-level applying and higher-level applying. The lowest level of interactivity was the static mode – meaning no interactivity. The second lowest was a simple animation mode. The third level allowed students to change the inputs to the learning object. And the fourth and highest level allowed students to practice and receive automated feedback from the system. In addition, their research also measured student confidence as well as student perceptions. Their research indicated that the higher levels of interactivity did increase two levels of the learning gains of the students. Interestingly enough, the results of this research indicated that positive correlations between interactivity were observed on understanding and lower-level applying learning capabilities. But there were not any learning differences on the remembering and the higher-level learning capabilities. Concerning the student confidence, the research indicated that there was not any differences among the students who used different interactive levels. Additionally, there was not any difference in students' perceptions of the different interactive levels.

In a similar study, Patwardhan and Murthy (2015) performed research on different levels of interactive features and measured learning. They compared four groups of students with different levels of interactivity in an electrical engineering course. They compared these levels of interactivity to three levels of learning: "understand conceptual knowledge", "understanding procedural knowledge", and "apply procedural knowledge". The lowest level of interactivity was the non-interactive mode. The second lowest was a

simple animation mode with play-pause-stop control. The third level was a simulation which allowed students to manipulate variables for interacting with the content. And the fourth and highest level was a guided simulation that allowed users to control different variables at different times to attempt to scaffold students' knowledge progressively. Their research indicated that the higher levels of interactivity did not impact learning on the "understand conceptual knowledge" category nor did it impact learning in the "understanding procedural knowledge" category. Interestingly enough, the results did indicate that the highest levels of interactivity did have a positive correlation on the highest level of learning: "apply procedural knowledge". In addition, this study also included a summary of the student perceptions of each mode of instruction. In this study, students reported that the higher levels of interactivity were more favorable to the lower levels of interactivity.

In a different study, Teo et al. (2003) reported similar findings at Patwardhan and Murthy on students' attitudes and perceptions of interactivity. They showed that an "increased level of interactivity on a Web site have positive effects on user's perceived satisfaction, effectiveness, efficiency, value, and overall attitude towards a Web site" (Teo et al., 2003).

Educational Simulations

In general, simulations are defined as "an act of imitating the behavior of a physical or abstract system, such as an event, situation or process that does or could exist" (Gibson & Baek, 2009). De Jong and van Joolingen (1988) gave a similar definition when they stated that a computer simulation is "a program that contains a model of a system (natural or artificial; e.g. equipment) or a process".

Increasingly, simulations are being used for educational purposes due to two main factors: increasing technological improvements and the growing focus on outcomes in education (Damassa and Sitko, 2010). When using simulations, caution must be taken though. Holton (2010) states, "Deciding when and how to support effective learning with simulations requires careful consideration of learner-centered, assessment-centered, knowledge-centered, and community-centered issues." Aleksandrova and Nancheva (2007) report "of course, when using simulation exercises, it is important to bear in mind that the actual reality is inevitably more complicated than the virtual one." Even with this caution, simulations have been used in many constructivist learning environments (Windschitl & Andre, 1998). Computer simulations seem to be ideal for these type of learning environments. Ruttan, van Joolingen and van der Veen (2012) state, "By placing emphasis on the learner as an active agent in the process of knowledge acquisition, computer simulations can support authentic inquiry practices that include formulating questions, hypothesis development, data collection, and theory revision."

Campbell et al (2002) showed that high quality educational simulations could be as effective and in some cases even better than physical laboratory experiences for students enrolled in a beginning Electrical Engineering course. In a similar light, Finkelstein et al (2005) showed that students enrolled in an introductory physics course did better on both the conceptual tests as well as developed a more intuitive skill at manipulating real laboratory components than students who only performed the physical laboratory experiments.

Windschitl and Andre (1998) showed that students' conceptual understanding can be enhanced when students use simulation in a constructivist manner. They showed that

when students interacted with simulations to make predictions and then test those hypotheses, their conceptual understanding increased. This result was tempered by the further study where they showed that a constructivist approach worked best with students with some prior knowledge. Those with less prior knowledge learned best by a more objectivist approach to the simulation.

Rutten, van Joolingen and van der Veen (2012) performed a meta-analysis of many different studies related to educational simulations for science education. In this article, the authors explored two fundamental questions concerning educational simulations. The first was "How can traditional science education be enhanced by the application of computer simulations?" The second was "How are computer simulations best used in order to support learning processes and outcomes?" The results of this meta-analysis indicate that educational simulations really "can enhance traditional instruction, especially as far as laboratory activities are concerned."

Another sub-area of simulations that have been explored is the level of immersion given to the learner (Rutten et al, 2012). Trindade, Fiolhais, and Almeida (2002) studied science simulations presented on a computer screen and compared to 3-D virtual environments. The results indicated that the 3-D virtual environments can support achievement of better conceptual understanding of some content, but not others. And it turns out that this increased conceptual understanding was only seen in students with higher spatial abilities. In a related study, Moreno and Mayer (2004) compared a 3-D virtual reality environment with a simulation on a desktop computer screen. In this study, the results indicated that the immersive virtual reality system did not influence test scores related to retention and transfer of information. Because of the cost of implementation,

their recommendation was to only use the 3-D virtual reality environments for learning when the focus of the learning is the virtual reality environment.

Adam et al. (2008a) specifically studied the effects of interactivity within simulations. They reported, "In all of the interviews, we've seen that interactions, guided by the student's personal questioning, are what make simulations an effective learning tool. Students engage in exploration and sense-making only after they begin to interact with the simulation. This finding suggests that the educational value of animations without interactivity is quite limited." In addition, they reported that the choice of parameters that can be manipulated is extremely important and several factors must be taken into account. Specifically they stated, "By limiting the parameters that can be changed and by emphasizing particular controls, a simulation scaffolds and guides student thinking." The results of their study published specific rule for animation and interactivity. These include:

- Students do not ask questions or make new connections when only observing. They need to interact with the simulation to really learn.
- Allowing user control of every perceived potentially significant parameter is valuable for student learning
- Limiting students control over certain items must be done carefully to ensure cognitive overload does not occur (Adams et al., 2008a).

In further work, Adam et al (2008b) outlined very specific guidelines for creating very intuitive interface designs for engaging students in simulations. These guidelines include intuitive controls such as click and drag controls, grabble objects, sliders, buttons, and check boxes. They also include guidelines for layout, backgrounds, and tabs. Using

these guidelines, they found "overwhelming evidence that simulations that suitably incorporate interactivity, animation, and context can provide a powerful learning environment where the students productively engage with and master physics content".

Learning Capabilities

There have been a number of educational taxonomies that have been developed over the years. These include Bloom's Taxonomy of Educational Objectives (Bloom et al., 1956), Gagne's Conditions of Learning (Gagne, 1985), Anderson and Krathwohl's Revision of Bloom's Taxonomy (Anderson & Krathwohl, 2001). Fink's Taxonomy of Significant Learning (Fink, 2003), and Marzano and Kendall's New Taxonomy of Educational Objectives (Marzano & Kendall, 2007).

Bloom (1956) defined six levels of learning capabilities. These capabilities are outlined in the following diagram:

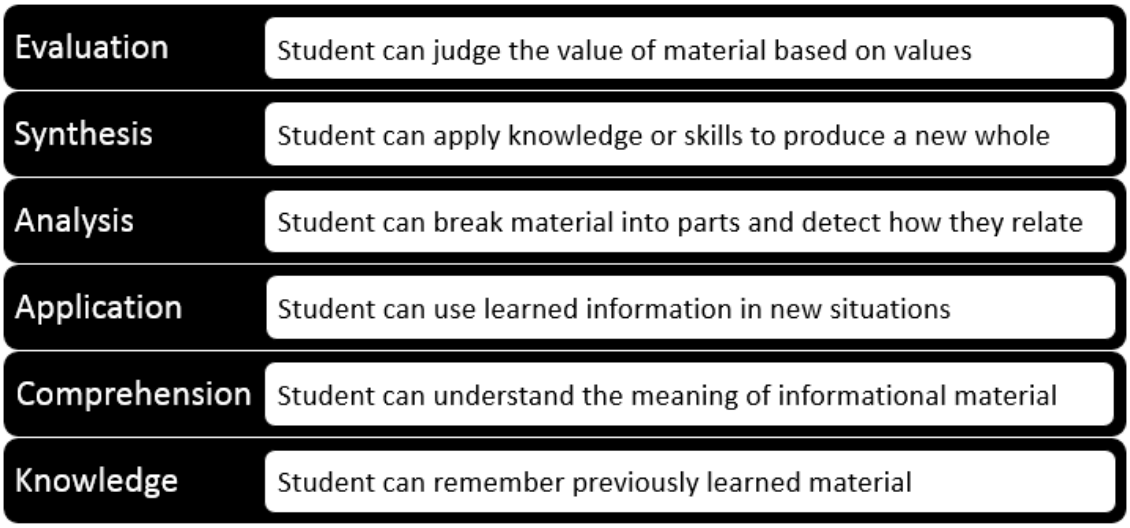

Figure 3. Six Levels of Learning Capabilities (Bloom, 1956)

These six levels of learning capabilities are considered hierarchical in nature which means that it is anticipated that students cannot perform a higher level learning

capability without some level of mastery in a lower level learning capability (Krathwohl, 2002).

Gagne (1985) also defined five categories of learning outcomes. These are outlined in the following diagram:

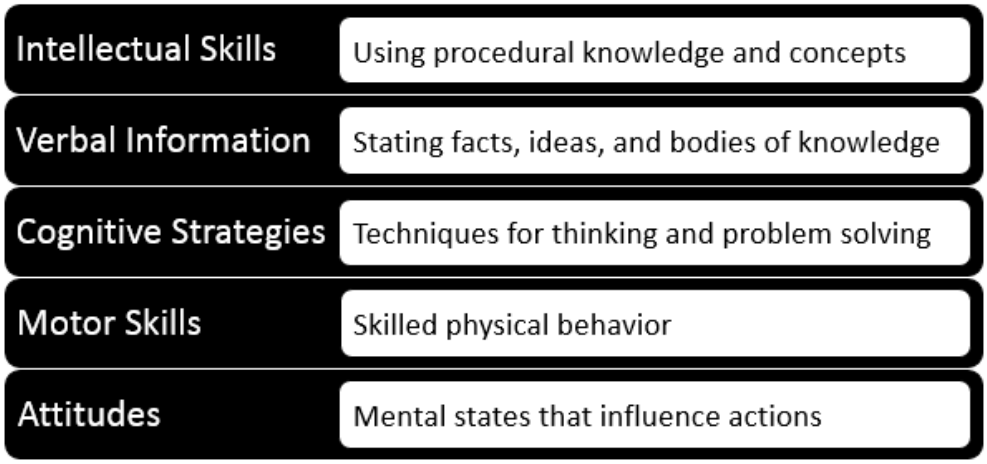

Figure 4. Five Categories of Learning Objectives (Gagne, 1985)

The Verbal Information category of learning outcomes includes declarative knowledge, including facts and comprehension (Gagné, Learning hierarchies, 1968). This also includes the process of memorizing facts as well as understanding them. However, making use of this knowledge would be classified in a different learning domain. The Intellectual Skills category of learning outcomes consists of using procedural knowledge and concepts. In addition, this category also includes the ability to apply and create a methodology to solve a problem (Gagné, Learning hierarchies, 1968).

Both the Intellectual Skills and the Cognitive Strategies capabilities include problem-solving skills.

Jonassen (2000) built on Gagne's work and further refined the definition and categorization of problem types and problem solving skills. He identified eleven

categories of problem types and associated problem solving skills. These are outlined in the following diagram:

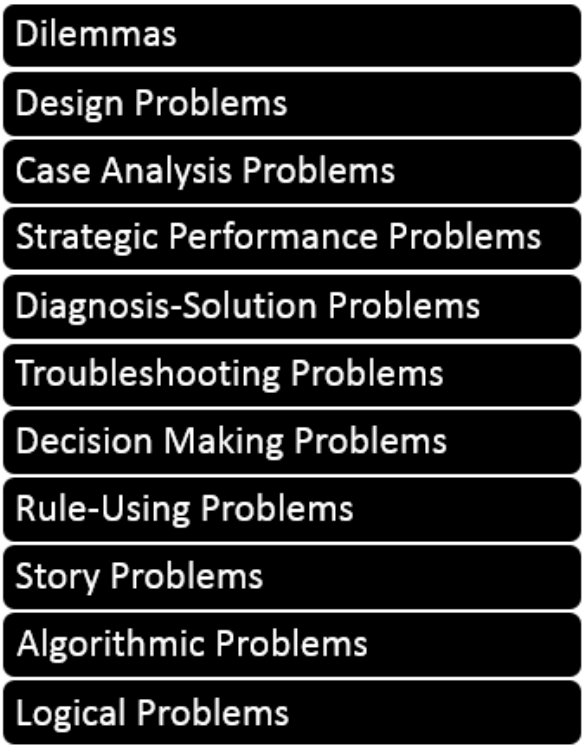

Figure 5. Eleven Categories of Problem Types (Jonassen, 2000)

These problem types represent a continuum of problems (from bottom to top) from well-structured to ill-structured problems. In addition, these problem types are taxonomic in nature. This implies that in order to successfully solve algorithmic problems, the problem solvers need to first be able to solve logical problems. Jonassen, Strobel, and Lee (2006) further defined some strategies pertinent for engineering educators in the development of these problem solving skills. These strategies include the use of ill-structured, open-ended design problems.

Anderson and Krawthwohl (2001) built upon Bloom's taxonomy and defined six levels of learning capabilities. These capabilities are outlined in the following diagram:

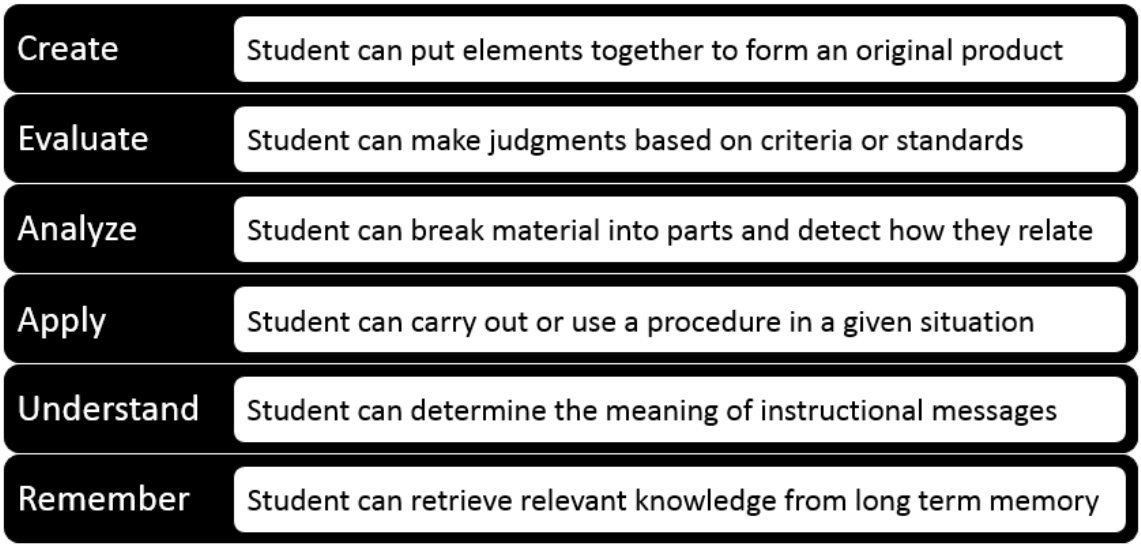

Figure 6. Six Levels of Learning Capabilities (Krathwohl, 2002)

Like Bloom's taxonomy, these six levels of learning capabilities are also considered hierarchical in nature that means that it is anticipated that students cannot perform a higher level learning capability without some level of mastery in a lower level learning capability (Krathwohl, 2002). The difference between this taxonomy and Bloom's taxonomy is two-fold. First, the nouns referred to in Bloom's taxonomy were replaced with verbs. This change facilitates the use of the taxonomy in the development of educational objectives. And secondly, two of the learning capabilities changed places (Synthesis and Evaluation/Create).

Fink (2003) defined six categories of significant learning. These categories are outlined in the following diagram:

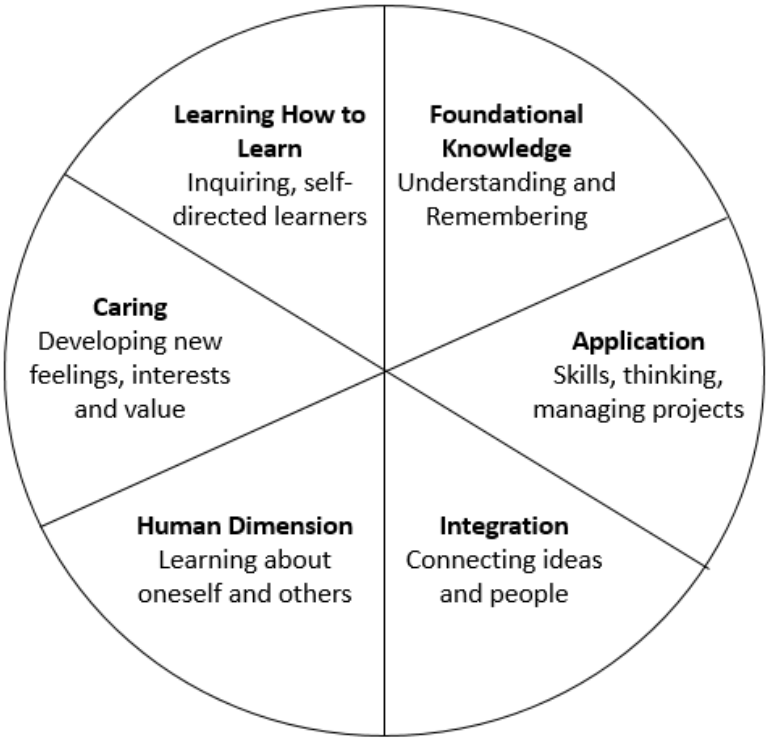

Figure 7. Six Categories of Significant Learning (Fink, 2003)

These six categories of significant learning were developed to include a broader set of learning than is included in the above taxonomies. Fink relates, "individuals and organizations involved in higher education are expressing a need for important kinds of learning that do not emerge easily from the Bloom taxonomy, for example" learning how to learn, leadership and interpersonal skills, ethics, communications skills, character, tolerance, and the ability to adapt to change" (Fink, p.29).

As with Anderson and Krathwohl, Marzano and Kendall (2007) extended Bloom's taxonomy. In their work, they defined three domains with six levels of processing in each domain. This taxonomy is outlined in the following diagram:

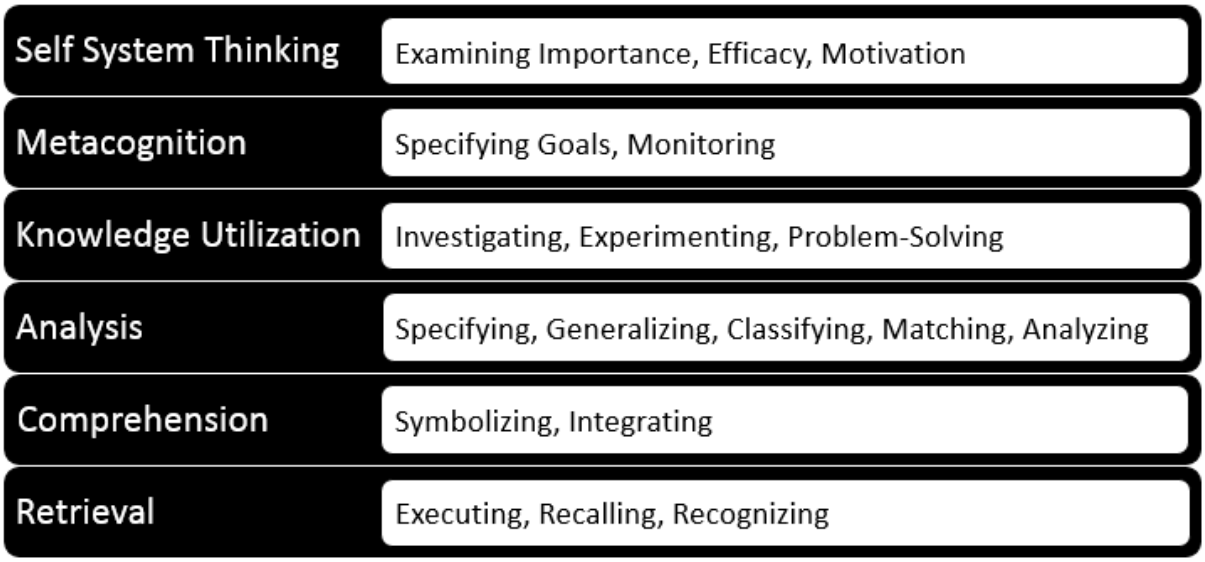

Figure 8. Six Levels of Processing (Marzano & Kendall, 2007)

The four lowest levels are cognitive in nature. The lowest level is retrieval, which is the least complex and then moves up through comprehension, analysis and knowledge utilization. The fifth level of process, Metacognition, involves the learner specifying their own goals and monitoring their progress. And the sixth level of the process, Self-System Thinking, involves the learner examining importance of the learning task and their own self-efficacy.

Because of the direct correlation between Krathwohl's learning capabilities and the learning objectives of this research, this study uses Krathwohl's Learning Capabilities as defined by Anderson and Krathwohl (2001) as the standard for comparison.

Conclusion/Summary

Even though there is a common perception that interaction in online education is really important (Bernard, et al., 2009), the research literature on the effectiveness of student achievement due to different levels of interactivity is mixed. There has been some research that shows that allowing higher levels of interactivity increases learning

(Boucheix & Schneider, 2009; Boucheix & Guignard, 2005; Lowe, 2004; Schwan & Riempp, 2004), but others have not shown any advantage (Kriz & Hegarty, 2007). Helfrich and Coffland (2014) have shown that there is a small effect of giving "Do" level interactivity for Rule/Problem Solving learning capabilities. In addition, Wang et al. (2011) and Patwardhan and Murthy (2015) also showed effects of giving "Do" level interactivity. To date there has not been any studies to determine the effectiveness of Use and Construct levels of interactivity on student learning.

The purpose of this study was to build on previous research and explore the influence of highly interactive online learning objects (Do, Use, and Construct level interactivity) on student learning.

CHAPTER 3

Method

The purpose of this study was to determine the effect of highly interactive learning objects on student learning. Specifically this study investigated the three areas of student achievement of Remember, Apply, and Create as defined by Krathwohl (2002). These learning achievements were investigated in relation to Perform levels of control within an online learning object (Do, Use, and Construct levels of interactivity) compared to Observe levels of control within the online learning object (Watch and Pace levels of interactivity). Additionally, this study attempted to determine the benefit to the student concerning the time required to complete the assignments.

This study was a quantitative experimental research design consisting of an objective pretest/posttest (measuring Remember student learning achievement), six lessons with summative assessments (measuring Apply student learning achievement), and a cumulative summative assessment (measuring Create student learning achievement). The participants were divided into two groups, the first exposed to the Observe levels of interactive learning objects and the second to the learning objects exhibiting Perform levels of interactivity.

Research Questions

The first Krathwohl Learner Capability (Remember) research question for this study was: RQ1: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Remember Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

H_1: There is a difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

The second Krathwohl Learner Capability (Apply) research question for this study was: RQ2: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Apply Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

The third Krathwohl Learner Capability (Create) research question for this study was: RQ3: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Create Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

The fourth research question for this study was: RQ4: Does the degree of interactivity in online learning objects influence the relative efficiency in student learning? The null and alternative hypotheses for this research question are:

H_0: There is no difference in the mean time to perform assignments between the two groups.

H_1: There is a difference in the mean time to perform assignments between the two groups.

Research Design

This study was a quantitative experimental research design consisting of an objective pretest/posttest measuring Remember student learning achievements, six lessons (consisting of 12 treatments) with summative assessments measuring Apply student learning achievements, and a cumulative summative assessment measuring Create student learning achievement. A block diagram of the research model is shown below:

Research Model	
$R_S – O_1 – X_1 – O_2 – X_3 – O_3 – X_5 – O_4 – X_7 – O_5 – X_9 – O_6 – X_{11} – O_7 – O_8 – O_9$ $R_S – O_1 – X_2 – O_2 – X_4 – O_3 – X_6 – O_4 – X_8 – O_5 – X_{10} – O_6 – X_{12} – O_7 – O_8 – O_9$	
R_S Random assignment into Observe and Perform groups O_1 Basic knowledge pretest O_2 Lesson 1 Apply assessment O_3 Lesson 2 Apply assessment O_4 Lesson 3 Apply assessment O_5 Lesson 4 Apply assessment O_6 Lesson 5 Apply assessment O_7 Lesson 6 Apply assessment O_8 Basic knowledge posttest (Remember assessment) O_9 Cumulative Create assessment	X_1 Low Interactivity treatment #1 X_2 High Interactivity treatment #1 X_3 Low Interactivity treatment #2 X_4 High Interactivity treatment #2 X_5 Low Interactivity treatment #3 X_6 High Interactivity treatment #3 X_7 Low Interactivity treatment #4 X_8 High Interactivity treatment #4 X_9 Low Interactivity treatment #5 X_{10} High Interactivity treatment #5 X_{11} Low Interactivity treatment #6 X_{12} High Interactivity treatment #6

Figure 9. Research Model

Participants

For this study, the target population was students enrolled in an online freshmen level university course called "WDD 100 - Introduction to Web Design and Development." This course was taught at a large private university in the Intermountain West. There were approximately 150 students enrolled in this course. And even though the course was a freshmen level course, students from all four academic years (i.e. freshmen, sophomore, junior, and senior) enrolled in this course. In addition, the students who enrolled in this course came from a wide variety of majors (e.g. Computer Science, Web Design and Development, Art, English, Communications, Biology, Business Management, International Studies, etc.). Because of the subject of this course, the students who enrolled in this class generally had a greater fluency and interest in computers and technology than the general population.

The students at the participating institution have different student demographics than other comparable universities. The average age of the students at the university is 22. The student population is approximately 86% Caucasian and only approximately 5% are international students. Approximately 25% of the students are married. And almost 45% have served missions for the sponsoring religious organization of the university. +

The participants were randomly divided into two groups. The first group was exposed to the Observe levels of interactive learning objects. The second group was exposed to the learning objects exhibiting Perform levels of interactivity. In addition, all students in the class had the option of not participating in this research study. Appendix A has a copy of the participation consent form.

Prior to the first treatment, students took a pretest assessment to gauge their prior knowledge of the subject matter. The pretest consisted of an objective 20-question assessment to evaluate students' factual knowledge of basic HTML and CSS constructs. If a student scored 75% or better on this pretest, their results were excluded from this study. This was done to ensure participating students were not experts in the subject matter and consequently skew the results of the research.

Development of the Treatment

This study was conducted in a beginning online web design and development course at a large private university in the Intermountain West. The course was a freshmen level course with students from many majors across the university. The purpose of the course is to introduce students to the fundamentals of web design and development and teach students the basics of HTML and CSS. As part of the class, the students developed a basic web site consisting of a main page and at least two child pages.

For this study, a total of six lessons were used to provide the required instruction. These lessons consisted of 12 online learning objects (12 treatments). These learning objects were divided into two groups of six learning objects each. The first group consisted of Observe level interactivity learning objects providing Watch and Pace level interactivity. The first group consisted of instructional videos demonstrating the basic principles of web design and development. The second group consisted of Perform level interactivity learning objects providing Do, Use, and Construct level interactivity. The Perform interactivity learning objects used the freely available Codecademy tool (www.codecademy.com) available on the web.

During the course of the treatments, in order to minimize differences in instructional material, students were encouraged to post all questions to the provided online discussion boards. In addition, all questions posed to the instructor directly through email were also entered to the discussion board and appropriate answers were given. This allowed all students the same access to all instructional material.

The students completed one lesson per week. The total calendar time for students completing all six lessons was six weeks. The following lesson plans were designed to support the experiment outlined above.

Lesson 1 – HTML Basics: Lesson 1 introduced students to the basics of HTML. The objectives of this lesson were that students would be able to:

1. Demonstrate how to structure a basic HTML document including the HEAD and BODY sections
2. Demonstrate the basic operation of the paragraph, heading and title HTML tags

3. Demonstrate how to include images in an HTML document
4. Demonstrate how to create hyperlinks within an HTML document

This lesson consisted of 2 separate learning objects. Both learning objects consisted of instruction covering:

- Basics of HTML and CSS
- Basic structure of HTML tags
- Basic structure of HTML pages including BODY and HEAD sections
- Title tag
- Paragraph tag
- Heading tags
- Image tag
- Hyperlink tag

The Observe Interactivity learning object consisted of instructional videos with Observe (Watch and Pace) level control over the instruction. The storyboards for the instructional video for this lesson are shown in Appendix B.

The Perform Interactivity learning object consisted of an interactive tutorial with Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson is located under the "HTML Basics" tab at http://www.codecademy.com/. The interactive tutorial for this lesson begins with this screen:

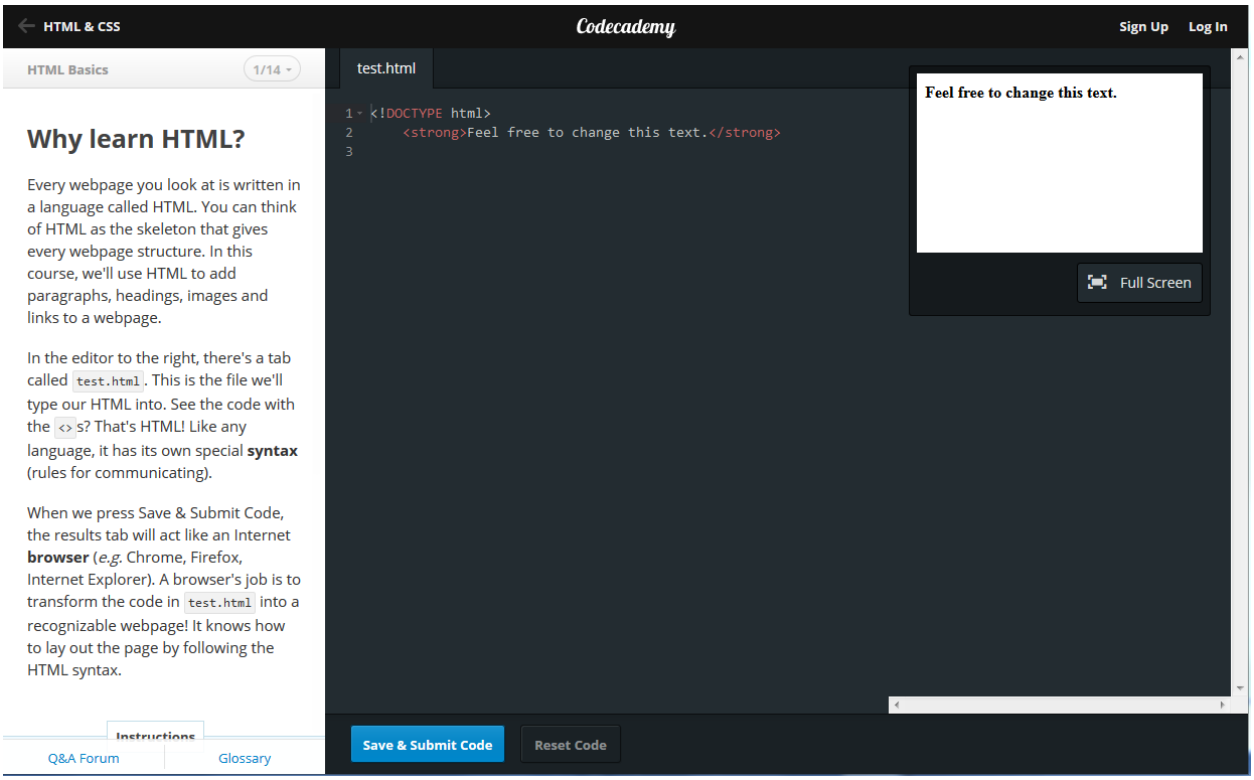

Figure 10. Lesson #1 - HTML Basics

Lesson 2 – HTML Basics II: Lesson 2 introduced students to more advanced features of HTML. The objectives of this lesson are that students would be able to:

1. Demonstrate the basic structure of an ordered list in HTML
2. Demonstrate the basic structure of an unordered list in HTML
3. Demonstrate the basics of styling fonts including size, color and family
4. Demonstrate the basics of other styling features including background color, text alignment, and emphasis tags

This lesson consisted of 2 separate learning objects. Both learning objects consisted of instruction covering:

- Ordered lists
- Unordered lists

- Nested lists
- Comments
- Font size and color
- Font family
- Background color
- Text alignment
- Bold and italicize font

Like lesson one, the Observe Interactivity learning object consisted of instructional videos with Observe (Watch and Pace) level control over the instruction. The storyboards for the instructional video for this lesson are shown in Appendix C.

The Perform Interactivity learning object also used the freely available tool at http://www.codecademy.com/. This tool provides an interactive tutorial with Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson is located under the "HTML Basics II" tab at http://www.codecademy.com/. The interactive tutorial for this lesson begins with this screen:

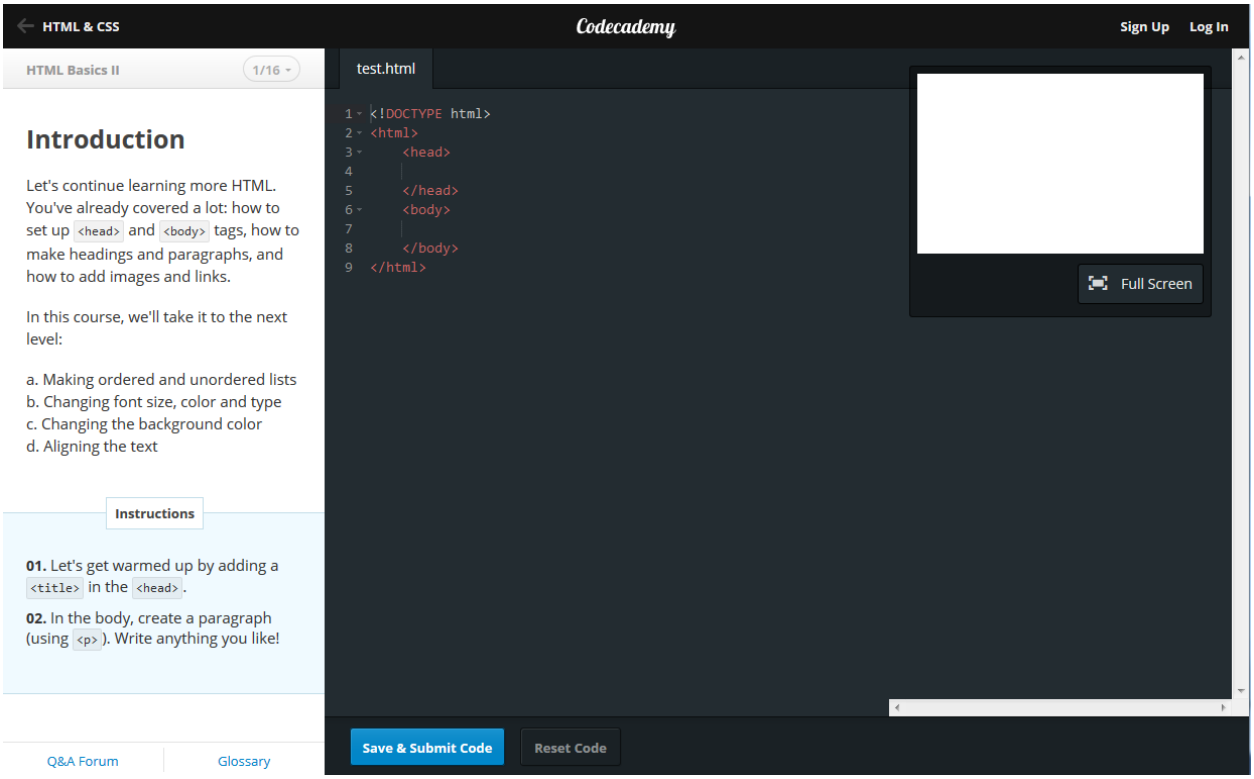

Figure 11. Lesson #2 - HTML Basics II

Lesson 3 – HTML Basics III: Lesson 3 further introduced students to more advanced features of HTML. The objectives of this lesson are that students would be able to:

1. Demonstrate the basic structure of HTML tables
2. Demonstrate the basic structure of both rows and columns of HTML tables
3. Demonstrate the basics of HTML table headers
4. Demonstrate the basics of styling HTML tables
5. Demonstrate the basics DIV and SPAN tags

This lesson consists of 2 separate learning objects. Both learning objects consisted of instruction covering:

- HTML tables
- Adding rows to a table

- Adding columns to a table
- Table headers
- Titles for tables
- Styling tables
- DIV tag
- SPAN tag

For this lesson, the learning object for the Observe group also consisted of instructional videos with Observe (Watch and Pace) level control over the instruction. The storyboards for the instructional video for this lesson are shown in Appendix D.

The learning object for the Perform group consisted of an interactive tutorial with Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson is located under the "HTML Basics III" tab at http://www.codecademy.com/. The interactive tutorial for this lesson begins with this screen:

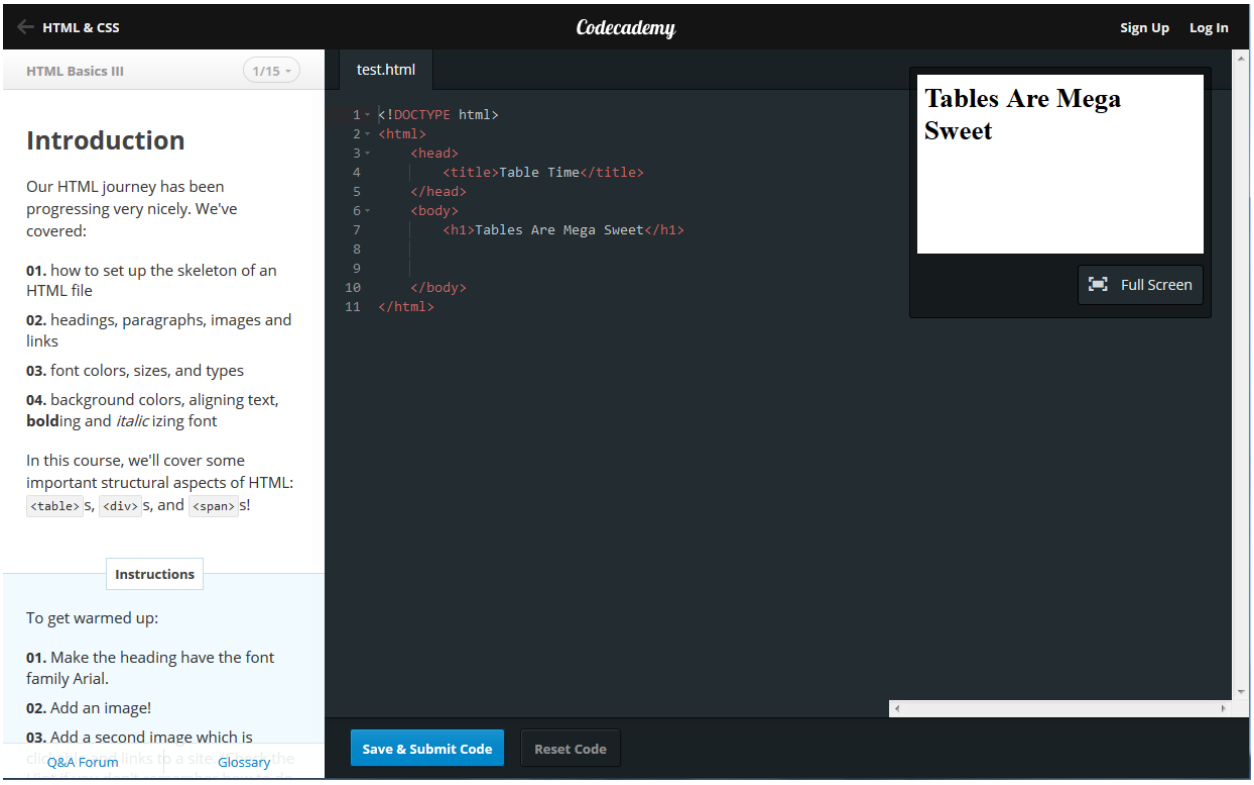

Figure 12. Lesson #3 - HTML Basics III

Lesson 4 – CSS: An Overview: Lesson 4 introduced students to the basics of CSS. The objectives of this lesson are that students would be able to:

1. Demonstrate the basic structure of both inline as well as external style sheets
2. Demonstrate the basic syntax of CSS attributes
3. Demonstrate the basics of styling text data
4. Demonstrate the basics of styling borders, links, and text decorations

This lesson consists of 2 separate learning objects. Both learning objects consisted of instruction covering:

- Purposes of CSS
- Internal and external style sheets
- Linking external style sheets

- Syntax for CSS elements
- Border styles
- Link styles
- Text decorations

For this lesson, the Observe interactivity learning object consisted of instructional videos with Observe (Watch and Pace) level control over the instruction. The storyboards for the instructional video for this lesson are shown in Appendix E.

The Perform interactive tutorial for this lesson is located under the "CSS: An Overview" tab at http://www.codecademy.com/. This learning object consisted of Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson begins with this screen:

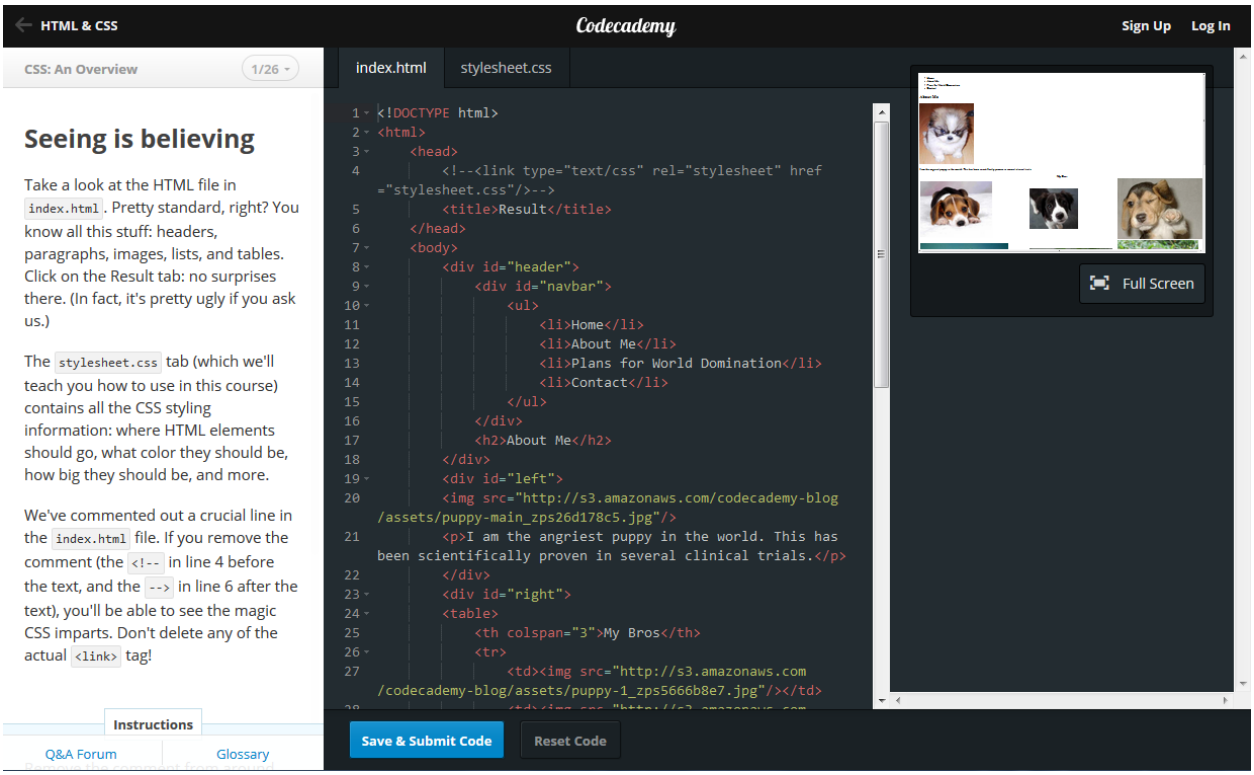

Figure 13. Lesson #4 – CSS: An Overview

Lesson 5 – CSS Selectors: Lesson 5 introduced students to the basics of CSS Selectors. The objectives of this lesson are that students would be able to:

1. Demonstrate the basic use of CSS Selectors within HTML documents
2. Demonstrate the basic use of CSS Classes
3. Demonstrate the basic use of CSS ID's

This lesson consisted of 2 separate learning objects. Both learning objects consisted of instruction covering:

- Purposes of CSS Selectors
- Use of parent to child inheritance of CSS selectors
- Use of sibling to sibling inheritance of CSS selectors
- Use of CSS classes
- Use of CSS ID's
- Use of CSS pseudo-class selectors

The instruction for the Observe interactivity learning object also consisted of instructional videos with Observe (Watch and Pace) level control. The storyboards for the instructional video for this lesson are shown in Appendix F.

The Perform interactivity learning object uses the "CSS Selectors" Codecademy interactive tutorial. This tutorial provides Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson is located under the "CSS Selectors" tab at http://www.codecademy.com/. The interactive tutorial for this lesson begins with this screen:

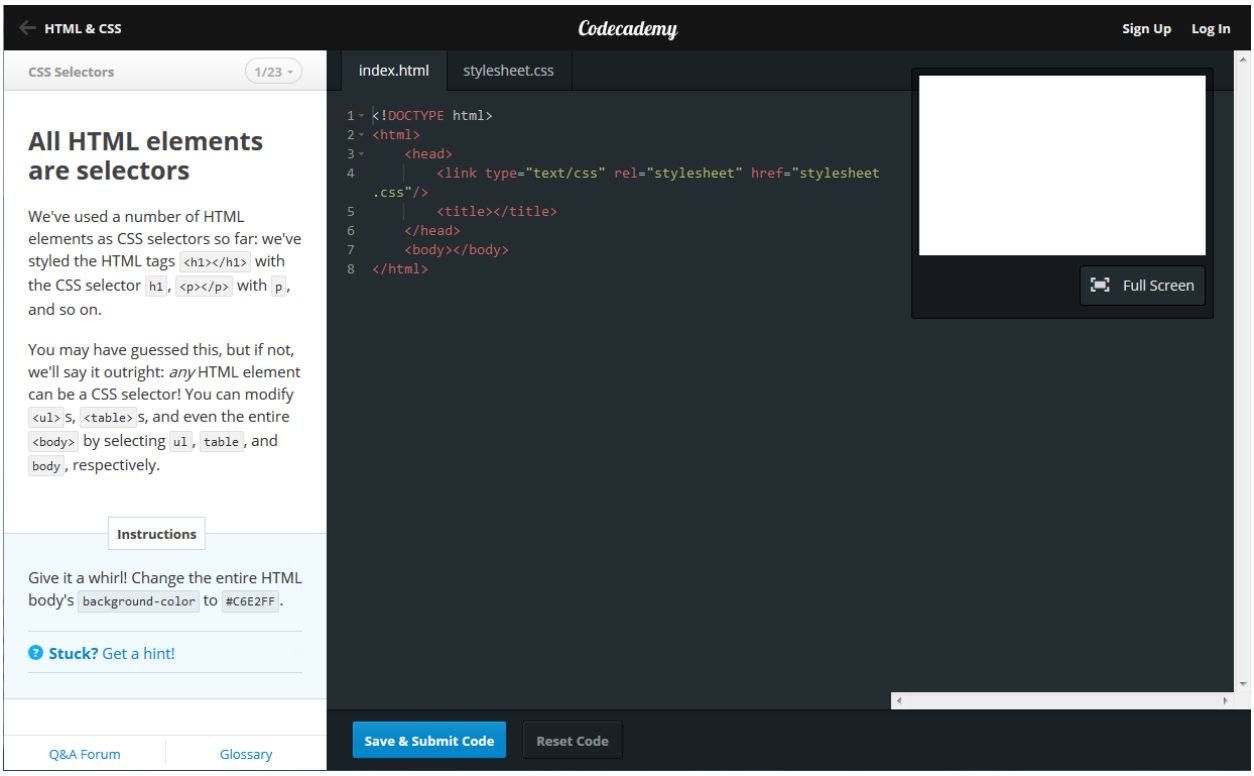

Figure 14. Lesson #5 – CSS Selectors

Lesson 6 – CSS Positioning: Lesson 6 introduced students to the basics of CSS Positioning. The objectives of this lesson are that students would be able to:

1. Demonstrate the basic use of the box model for spacing HTML elements
2. Demonstrate how to set the margins, borders, and padding of HTML elements
3. Demonstrate the basic use of the CSS "float" positioning element
4. Demonstrate the basic use of absolute, fixed, and relative positioning of HTML elements

This lesson consists of 2 separate learning objects. Both learning objects consisted of instruction covering:

- CSS box model
- Setting and styling margins
- Setting and styling borders

- Setting and styling padding
- Using the float parameter
- Fixed positioning of HTML elements
- Relative positioning of HTML elements
- Absolute positioning of HTML elements

The Observe interactivity learning object also consisted of an instructional video with Observe (Watch and Pace) level control over the instruction. The storyboards for the instructional video for this lesson are shown in Appendix G.

The Perform interactivity learning object also used a Codecademy tutorial and provides Perform (Do, Use, and Construct) level control over the instruction. The interactive tutorial for this lesson is located under the "CSS Positioning" tab at http://www.codecademy.com/. The interactive tutorial for this lesson begins with this screen:

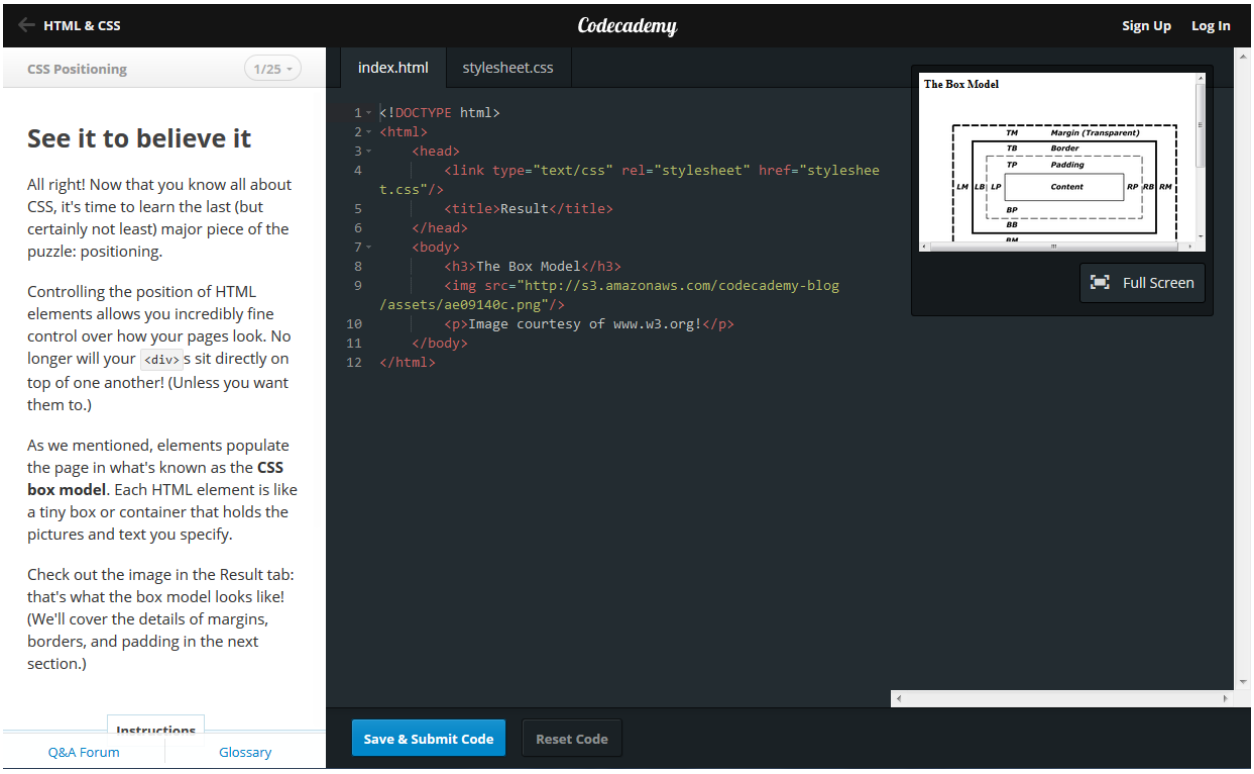

Figure 15. Lesson #6 – CSS Positioning

After each lesson and for the final assessment, students completed their assignments using an online tool called handcraft.com. This tool provides a simple web design and development prototyping platform. The handcraft tool was not be used in any of the 12 online learning objects. This minimized any potential advantage in the completion of the assessments.

Assessment Instruments

Three assessment instruments were developed to investigate the three areas of student achievement (Remember, Apply, and Create). The details of each assessment instrument are detailed below.

Remember: Student achievement in the Remember category refers to the ability of a student to demonstrate knowledge of the terminology and specific facts of a particular subject (Krathwohl, 2002). Student achievement in the Remember category

was measured using an objective, 20-question assessment instrument. The purpose of this assessment was to evaluate factual knowledge of basic HTML and CSS constructs. Specifically, this instrument tested students' knowledge on

- Basic HTML document structure
- Head tag
- Body tag
- Title tag
- Paragraph tag
- Heading tags
- Image tags
- Lists
- Class tag
- Div tag
- Basic CSS structure
- CSS color changes
- CSS positioning

The assessment instrument used for this learning achievement consisted of a subset of a formative assessment that is part of the HTML certification used by www.w3schools.com. W3Schools is the largest web developer reference site on the World Wide Web and provides online web developer training and certification (Alexia, 2015).

The specific questions used for this assessment instrument were chosen to align with the objectives of the instruction (as detailed above). After this assessment

instrument was developed, the researcher provided the learning objectives and the assessment instrument to three subject matter experts to verify content validity. These experts reviewed the objectives and the assessment instrument and found that the assessment was adequate and appropriate for the objectives of the instruction. In addition, they determined that all learning objectives were assessed appropriately and no objectives were missed in the assessment.

The same assessment was used for the pretest as well as the posttest. However, in order to minimize the effect of pretest sensitization, the posttest had the order of the questions as well as the order of the distractors randomized. The pretest is located in Appendix H and the posttest is located in Appendix I.

Apply: Student achievement in the Apply category refers to the ability of a student to carry out or use a procedure to implement or execute in a given situation (Krathwohl, 2002). Student achievement in the Apply category was measured using six rubric assessments. Specifically, these rubrics tested students' ability to

- Correctly use HTML tags for including titles, headings, paragraphs, links, and images into a web page
- Correctly use both ordered lists and unordered lists
- Correctly style the font for emphasis (i.e. bold, italicize), size, color, and family
- Correctly use HTML tag attributes for setting the background color of items
- Correctly use tables, using headers and body tags
- Correctly use DIV and SPAN tags to organize an HTML file
- Correctly use external style sheets
- Correctly use CSS to style text, borders, and hyperlinks.

- Correctly use CSS classes and ID's
- Correctly use the box model to position HTML elements
- Correctly use different positioning elements to position elements on a web page

These rubric assessments were used to measure how well the students are able to apply the principles taught in each of the six lessons in the treatments. These six assessments were administered at six different points in the instruction. They were administered as homework assignments following each of the six treatments.

Three web development professionals and one curriculum designer reviewed the instructional objectives and the associated rubrics for content validity. The results of that review were that the instructional objectives were adequate and appropriate for the course and that the rubrics adequately assessed the instructional objectives. The complete rubrics are located in Appendix J.

Create: Student achievement in the Create category refers to the ability of a student to put concepts and elements together to form a novel or original product (Krathwohl, 2002). It also refers to the students' ability to plan a solution to a problem or produce an original work.

The Create student achievement was measured using a rubric instrument. The rubric was used to measure how well the students were able to create an original web site on any subject of their choice. Specifically, this rubric measured students' ability to:

- Organize a web site for usability (logical organization, navigation, completeness etc.)
- Present content in a visually appealing manner
- Create a web site of at least three web pages with a consistent theme

- Report all details of the development process in a clear and concise manner

Three web development professionals and one curriculum designer reviewed the instructional objectives of the rubric for content validity. The results of that review were that the instructional objectives were adequate and appropriate for the course and that the rubric adequately assessed the instructional objectives. The complete rubric is located in Appendix K.

Data Collection

As detailed above, there were numerous data points that were collected. The Remember learning achievement was assessed using an objective pretest/posttest instrument. The Apply learning achievement was assessed using six rubric instruments. The Create learning achievement was assessed also using a rubric instrument. For each of these assessments, data was collected that showed how well students achieved the desired learning outcomes.

Remember: The Remember assessment consisted of a 20-question objective pretest/posttest assessment. Prior to beginning the treatment, students were given the objective pretest for the Remember assessment. This assessment was administered as an assignment included within the Learning Management System (LMS). This assessment was assigned as a formative assessment that did not affect the final grade. Students were instructed to complete the assignment as quickly as possible without help from any outside source.

At the completion of the six experimental lessons, the posttest for the Remember learning achievement was administered. This assessment used the same format as the pretest (i.e. formative assessment administered within the LMS).

Apply: The assignments that generated the data for the Apply assessments was administered through the course LMS. During the course of the six treatments, students were given weekly homework assignments to evaluate how well they can apply the principles outlined in the lessons. For each assignment, students demonstrated their application of these principles by building web pages with features aligned with the objectives of each lesson. The students submitted their finished web site URL's to the course LMS and was graded accordingly.

Create: The Create assessment was the culmination of the beginning web design and development course where this study took place. For this final assessment, students created an original web site that demonstrated their overall proficiency in web design and development principles. This assignment was given after the six treatments were completed and was administered through the course LMS.

Efficiency: The data for efficiency of instruction was collected with self-reported times for how long each Apply homework assignment took the students to accomplish. No attempt was made to measure the time required for either the Remember assessment or the Create assessment.

Data Analysis

At the conclusion of the treatments and associated assessments, the results were analyzed to evaluate the four research questions of this study.

Remember: The objective pretest/posttest data was analyzed to determine whether the treatment had any effect on the students' ability to recall basic facts on HTML and CSS. This data was analyzed using the ANCOVA statistical procedure using the pretest as the covariate. An ANCOVA answered the question of whether the posttest means, adjusted for pretest scores, differ between the two groups (Dimitrov, 2003).

This assessment had one independent variable (the level of interactivity provided to students) and one dependent variable (students' scores on the posttest). The students were randomly assigned into the two treatment groups and the ANCOVA analysis used a significance level $\alpha = 0.05$ which normally provides reasonable protection against a Type I error. Assuming a medium effect size of 0.25, the power of this experiment was approximately 0.75.

Apply: The data from the six rubric assessments was analyzed to determine whether there was any difference between the Observe group and the Perform group on their ability to apply the basic principles of web design and development. This data was analyzed using a One-Way MANOVA. This statistical procedure is used to determine whether there are any differences between independent groups on more than one continuous dependent variable (Myers, Well, & Lorch, 2010, p. 345).

Create: The final rubric instrument was designed to measure the students' ability to create a new web site from scratch, and the data was analyzed to determine whether there was any difference between the Observe group and the Perform group on their ability to create that original web site. The data set from this instrument was analyzed using an independent-samples T-Test. This statistical procedure is used to analyze the

difference between two groups with different treatment conditions (Gravetter & Wallnau, 2009, p. 309).

Efficiency: The students' self-reported times to complete each of the six Apply assignments were measures of the efficiency of the instruction. This data was analyzed using a One-Way MANOVA. This statistical procedure is used to determine whether there are any differences between independent groups on more than one continuous dependent variable (Myers, Well, & Lorch, 2010, p. 345).

Summary

This study attempted to answer the basic instructional design question of what (if any) the learning gains would be if students were provided with very rich interactive online learning objects. Additionally, it attempted to determine the relative efficiency of these modes on instruction. To help answer the learning gains question, three specific research questions were formulated to help frame the investigation. The three research questions probe the degree of interactivity in online learning objects and their influence on student achievement relative to Krathwohl's Remember, Apply, and Create learning capabilities. A fourth research question was formulated to probe the learning efficiency of the two groups while the students completed the Apply lessons.

For this study, students in a beginning web design and development course were randomly assigned into the two groups. The Observe group received six minimally interactive online learning objects that instructed them in the basics of web design and development. The Perform group received six very highly interactive online learning objects that taught the same principles.

Students were also given an objective pretest and posttest to evaluate their basic knowledge of web design and development principles. They were also given assessments after each online learning object to assess how well they applied the concepts taught in each learning object. Students were also asked to self-report the time that was required to complete each of the six learning objects. And finally, students were given a final comprehensive assessment to evaluate how well they used their knowledge and application skills to create a complete web site.

CHAPTER IV

Results

The purpose of this study was to investigate whether different levels of interactivity promote different learner capabilities. Specifically, this study attempted to determine whether there was a relationship between different levels of interactivity and the Remember, Apply, and Create learner capabilities as defined by Krathwohl (2002). Additionally, this study investigated whether different levels of interactivity promote learning at different rates. The results of this study will help to inform educators on the benefits of providing the highest levels of user interactivity in online learning objects.

Sample

The population for this experiment consisted of students in an online freshman level university course called "WDD 100 – Introduction to Web Design and Development." This class was taught at a large university in the Intermountain West. The course was open to all students admitted by the university.

The students consisted of 71 students enrolled in the fall semester 2015 and 78 students enrolled in the winter semester 2016. In each semester, students were randomly assigned into either the Observe experimental group or the Perform experimental group. Following this assignment, students were invited to participate in this research experiment.

In the fall semester, of the 71 students enrolled in the course, 25 students declined to participate in the research experiment, eight students eventually dropped the course, and six participants scored higher than the predetermined cutoff on the pretest. This left a

total of 32 students in the research experiment (17 in the Observe group and 15 in the Perform group).

In the winter semester, of the 78 students enrolled in the course, 19 students declined to participate in the research experiment, 10 students eventually dropped the course, 17 participants scored higher than the predetermined cutoff on the pretest, and one student was disqualified due to self-reporting of using both sets of interactivity features. This left a total of 31 students in the research experiment (15 in the Observe group and 16 in the Perform group).

Therefore, the students for this experiment consisted of 63 total students with 32 students in the Observe group and 31 students in the Perform group. The students in the experiment had the following demographic characteristics:

Table 1

Description of Student Population

Characteristic	Observe Characteristics	Perform Characteristics	Total Characteristics
# Students	32 Students	31 Students	63 Students
Gender	19 Females 13 Males	19 Females 12 Males	38 Females 25 Males
Year In School	4 Freshmen 7 Sophomores 11 Juniors 10 Seniors	5 Freshmen 9 Sophomores 10 Juniors 7 Seniors	9 Freshmen 16 Sophomores 21 Juniors 17 Seniors
Mean GPA	3.34	3.50	3.42
GPA Range	2.08 to 4.00	2.04 to 4.00	2.04 to 4.00
Mean Age	27.97	31.84	29.91
Median Age	25	28	26
Marital Status	11 Single 21 Married	14 Single 17 Married	25 Single 38 Married
Mode of Degree Delivery	15 Online Students 17 Campus Students	17 Online Students 14 Campus Students	32 Online Students 31 Campus Students

As shown in the table above, the students' demographics were quite similar between the Observe and the Perform groups. There were very similar numbers of males and females in each group. Additionally, there was very similar demographics as far as year in school, degree type, marital status and mode of delivery for the degree. There were slight variations between the groups on mean GPA and age. However, neither difference was statistically significant (GPA $t(58) = 1.10$, $p = 0.28$; Age $t(61) = 1.49$, $p = 0.14$).

The students included in this study did differ from students at many other universities. Of the 63 participants, 32 students (50.8%) in this study were students enrolled in an online degree program instead of an on campus degree program. In addition, the mean age of these students was 29.91 years, which is older than traditional college age students. Additionally, 38 of the 63 participants (60.3%) in this study were married. This suggests that this student population may have greater maturity and life experience than a traditional college student. This factor may limit this study's generalizability. Possible implications of these demographic differences will be discussed in Chapter Five.

Method of Analysis

Student achievement in the Remember category was measured using an objective, 20-question assessment instrument. The purpose of this assessment was to evaluate the students' factual knowledge of basic HTML and CSS constructs. The data from the objective pre and posttest assessments were analyzed using the ANCOVA statistical procedure using the pretest as the covariate.

Student achievement in the Apply category was measured using six rubric assessments. The Apply rubric instruments were designed to measure the students' ability to apply the basic principles of web design and development. Each of the six assessments were administered after each of the six lessons. These data were analyzed using a One-Way MANOVA.

The Create student achievement was measured using a rubric instrument. The rubric was used to measure how well the students were able to create an original web site on any subject of their choice. The data set from this instrument was analyzed using an independent-samples t-test.

The students' self-reported times (in minutes) to complete each of the six Apply assignments was the measure of the efficiency of the instruction. These data were analyzed using a One-Way MANOVA.

Research Question One

The first research question considered the students' learning of basic factual concepts of HTML and CSS. The question as stated was: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Remember Learning Capability? The null and alternative hypotheses for this research question were:

H_0: There is no difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

H_1: There is a difference in mean posttest scores when controlling for pretest scores between the two groups on an objective exam covering Krathwohl's Remember Learning Capability material presented in the learning objects.

This question was answered by collecting data on both a pretest and posttest objective assessment. The assessment was an objective 20 question quiz administered through the LMS.

From the original 32 students in the Observe group, two students failed to take the pretest and three additional students failed to take the posttest. Additionally, in the Perform group, one student failed to take the posttest. Consequently, these students' scores were not included in the analysis. A summary of the descriptive statistics for the data is shown in Table 2 below, and the complete data set is shown in Appendix L.

Table 2

Descriptive Statistics of Remember Learning Capability Data

Treatment	Test	Mean	Std. Deviation	N
Observe	Pretest	38.33	20.48	27
	Posttest	82.78	11.55	27
Perform	Pretest	41.83	13.74	30
	Posttest	87.83	10.06	30

The difference in student achievement between students who used the Observe level interactivity learning objects and students who used the Perform level interactivity learning objects were analyzed using an ANCOVA statistical procedure using the pretest as the covariate. The results showed that the differences in learning gains were not statistically significant, $F(1,57) = 2.64$, $p = 0.11$. Therefore, this study failed to reject the null hypothesis and concluded that this study found no difference in mean posttest scores between the two treatment groups when controlling for pretest scores on an objective

assessments covering Krathwohl's Remember Learning Capability material presented in the learning objects.

Furthermore, the Cohen's d was $d = 0.03$, which is a very small effect size (Gravetter & Wallnau, 2009). This also supports the conclusion that the level of interactivity used in the learning objects had little effect on basic knowledge acquisition in the Remember learning category. Full statistical results are included in Appendix M.

Research Question Two

The second research question considered the students' ability to apply the basic principles of web design and development. The question as stated was: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Apply Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects

This question was answered by collecting data on six rubric instruments administered after each treatment. The complete data set is shown in Appendix L and the descriptive statistics of this test are shown in Table 3 below:

Table 3

Descriptive Statistics of Apply Learning Capability Data

	Treatment	Mean	Std. Deviation	N
Lesson1	Observe	9.69	0.78	32
	Perform	9.45	0.85	31
Lesson2	Observe	9.31	1.12	32
	Perform	9.39	0.95	31
Lesson3	Observe	8.69	1.94	32
	Perform	8.81	1.35	31
Lesson4	Observe	8.88	2.59	32
	Perform	9.48	1.15	31
Lesson5	Observe	9.22	2.04	32
	Perform	9.35	1.82	31
Lesson6	Observe	8.66	2.62	32
	Perform	7.39	3.07	31

Note: Each lesson assignment was scored on a zero to ten-point scale.

The data were analyzed using a One-Way MANOVA statistical procedure. The results showed that the difference in learning gains between the two modes of instruction were not statistically significant for any of the six lessons. The statistical details are shown in Table 4 below:

Table 4

Results of One-Way MANOVA of Apply Learning Capability Data

	df	*F*	*p*	η^2	*Cohen's d*
Lesson1	1,62	1.32	0.26	0.02	+0.29
Lesson2	1,62	0.08	0.78	0.00	-0.08
Lesson3	1,62	0.08	0.78	0.00	-0.07
Lesson4	1,62	1.44	0.24	0.02	-0.30
Lesson5	1,62	0.08	0.78	0.00	-0.07
Lesson6	1,62	3.12	0.08	0.05	+0.45

Since all six of the *p* values are greater than the significance level of 0.05 (confidence interval of 95.0%), this corresponds to a non-statistically significant result for each individual lesson. Therefore, this study failed to reject the null hypothesis and

concluded that this study found no difference in mean scores between the two treatment groups on rubric assessments covering Krathwohl's Apply Learning Capability material presented in the learning objects.

Furthermore, of the six effect sizes, three are considered very small effect sizes (Lessons 2, 3 and 5), while three are considered small to medium effect sizes (Lessons 1, 4, and 6). Interestingly, two of the small to medium effect sizes (Lessons 1 and 6) indicated that the Observe group scored higher than the Perform group while the effect size of Lesson 4 indicated the opposite. Due to the small to medium effect sizes cancelling each other out, the Cohen's d for all six treatments combined was $d = 0.09$, a very small effect size (Gravetter & Wallnau, 2009). This also supports the conclusion that the level of interactivity used in the learning objects had little effect on students' ability to apply the knowledge they learned in the lessons. Full statistical results are included in Appendix M.

Research Question Three

The third research question considered the students' ability to create an original web site after learning the basic principles of web design and development. The question as stated was: Does the degree of interactivity in online learning objects influence student achievement relative to Krathwohl's Create Learning Capability? The null and alternative hypotheses for this research question are:

H_0: There is no difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

H_1: There is a difference in mean scores between the two groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects

This question was answered by collecting data on a comprehensive rubric based assessment after all six treatments were administered. A summary of the descriptive statistics for the data is shown in Table 5 below. And the complete data set is shown in Appendix L.

Table 5

Descriptive Statistics of Independent Samples T-Test of Create Learning Capability Data

Treatment	Mean	Std. Deviation	N
Observe	92.50	11.43	32
Perform	93.55	7.77	31

Note: The Create assignment was scored on a zero to 100-point scale.

The difference in student achievement between students who used the Observe level interactivity learning objects and students who used the Perform level interactivity learning objects were analyzed using an independent samples t-test statistical procedure.

The results showed that the difference in learning gains was not statistically significant, $t(61) = -0.42$, $p = 0.67$. Therefore, this study failed to reject the null hypothesis and concluded that this study found no difference in mean scores between the two treatment groups on a rubric assessment covering Krathwohl's Create Learning Capability material presented in the learning objects.

Furthermore, the Cohen's *d* effect size was $d = 0.11$, a small effect size (Gravetter & Wallnau, 2009). This also supports the conclusion that the level of interactivity used in the learning objects did not affect the students' ability to create a new website. Full statistical results are included in Appendix M.

Research Question Four

The fourth research question considered the students' relative rate of learning and being able to apply the basic principles of web design and development. The question as stated was: Does the degree of interactivity in online learning objects influence the relative efficiency in student learning? The null and alternative hypotheses for this research question are:

H_0: There is no difference in the mean time to perform assignments between the two groups.

H_1: There is a difference in the mean time to perform assignments between the two groups.

This question was answered by collecting data on how long it took the students to complete each of the six apply assessments. Students self-reported these times in the learning management system.

The complete data set is shown in Appendix L. It is noted that there were numerous cases where students failed to self-report the time required to complete the lessons. Because the One-Way MANOVA statistical procedure requires a complete data set, all timing data had to be discarded for any student who failed to report even one assignment time. The discarded data resulted in a total of only 22 sets of data for the Observe group and 19 data sets for the Perform group. Table 6 below illustrates the descriptive statistics of this test.

Table 6

Descriptive Statistics of Efficiency of Treatment (in minutes)

	Treatment	Mean	Std. Deviation	N
Lesson1	Observe	147.05	81.10	22
	Perform	192.63	106.45	19
Lesson2	Observe	121.36	60.75	22
	Perform	158.16	101.15	19
Lesson3	Observe	132.27	73.29	22
	Perform	165.00	94.74	19
Lesson4	Observe	107.73	56.37	22
	Perform	152.37	98.01	19
Lesson5	Observe	113.64	71.87	22
	Perform	140.53	83.81	19
Lesson6	Observe	194.09	168.85	22
	Perform	222.63	137.14	19

Note: Students self-reported their time in minutes to complete each lesson. So for example, on average, the Observe students were able to complete Lesson 1 in 147.05 minutes while it took on average 192.63 minutes for the Perform group.

It was noted that in all cases, it took longer for the Perform group to complete their assignments than the Observe group. The data were analyzed using a One-Way MANOVA statistical procedure. The following results were obtained (full statistical results are included in Appendix M).

Table 7

Results of One-Way MANOVA of Efficiency of Treatment

	df	*F*	*p*	η^2	*Cohen's d*
Lesson1	1,41	2.41	0.13	0.06	0.49
Lesson2	1,41	2.06	0.16	0.05	0.44
Lesson3	1,41	1.55	0.22	0.04	0.38
Lesson4	1,41	3.31	0.08	0.08	0.56
Lesson5	1,41	1.22	0.28	0.03	0.34
Lesson6	1,41	0.35	0.56	0.01	0.18

Since the *p* values are all greater than the significance level of 0.05 (confidence interval of 95%), this corresponds to a non-statistically significant result for each lesson.

Therefore, this study failed to reject the null hypothesis and concluded that this study found no differences in the time required for the two treatment groups to complete the lessons covering Krathwohl's Apply Learning Capability material presented in the learning objects.

Furthermore, the Cohen's d effect size for each lesson were between $d = 0.18$ and $d = 0.56$. And cumulatively, the effect size for all six treatments was $d = 0.44$, which is a medium effect size (Gravetter & Wallnau, 2009). This supports the conclusion that while not statistically significant, the level of interactivity used in the learning objects did have a medium level effect on the time required for students to complete the lessons. And it indicates that it took the Perform group longer to complete the lessons than the Observe group. Full statistical results are included in Appendix M.

As stated above, there were 22 of the 63 students who failed to report at least one lesson time, thereby causing all their timing data to be discarded for the MANOVA procedure. This severely limited the power of the MANOVA calculation. Because of the medium effect size in the preceding analysis, and because missing reported times were distributed over all six lessons, follow-up analysis was conducted to determine if any significant results would become evident by examining all of the available data for each individual lesson.

Additionally, during this follow-up analysis, it was noted that there were several data points that could be considered outliers using the Tukey's hinge method. Specifically there was one outlier in the Observe group in lesson three, one outlier in the Observe group in lesson five and two outliers from the Observe group in lesson 6. These outliers were subsequently trimmed from the analysis and a trimmed t-test was conducted

for these lessons. Myers, Well, and Lorch (2010) stated that "when the tails of the distribution are longer than would be expected in a normal distribution, this test often will prove more powerful than the usual t-test". They also stated that "Type 1 and 2 error rates are little affected by trimming" (Myers, Well, & Lorch, 2010, p. 136). Table 8 below illustrates the descriptive statistics for these tests.

Table 8

Descriptive Statistics of Efficiency of Treatment (in minutes)

	Treatment	Mean	Std. Deviation	N
Lesson1	Observe	131.72	78.91	29
	Perform	170.38	107.01	26
Lesson2	Observe	115.38	59.56	26
	Perform	159.82	103.77	28
Lesson3	Observe	110.92	56.70	27
	Perform	152.86	90.56	28
Lesson4	Observe	101.15	60.47	26
	Perform	171.67	120.96	27
Lesson5	Observe	92.20	50.44	25
	Perform	144.04	80.36	26
Lesson6	Observe	137.78	84.22	27
	Perform	221.92	143.69	26

Note: Students self-reported their time in minutes to complete each lesson. So for example, on average, the Observe students were able to complete Lesson 1 in 131.72 minutes while it took on average 170.38 minutes for the Perform group.

These data were analyzed using independent samples t-tests for each of the six lessons. The following results were obtained (full statistical results are included in Appendix M).

Table 9

Results of Independent Samples T-Test of Efficiency of Treatment

	df	*t*	*p*	*Cohen's d*
Lesson1	55	1.53	0.13	0.41
Lesson2	52	1.91	0.06	0.53
Lesson3	53	2.05	0.045	0.56
Lesson4	51	2.67	0.01	0.74
Lesson5	49	2.77	0.01	0.77
Lesson6	51	2.59	0.01	0.71

The results showed that the difference in time to learn and apply the principles was statistically significant for four of the lessons, Lesson 3, $t(53) = 2.05$, p=0.045, Lesson 4, $t(51) = 2.67$, $p = 0.01$, Lesson 5, $t(49) = 2.77$, $p = 0.01$, Lesson 6, $t(51) = 2.59$, $p = 0.01$. The differences in the time required to learn and apply the principles for the other two lessons were not statistically significant. It was also noted that in all cases, it took more time for the Perform group to complete the exercises than the Observe group. Specifically, in this study, it took the Perform group students an average of 1020.69 minutes (17.01 hours) to complete the six lessons while it took the Observe group students an average of 689.15 minutes (11.49 hours) to complete the same six lessons. This translates to an extra 331.54 minutes (5.52 hours) longer for the Perform group to complete the six lessons than it took the Observe group of students. This significance will be discussed in Chapter 5.

Furthermore, the Cohen's d effect sizes for each lesson were between 0.41 and 0.77. And cumulatively, the Cohen's d effect size for all six treatments was $d = 0.62$, a medium effect size (Gravetter & Wallnau, 2009). This result supports the conclusion that the students who used the Perform level of interactivity tools, took longer to complete

their assignment than the students who used the Observe level of interactivity tools. Full statistical results are included in Appendix M.

Summary

The first three research questions were studied with the purpose to investigate whether different levels of interactivity influence different learner capabilities. Specifically, these questions attempted to determine whether there was a relationship between different levels of interactivity and the Remember, Apply, and Create learner capabilities as defined by Krathwohl (2002). Additionally, the fourth research question, attempted to investigate whether different levels of interactivity in online learning objects promote learning at different rates.

The results of the first three research questions showed that there were no statistically significant differences in students' learning capabilities between the Perform level interactivity and the Observe level interactivity modes of instruction. Additionally, the results for each of these experiments yielded small effect sizes. Therefore, the results indicated that higher levels of interactivity within an online learning object (which typically cost much more to develop) did not significantly increase student assessment scores across three levels of Krathwohl's learning taxonomy.

The result of the fourth research question showed that there was a significant difference in the rate in which students were able to learn and apply knowledge of web design and development between the two modes of instruction. And it was noted that it took more time for the Perform group to complete the exercises than the Observe group. The implications of this will be discussed in Chapter 5.

CHAPTER V

Conclusions

The purpose of this study was to investigate whether different levels of interactivity in online learning objects promote different learner capabilities. Specifically, this study attempted to determine whether there was a relationship between different levels of interactivity and the Remember, Apply, and Create learner capabilities as defined by Krathwohl (2002). Additionally, this study investigated whether different levels of interactivity promote learning at different rates.

A total of 63 students participated in this study from a freshman level Web Design and Development class taught at a large university in the Intermountain West. Students from all four undergraduate academic years were participants. Additionally, because the class was an online class and is part of an online degree program, the students involved with the study were older than traditional college age students (M = 29.91 years old) and a high proportion of these students were married (60.3% married).

Summary of Results

The first three research questions considered student learning relative to different levels of interactivity. Specifically, these questions attempted to determine whether there was a relationship between two different levels of interactivity (Perform level and Observe level) and the Remember, Apply, and Create learner capabilities as defined by Krathwohl (2002).

The first research question (Remember learning capability) considered students learning the basic factual concepts of HTML and CSS. The second research question (Apply learning capability) considered the students' ability to apply the basic principles

of web design and development. Lastly, the third research question (Create learning capability) considered the students' ability to create an original web site after learning and applying the basic principles of web design and development.

The results of the first three research questions showed that there were no statistically significant differences in students' learning capabilities between the Perform level interactivity and the Observe level interactivity modes of instruction. Additionally, the results for each of these experiments yielded very small effect sizes. Therefore, the results indicated that the Perform levels of interactivity within an online learning object (which typically cost much more to develop) had very little influence on student assessment scores across these three levels of Krathwohl's learning taxonomy.

The fourth research question considered the students' relative rates of learning and being able to apply the basic principles of web design and development. The question as stated was: Does the degree of interactivity in online learning objects influence the relative efficiency in student learning.

The MANOVA result of the fourth research question showed that there was also no significant difference in the rate in which students were able to learn and apply basic principles of web design and development between the two modes of instruction. Furthermore, the cumulative effect size for all six treatments was $d = 0.44$, which is between a small and a medium effect size. It was noted that in all cases, the Perform group took longer to complete the lessons than the Observe group.

Because the MANOVA calculation requires a complete data set and due to the relatively high number of students who failed to report at least one lesson time, follow-up analysis were conducted. Each lesson was investigated individually using independent

samples t-tests with the most complete data set available. This analysis raised the N from 41 for the MANOVA to between 53 and 56 for the individual t-tests. These analyses found that there was a statistically significant result for four of the lessons, Lessons 3, 4, 5, and 6. The analysis also indicated that the cumulative effect size for all six lessons was $d = 0.62$, a medium effect size.

Interpretation of Results

Even though there is a common perception in the research literature that student-content interactivity will increase both the motivation and the success of online education (Wagner, 1994; Scott, 2005; Lou, Bernard, & Abrami, 2006), the actual results of numerous studies are mixed as to their effectiveness on student learning. Some studies found no significant differences in student learning when using different levels of interactivity within online learning objects (Helfrich, 2011; Lowe, 2004; Kriz and Hegarty, 2007; Schwan and Riempp, 2004; Wang et al., 2011). In other studies, researchers did find significant differences in student learning when using different levels of interactivity (Boucheix & Schneider, 2009; Boucheix and Guignard, 2005; Moreno and Mayer, 2000; Patwardhan and Murthy, 2015). Additionally, at least one study found that while there were no learning differences between two interactivity groups, the higher interactivity learning group "proceeded in a far more efficient manner" than the lower interactivity learning group (Schwan and Riempp, 2004).

The results of this research were consistent with those previous studies where no significant differences in student learning were found when using different levels of interactivity. Specifically, the results of this study indicated that Perform levels of interactivity within an online learning object (which typically cost much more to develop)

had very little influence on student learning compared to Observe levels of interactivity. Additionally, the findings of this study were in contrast to that of Schwan and Riempp (2004) in that the lower level Observe interactivity group of students in this study were actually more efficient in learning and applying the lessons than the higher level Perform interactivity group. Specifically, in this study, it took the Perform group students an average of 1020.69 minutes (17.01 hours) to complete the six lessons while it took the Observe group students an average of 689.15 minutes (11.49 hours) to complete the same six lessons. This translates to an extra 331.54 minutes (5.52 hours) longer for the Perform group to complete the six lessons than it took the Observe group of students. Even though this research was not able to determine the underlying causes for these results, there are several possible explanations that may explain them.

First, it was possible that the Perform level lessons simply took longer to complete than the Observe level lessons. As detailed above, each Observe level lesson consisted of an instructional video with Watch and Pace level controls. The videos that were produced for these lessons ranged from 22 minutes to 43 minutes in length. In this study, there was no attempt made to determine the required time to complete the interactive portion of the Perform level lessons. Therefore, it was possible that the Perform level lessons required more time to complete. In this case, the finding of no significant differences in student learning between the groups would imply that instructional videos with Watch and Pace level controls are just as effective as highly interactive tools with Do, Use and Construct level controls in helping students learning the basics of HTML and CSS.

A second possible explanation for the extra time required of the Perform group was that the possibility of the Perform level interactivity exercises were more interesting to the students than the Observe level interactivity lessons and so students interacted longer with the Perform tools out of curiosity. The Codecademy tools are very interactive and allow a high degree of experimentation and exploration. These features may have motivated the students to voluntarily experiment and explore the constructs of HTML and CSS on their own; resulting in a longer time spent completing the lessons. If this was the case, the fact that there were no significant differences in student learning between the groups, would imply that the extra time the Perform group spent exploring may have just been more "fun" and "engaging" for them.

A third possible explanation for the extra time required of the Perform group and the non-significant differences in learning achievement, was the possibility that the assessments used in this research did not adequately measure the actual learning that occurred. It is possible that the Perform group students did acquire a deeper understanding of the material due to the extra time spent, but the assessments that were used did not reflect this deeper understanding. The assessments were developed to correspond with the specific learning outcomes of this class (i.e. learning and applying the basics of HTML and CSS and creating a simple web site from scratch). It is possible that more robust assessments would have been able to detect differences in learning due to the observed extra time spent by the Perform group. Related to this, is the possibility that the Perform group students did acquire a deeper understanding of the material and it would have been detectable had development time efficiency been measured on the Create assessment as well as the Apply assessments. For example, there was no attempt

made to determine how long it took students to create a new web site from scratch. It is possible that because of the extra time spent in the Apply lessons, that the Perform group students would have been able to accomplish this task more efficiently than the Observe group.

A fourth possible explanation for the differences in efficiency between the groups was cognitive overload. Lowe (2004) performed a study and observed that care needs to be taken when allowing interactivity within an animation to ensure that the content and the complexity of the learning object is suitable to the cognitive level of the learner. His study concluded that novice students can actually become cognitively overwhelmed when using higher levels of interactivity (Lowe, 2004). The students included in this study were pre-screened to ensure they were novices in HTML and CSS, and because the Codecademy tools are very interactive and allow a high degree of experimentation and exploration, these features may have cognitively overwhelmed these students. If this was the case, the fact that there were no significant differences in student learning between the groups would imply that the extra time spent was necessary to overcome the cognitive overload of the tool.

Related to cognitive overload is the possibility that the Codecademy tools do not appropriately scaffold novice students' knowledge acquisition. Wood, Bruner, and Ross (1976) stated that "scaffolding consists essentially of the adult 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence". Because the students included in this study were novices in HTML and CSS, if the Codecademy tools did not appropriately scaffold students' knowledge

acquisition, then the Perform group students needed to spend extra time constructing their fundamental knowledge and skills.

According to the Cognitive Theory of Multimedia Learning, Mayer (2009) observes that there is a dual-coding effect when students are presented with both auditory and visual information. This dual-coding effect enhances the learning capability of the students. The learning objects for the Perform group presented only visual information, while the learning objects for the Observe group were given a multimedia environment with both audio and visual information were presented. It is possible that this effect enabled a more efficient learning environment for the Observe students.

And lastly there is a possibility that different levels of interactivity are more appropriate for learners with different cognitive levels. It is possible that there is a relationship between the level of interactivity in learning objects and the knowledge and experience of the learners. One interpretation of the findings of this study is that novice students learn more efficiently using lower level interactivity learning objects (i.e. direct instructional strategies), while students with more advanced knowledge and experience could learn more efficiently, and possibly deeper, using higher level interactivity learning objects.

Implications for Practitioners

The first implication of this research is that the level of student-content interactivity provided in an online learning environment may not have any statistically significant effect on student achievement. This finding contrasts the common perception that higher levels of student-content interactivity increases both the motivation and the success of online education (Wagner, 1994; Scott, 2005; Lou, Bernard, & Abrami, 2006).

This research indicated that there were no significant differences in learning between the Observe and Perform levels of interactivity in the Remember, Apply and Create learning capabilities as defined by Krathwohl (2002).

A related implication of this research is that because higher level interactivity features generally take more time and effort to develop, practitioners can use lower levels of interactivity without adversely affecting student learning. And because this research showed that the effect sizes for the first three research questions were very low, the time and effort required to develop higher level interactivity features could be spent on improving other aspects of the lesson material with higher effect sizes.

A third implication of this research is that care should be taken when practitioners are considering using high levels of student-content interactivity in online learning objects. As defined by Helfrich and Moulton (2009), this research showed that providing Do, Use and Construct levels of interactivity actually reduced the efficiency of student learning. The findings of this study were in contrast previous studies where higher levels of interactivity had a positive effect on student learning (Boucheix & Schneider, 2009; Boucheix and Guignard, 2005; Moreno and Mayer, 2000; Patwardhan and Murthy, 2015). And this also contrasts a study showing higher level interactivity leading to a more efficient learning environment (Schwan and Riempp, 2004). Therefore, practitioners should exercise good judgement and only use higher levels of interactivity where there is a direct benefit to the students.

A fourth implication of this research is specific to the discipline of web design and development. There are many web design and development training resources freely available on the web. The Perform level interactivity tool used in this research is freely

available on the web at www.codecademy.com. Additionally, there are numerous Observe level interactivity tools (i.e. instructional videos) on web design and development on www.youtube.com. Because of the general high quality and the ubiquitous access to these tools, instructors of web design and development need to understand that students will use all resources available to them – even resources that may be misleading to the specific learning objectives being taught. This implication became evident during the course of this experiment. In this research, there was anecdotal evidence that showed at least one student in the Observe group used both the instructional videos as well as the codecademy lessons to do their homework. This anecdotal evidence manifested itself on a discussion board within the course LMS and may have had a limiting effect due to diffusion of treatment effects. A transcript of the student exchange is detailed in Appendix N.

Recommendations for Future Research

There are several areas for possible future research related to this study. These include studying different levels of interactivity, interactivity and student motivation, long term retention of knowledge and skills based on different levels of interactivity, interactivity in different class modalities (i.e. face-to-face and hybrid courses), efficiency of different learning capabilities, the effect of interactivity on different student populations, and the effect of interactivity with different experience levels of students.

Different Levels of Interactivity. This study was not a complete analysis of the effects of all levels of interactivity. This study only measured learning gains using features from two of the three broad categories of interactivity: Observe level and Perform level. There was no attempt to use features from the Choose level interactivity

category. Additionally, the Observe level interactivity consisted of Watch and Pace level features and the Perform level interactivity consisted of Do, Use and Construct level features. There was no attempt to isolate potential effects of these individual levels of interactivity. Future research could measure the effects of the Choose category interactive features as well as measure the effects of different levels of features within each interactivity category.

Interactivity and Student Motivation. Salajan et al (2009) reported that students perceived higher levels of interactive learning objects as superior to lower level interactive learning objects. This might indicate that students would be motivated to spend more time in learning from the higher interactive learning objects than lower interactivity learning objects. This study did not measure students' interactivity level preferences nor did it measure students' overall perceptions of the learning objects. However, the time spent doing the Apply exercises was measured and that could be an indicator of motivation. Future research could measure these factors and possibly determine if there is a relationship between them.

Long Term Retention of Knowledge and Skills. While the Observe group and the Perform group both developed web pages, the Perform level group spent extra time in the development process. Due to the higher interactivity tool, the Perform group developed web pages as part of the instruction and the assessments, while the Observe group only developed web pages as part of the assessments. Because of the extra practice, it is conceivable that the Perform group would exhibit a longer-term retention of the knowledge and skills gained than the Observe group would. Future research could measure these effects.

Effect of Interactivity in different class modalities. The course where this experiment was conducted was an asynchronous online class. In face-to-face and hybrid courses students have an opportunity to receive synchronous (i.e. real-time) feedback on their questions and concerns. This synchronous feedback has the potential to affect the efficiency in which students learn new concepts and skills. No attempt was made to measure the effects of student-content interactivity in face-to-face or hybrid courses. Future research could attempt to measure these effects.

Efficiency of Different Learning Capabilities. This study only measured the efficiency of student learning while the students were doing each of the six Apply lessons. It is conceivable that because of the extra practice the Perform students experienced in this study, that they would have been more efficient as they created their final class project. In this study, there was no attempt to measure the relative efficiency of the students as they accomplished their final project. Future research could attempt to measure this potential difference.

Interactivity with Different Student Populations. The students in this study had an average age of 30.01 years, which is significantly older than traditional college age students. Additionally, almost 61% of the students were married. This suggests that this student population may have greater maturity and life experiences than traditional college students. It is conceivable that younger, digital-native students' experience and expectations for more sophisticated learning objects, would influence the outcomes of similar research. Future research could attempt to replicate the results of this experiment with different student populations.

Interactivity with Different Cognitive Levels of Students. Lowe (2004) observed that care needs to be taken when allowing interactivity within an animation to ensure that the content and the complexity of the learning object is suitable to the cognitive level of the learner. Specifically, he stated, "It seems that it is not sufficient to offer learners who are novices in a domain an accurate, comprehensive dynamic depiction of a dynamic referent situation and expect them to be able to interrogate it productively on their own" (Lowe, 2004). Since the students in this study were exclusively novice students with respect to HTML and CSS, it is conceivable that students with a little more experience in HTML and CSS would have reacted differently to the level of interactivity provided than these novice students. Future research could attempt to determine what levels of interactivity are more appropriate for different student populations.

Summary

The purpose of this study was to investigate whether there was an effect between different levels of student-content interactivity and three levels of learner capabilities. Additionally, this study investigated whether different levels of interactivity promote learning at different rates.

This study determined that there were no statistically significant differences in students' learning capabilities between the Perform level interactivity and the Observe level interactivity modes of instruction. Additionally, the results for each of these experiments yielded very small effect sizes. Therefore, the results indicated that higher levels of interactivity within an online learning object (which typically cost much more to

develop) had very little influence on student assessment scores across the Remember, Apply, and Create levels of Krathwohl's learning taxonomy.

This study did determine that there was a statistically significant difference in the rate in which students were able to learn and apply the basic principles of web design and development between the Perform and the Observe modes of instruction. The results of this study indicated that it took the Perform group students an average of 1020.69 minutes (17.01 hours) to complete the six lessons while it took the Observe group students an average of 689.15 minutes (11.49 hours) to complete the same six lessons. This translates to an extra 331.54 minutes (5.52 hours) longer for the Perform group to complete the six lessons than it took the Observe group of students.

The main implications of this research are that care should be taken by practitioners when they are considering using high levels of student-content interactivity in online learning objects. The findings of this study showed that the level of interactivity did not have any significant effect on student learning in the Remember, Apply and Create learning capabilities as defined by Krathwohl (2002). And because higher level interactivity features generally take more time and effort to develop, practitioners can use lower levels of interactivity without adversely affecting student learning. Additionally, and maybe even more importantly, this research showed that providing Do, Use and Construct levels of interactivity actually can reduce the efficiency (as measured by time to complete the lessons) of student learning. Therefore, practitioners should exercise good judgement and only use higher levels of interactivity where there is a direct benefit to the students.

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APPENDIX A

HTML Basics Video Instruction Storyboard

"HTML Basics" Video Instruction Storyboard

Module #1: HTML Basics Video

Objectives:

1. Understand the basic structure of an HTML document including the HEAD and BODY sections
2. Understand the basic operation of HTML tags
3. Understand the paragraph, heading and title tags
4. Understand how to include images in an HTML document
5. Understand how to create hyperlinks within an HTML document

Audio Narration	Video Animation
Every webpage you look at is written in a language called HTML. You can think of HTML as the skeleton that gives every webpage structure. In this lesson, we'll use HTML to add paragraphs, headings, images and links to a webpage. HTML stands for **HyperText Markup Language**. **Hypertext** means "text with links in it." Any time you click on a word that brings you to a new webpage, you've clicked on hypertext! A **markup language** is a programming language used to make text do more than just sit on a page: it can turn text into images, links, tables, lists, and much more. HTML is the markup language we'll be learning. What makes webpages pretty? That's CSS—**Cascading Style Sheets**. Think of it like skin and makeup that covers the bones of HTML. We'll learn HTML first, then worry about CSS in later courses.	<!DOCTYPE html> <html> Hello world this is Bro Karl </html>

The first thing we should do is set up the skeleton of the page. a. Always put <!DOCTYPE html> on the first line. This tells the browser what language it's reading (in this case, HTML). b. Always put <html> on the next line. This starts the HTML document. c. Always put </html> on the last line. This ends the HTML document.	

Audio Narration	**Video Animation**
To learn more HTML, we should learn how to talk about HTML. Already you have seen we use <>s a lot. Things inside <>s are called **tags**. Tags nearly always come in pairs: an opening tag and a closing tag. Example of opening tag: <html> Example of closing tag: </html> You can think of tags as being like parentheses: whenever you open one, you should close it. Tags also **nest**, so you should close them in the right order: the most recently opened tag should be the first one closed, like in the example below. The last exercise taught us how to set up our HTML file. Everything we do now will go between <html> and</html>.	<first tag> <second tag> Some Text </second tag> </first tag>

Audio Narration	Video Animation
Everything in our HTML file will go between the opening <html> and closing </html> tags. There are always two parts to the file: the head and body. Let's focus on the head. a. It has an opening and a closing tag. b. The head includes important information about the webpage, such as its title. c. The title is the words we see in the tab (for example, the title of this page is "Introduction to HTML").	<!DOCTYPE html> <html> <head> <title> Bad to the Bonez Webpage </title> </head> </html>

Audio Narration	Video Animation
We have set up a lot of the basic things for your HTML file for you. We have learned about opening and closing tags. When we put content between the tags, the entire bit is called an **element**. Notice we have both title tags now, but we need <body> tags. The content in the body is what will be visible on the actual page. The body goes inside the html tags, but not inside the head tags, like this:	<!DOCTYPE html> <html> <head> <title> My First Web Page </title> </head> <body> This is one paragraph This is another paragraph </body> </html>

Audio Narration	Video Animation
We're definitely making good progress! We've learned when and why we use HTML. We've also learned how to: a. Set up an HTML file with tags b. Title the webpage (in the <head>)	<!DOCTYPE html> <html> <head> <title> Headings & Paragraphs </title> </head> <body>

c. Create paragraphs (in the <body>with tags) The next step is to give our paragraphs headings using **heading tags**. Let's start with the<h1> tag. The content between this tag will be the biggest!	This is my first heading This is my first paragraph This is my 2nd paragraph </body> </html>

Audio Narration	**Video Animation**
HTML actually lets us have more than one heading size. There are six heading sizes, where <h1> is the boss and <h6> is puny! <h1> - The CEO <h2> - VP <h3> - Director <h4> - Middle management <h5> - Lowly assistant <h6> - Gets coffee for everyone Below we'll ask you to add headings of various sizes. Feel free to write whatever you like for the headings!	<!DOCTYPE html> <html> <head> <title> Headings & Paragraphs </title> </head> <body> This is my first heading This is my first paragraph Heading 3 This is my second paragraph Heading 5 This is my third paragraph </body> </html>

Audio Narration	**Video Animation**
Given that there are six heading sizes altogether, we should make use of all six.	<!DOCTYPE html> <html> <head> <title> Headings & Paragraphs </title> </head> <body> This is my first heading This is my first paragraph Heading 3 This is my second paragraph

	Heading 5 This is my third paragraph Heading 2 4th paragraph Heading 4 5th paragraph heading 6 6th paragraph </body> </html>

Audio Narration	Video Animation
You've done an awesome job! Here's a quick summary of things we've learned: 1 - HTML is used to give websites structure. 2 - We open HTML files using a browser, and the browser **renders** (shows us) the file. 3 - HTML files have a <head> and a<body> (just like you!) 4 - In the head, we have the <title>tags, and we use these to specify the webpage's name. 5 – In the body, we can now make headings and paragraphs.	<!DOCTYPE html> <html> <head> <title>My First Web Page</title> </head> <body> Heading 3 Para 1 Para 2 Para 3 </body> </html>

Audio Narration	Video Animation
You can add images to your websites to make them look fancy. We use an image tag, like so: <img>. This tag is a bit different from the others. Instead of putting the content between the tags, you tell the	<!DOCTYPE html> <html> <head> <title></title> </head> <body> </body> </html>

tag where to get the picture using src. It's also different because there is no ending tag. It has / in the tag to close it: . Check out the tag to the right—it adds a picture of a rubber duck to the page! (You can see it by clicking on the Preview button.) See the web address (or **URL**) aftersrc=? It's"http://s3.amazonaws.com/codecademy-blog/assets/f3a16fb6.jpg". That tells the <img> tag where to get the picture from! Every image on the web has its own image URL. Simply right-click on an image and choose "Copy image URL." Paste that URL in quotes aftersrc= to insert with your <img> tag.	

Audio Narration	**Video Animation**
Good work! Now you know how to add images to your website. But what if you want to click on that image to lead you somewhere else? The <a> tag is the one used to make **hyperlinks** (or just **links**) on webpages. These are the	<!DOCTYPE html> <html> <head> <title></title> </head> <body> </body>

words or images you click to go to a new page! Just like <img>, <a> has an **attribute** that tells the link where to go. Instead of src, <a> uses href, like so: src stands for "source." It tells the <img> link where the picture comes from! href stands for "hypertext reference." Remember when we said that hypertext (that is, links) is text you can click on? Well, hreftells that link where to go! The text after href is the web address, and the text between <a> and is the text you click on.	</html>

Audio Narration	Video Animation
Good work! Let's make sure you really understand images and links before we move on to the review.	<!DOCTYPE html> <html> <head> <title></title> </head> <body> LDS </body> </html>

Audio Narration	Video Animation
Well done! You now know the basics of creating a web page.	<!DOCTYPE html> <html> <head> <title></title> </head> <body> LDS </body> </html>

APPENDIX B

HTML Basics II Video Instruction Storyboard

"HTML Basics II" Video Instruction Storyboard

Module #2: HTML Basics II Video

Objectives:

1. Understand the basic structure of an ordered list in HTML
2. Understand the basic structure of an unordered list in HTML
3. Understand the basics of styling fonts including size, color and family
4. Understand the basics of other styling features including background color, text alignment, and emphasis tags

Audio Narration	Video Animation
Let's continue learning more HTML. You've already covered a lot: how to set up <head> and <body> tags, how to make headings and paragraphs, and how to add images and links. In this course, we'll take it to the next level: a. Making ordered and unordered lists b. Changing font size, color and type c. Changing the background color d. Aligning the text	<!DOCTYPE html> <html> <head> <title> My first web page </title> </head> <body> My first paragraph </body> </html>
Now is a good time to quickly mention **indentation**—that is, the amount each line is spaced in from the margin. You'll notice that when we place tags inside of other tags, we indent them more. This really helps make your code more readable! Check out our indentation in the editor to the right. Try to follow this indentation style when you're writing HTML so you don't get confused.	<!DOCTYPE html> <html> <head> <title></title> </head> <body> </body> </html>

Good! Now let's learn how to make **ordered lists**. An ordered list is simply a list that is numbered, like the one below. On line 8, we begin the ordered list with the opening tag . On lines 9 – 11, we **wrap** (*i.e.*surround) each individual item with and tags. Because each listed item is only on one line, we put the entire **element** on one line. On line 12, we finish the ordered list with the closing tag . How cool is this? We can now add ordered lists to headings and paragraphs as things we can use in our HTML body.	<!DOCTYPE html> <html> <head> <title>Lists</title> </head> <body> List of my favorite things - raindrops on roses - whiskas on kittens - call of duty: modern warfare List of things I find OK - Puppies - Kids - Pizza </body> </html>
We really think that ordered lists are excellent. Who doesn't love a bit of order? So let's do a bit more practice. If you forget what an ordered list looks like, feel free to look back at the previous section!	<!DOCTYPE html> <html> <head> <title>Title</title> </head> <body> Most Annoying TV Celebrities - Kardashians - Kardashians - Kardashians Top 3 things I can do for Mothers Day - Wash Dishes - Clean house - Give flowers </body>

	</html>
We just learned how to make ordered lists, but what if the order doesn't matter, what if we just want bullet points? First, we open our list with an unordered list tag For each item we wish to add to the list, we use a list item tag with text in between We then tell the browser we are done with our list by calling our closing tag	<!DOCTYPE html> <html> <head> <title>Unordered Lists</title> </head> <body> Some random thoughts this is a paragraph - random1 - random2 - random3 - random4 </body> </html>
So you've made ordered lists and unordered lists. Top work! What if you have an ordered list, but each item in the ordered list also has an unordered list nested in it? Nested simply means 'inside' the list. The editor has a small example of this. Hit save & submit to see what the result looks like! Remember: you've been nesting tags already. When you nest tags, the last tag you open is the first one you close.	<!DOCTYPE html> <html> <head> <title>Nested lists</title> </head> <body> - Dad's interests - football - knitting - Mom's interests - hating football - skydiving - Favorite Boys Names - Eric - Eric

	- Eric - Favorite Girls Names - Eric - Eric - Eric </body> </html>
We have covered a lot about lists. Let's change gears and do some styling. If you recall, HTML is the skeleton of the webpage, and CSS lets you give the skeleton some skin and makeup. But it is possible to do some **inline CSS**. This simply means we can do some styling in our HTML file without worrying about a separate CSS file! We'll learn this first because it will make learning CSS a lot easier later. Before we dive into fonts, it's important to learn about making comments. You can include little notes in your HTML code that the browser won't display. But it will be in the code to help you remember why you did certain things.	<!-- Make me into a comment. --> But leave me visible to the user! <!-- comment -->
Recall that and are opening and closing **tags**. We can give tags more instructions by including **attributes** in the opening tag. An attribute is simply a characteristic or some description for the content in the element.	<!DOCTYPE html> <html> <head> <title>First font size change</title> </head> <body> Some text for you to make tiny!

You saw this with src in <img> and hrefin <a>. Let's change the size of the text. How? We use the **style** attribute. We make it equal to font-size, followed by a colon, the size you want, and end it with px (short for "pixels").	 Some text for you to make normal size! Some text for you to make super big! </body> </html>

Font color
What is awesome about the **style** attribute is that we use it a lot! And we can use it with many different tags, not just <p>. Let's now change the colors of our text in a heading.
 	
To change the color of text, simply add the style attribute in the opening tag, then make the style equal to "color:blue" (or whatever color you like). For example:
 	
`<h2 style="color:red">`
What if you want to change the color *and* the size of the text? Simple! Just add a semi-colon between each bit. For example:
 	
`<h2 style="color: green; font-size:12px">`
A full list of available colors can be found here.
 	
Note: *do not* type something like:
 	
`<h2 <h2 style="color: green; font-size:12px">`
If you incorrectly nest your HTML tags like that, your code **will not pass**.
	<!DOCTYPE html>
	<html>
	<head>
	<title>Changing the colors!</title>
	</head>
	<body>
	 Big Heading
	 A giant bear and a little duck were friends.
	 But the bear got hungry and ate the duck.
	</body>
	</html>

Font family We've covered font colors and font sizes. But we want more power! We want to decide	<!DOCTYPE html> <html> <head> <title>Loving the font changes</title> </head>

what font type to use. We can do this using font-family, like this:
 	
`<h1 style="font-family: Arial">Title</h1>`
 	
First we wrote <h1>Big title</h1>
 	
Then inside the opening <h1>tag, we added a style attribute, and set it equal to "font-family: Arial".
 	
This styles the <h1> tag with Arial font.
 	
We can do the same for other tags. So we could have a li:
 	
`<li style="font-family: Arial">Hello!</li>`
	<body>
	 Big title
	
	 - This item is big Garamond.
	 - This item is medium Verdana.
	 - This item is small Impact.
	
	</body>
	</html>

Recap Awesome job! You've now got control of your webpage, including the color, size and type of your font. To recap, we use the style attribute in the opening tag, like so: a. font-size: 14px b. color: orange c. font-family: Bodoni `<p style = "font-size:14px; color: orange; font-family: Bodoni">` It's important to know that you can use the style attribute for paragraphs, headings, and even links!	<!DOCTYPE html> <html> <head> <title>Putting it all together</title> </head> <body> A truly spectacular paragraph! </body> </html>
Background color The previous section covered a number of nice tricks to control how the text looks. Now we want to learn about how to change the color of the webpage's background.	<!DOCTYPE html> <html> <head> <title>Sexy background color!</title> </head> <body style="background-color: brown"> Favorite Football Teams

We can use the style attribute again, and set it equal to"background-color: red" (or whatever color you want). For example, here's how to change the background color of a tag to red: `<p style="background-color: red;">Hello!`	 - The Hawthorn Football Club - San Franscisco 49ers - Barcelona FC </body> </html>
Aligning the text Often it is nice to be able to move the text around. To do so, we again use the **style** attribute. And then we use "text-align:left" (or right, or center) to determine the location of the text. `<h1 style="text-align:center">`	<!DOCTYPE html> <html> <head> <title>Sexy background color!</title> </head> <body> Favorite Football Teams - The Hawthorn Football Club - San Franscisco 49ers - Barcelona FC </body> </html>
Strong words! We can change the appearance of words. What if we want to make them **bold**? Surprise! We don't have to use the style attribute. Here are the steps: Identify the word or words you want to **bold**. Surround those words with opening tag and closing tag . Celebrate how awesome you are at HTML!	<!DOCTYPE html> <html> <head> <title>Viva La Revolution!</title> </head> <body> Do you hear the people sing? No I don't. I'm too busy eating cake. </body> </html>
Emphasize words!	<!DOCTYPE html>

Aside from bolding words, we often want to *italicize* words for **em**phasis. (Hint, hint.) Like bolding, we do not need to use the style attribute. Instead: Identify the word or words you want to italicize. Surround the word or words with the opening tag and closing tag . Be humble and grateful for your newfound powers.	<html> <head> <title>Some nice practice</title> </head> <body> Hey, don't say that! I am so tired. </body> </html>
Summary This has been an incredibly busy lesson, and you've covered a lot. Congratulations! We have learned how to: Make ordered and unordered lists Change the color, size and type of font Add comments to our HTML file Change the page's background color Align text Bold and italicize text	<!DOCTYPE html> <html> <head> <title></title> </head> <body></body> </html>

APPENDIX C

HTML Basics III Video Instruction Storyboard

"HTML Basics III" Video Instruction Storyboard

Module #3: HTML Basics III Video

Objectives:

1. Understand the basic structure of HTML Tables
2. Understand the basic structure of both rows and columns of HTML Tables
3. Understand the basics of HTML Table Headers
4. Understand the basics of styling HTML Tables
5. Understand the basics DIV and SPAN tags

Audio Narration	Video Animation
Introduction Our HTML journey has been progressing very nicely. We've covered: how to set up the skeleton of an HTML file headings, paragraphs, images and links font colors, sizes, and types background colors, aligning text,**bold**ing and *italic* izing font In this course, we'll cover some important structural aspects of HTML: <table>s, s, ands!	<!DOCTYPE html> <html> <head> <title>Table Time</title> </head> <body style="font-family:Garamond; color:red"> Tables Are Mega Sweet <img src="http://web.byui.edu/Directory/Employee/karle.jpg"> </body> </html>
What are tables? Tables are very useful. We use them to store tabular data so it is easy to read! When you want to present information neatly in a table with rows and columns—you guessed it—the <table> tag is what you need. There are many tags associated with tables, but it all starts with the<table> tag, so let's add that first.	<html> <head> <title>Table Time</title> </head> <body> <table></table> </body> </html>

Rows of information A table is just a bunch of information arranged in rows and columns. We use the <tr> tag to create a **table row**. We'll learn how to create columns shortly, and everything will start to come together. (You don't really create columns in <table>s: instead, you tell each row how many cells to have, and that determines your number of columns).	<html> <head> <title>Table Time</title> </head> <body> <table> <tr></tr> <!-- Add two more rows below this! --> > <tr></tr> <tr></tr> </table> </body> </html>
A single column Look at the HTML now. Can you tell that there are still three rows? We've added a little more whitespace to make it easier to deal with **table columns** and **table data**. We've added a single <td> ("table data") cell to the first row, essentially creating a single column. If you view the Result tab now, you'll see that we've drawn a border around it. it's not that impressive, but don't worry: we're about to add more table data cells. We're starting to add a lot of HTML elements now. Make sure to indent your tags as you nest them so you don't get confused!	<html> <head> <title>Table Time</title> </head> <body> <table border="1px"> <tr> <td>One</td> </tr> <tr> <td>Two</td> </tr> <tr> <td>Three</td> </tr> </table> </body> </html>
Adding a second column	<html> <head>

It may not have seemed like much, but you just created a single-column table in the last exercise. Nice work! Now take a look at what we have on our page. Notice in the first table row we now have *two* table data cells. Adding a second table data cell has the effect of adding a second table column, although if you go to the Result view, it may look funny because only the first row has two cells. Let's fix that!	<title>Table Time</title> </head> <body> <table border="1px"> <tr> <td>King Kong</td> <td>1933</td> </tr> <tr> <td>Dracula</td> <td>1897</td> </tr> <tr> <td>Bride of Frankenstein</td> <td>1935</td> </tr> </table> </body> </html>
Head of the table Here's the table we made earlier. It's okay, but it just looks like we have a list of famous Hollywood people (monsters?) and their birth years. To make our table look a little more like a table, we'll use the<thead> and <tbody> tags. These go within the <table> tag and stand for **t**able head and **t**able body, respectively. The <head> HTML tag contains information about a web page (*e.g.*its title) and the <body> tag contains the contents of the web page. In the same way, the <thead> tag can be thought of as containing information about a table and the<tbody> tag containing the actual tabular data.	<html> <head> <title>Table Time</title> </head> <body> <table border="1px"> <tbody> <tr> <td>King Kong</td> <td>1933</td> </tr> <tr> <td>Dracula</td> <td>1897</td> </tr> <tr> <td>Bride of Frankenstein</td>

	<td>1935</td> </tr> </tbody> </table> </body> </html>
Table Heads We have just added a <thead> tag above the <tbody>. It will hold the heading for each column. You add text to a <thead> similar to a <tbody>, like this: <thead> <tr> <th> Name </th> <th> Favorite Color </th> </tr> </thead> First we have an opening <thead>tag for the table head. Then we have an opening <tr>tag for the row. (to start the row) After that, a <th></th> cell for the Name column heading. Notice that we use <th></th> for the table heading cells instead of<td></td>. Then another <th></th> cell for the Favorite Color column heading. Finally, we close the row element with a closing </tr> tag, and close out the table heading element with a closing </thead> tag.	<html> <head> <title>Table Time</title> </head> <body> <table border="1px"> <thead> <tr> <th>Famous Monster</th> <th>Birth Year</th> </tr> </thead> <tbody> <tr> <td>King Kong</td> <td>1933</td> </tr> <tr> <td>Dracula</td> <td>1897</td> </tr> <tr> <td>Bride of Frankenstein</td> <td>1935</td> </tr> </tbody> </table> </body> </html>
Naming your table	<html>

Our table is missing a title. We want to add a title row that goes all the way across the top.

To do so, we need to use the **colspan** attribute for the <th> tag. By default, table cells take up 1 column. If we want a table cell to take up the space of 3 columns instead of 1, we can set the colspan attribute to 3.

It looks like this:

```
<th colspan="3">3 columns across!</th>
```

```
    <head>
      <title>Table Time</title>
    </head>

    <body>

      <table border="1px">
        <thead>
          <tr>
            <th colspan="2">Famous
Monsters by Birth Year</th>
          </tr>
          <tr>
            <th>Famous Monster</th>
            <th>Birth Year</th>
          </tr>
        </thead>
        <tbody>
          <tr>
            <td>King Kong</td>
            <td>1933</td>
          </tr>

          <tr>
            <td>Dracula</td>
            <td>1897</td>
          </tr>

          <tr>
            <td>Bride of Frankenstein</td>
            <td>1935</td>
          </tr>
        </tbody>
      </table>

    </body>

</html>
```

Style that head!

Your table is starting to look great, but it's still a little bland. We've gone ahead and added some styling to the table to make it a bit easier to read. It's your job to add the finishing touches!

```
<html>
    <head>
      <title>Table Time</title>
    </head>

    <body>

      <table style="border-collapse:collapse;">
```

Feel free to play around with any of the style attributes we added; you'll learn much more about these things later during the CSS courses.

If you want to add more than one style, you just separate your styles with a semicolon, like so:

```
<th style="font-size:12px; color:red"><
```

```
        <thead>
          <tr>
            <th colspan="2" style="color:red">Famous Monsters by Birth Year</th>
          </tr>
          <tr style="border-bottom:1px solid black;">
            <th style="padding:5px;font-style:italic">Famous Monster</th>
            <th style="padding:5px;border-left:1px solid black;">Birth Year</th>
          </tr>
        </thead>
        <tbody>
          <tr>
            <td style="padding:5px;">King Kong</td>
            <td style="padding:5px;border-left:1px solid black;">1933</td>
          </tr>

          <tr>
            <td style="padding:5px;">Dracula</td>
            <td style="padding:5px;border-left:1px solid black;">1897</td>
          </tr>

          <tr>
            <td style="padding:5px;">Bride of Frankenstein</td>
            <td style="padding:5px;border-left:1px solid black;">1944</td>
          </tr>
        </tbody>
      </table>

  </body>

</html>
```

Recap

Woosh! We've learned quite a bit.

What can you do now?

```
<html>
  <head>
    <title>Table Time</title>
  </head>
```

Write an HTML comment Create a list (ordered and unordered) Make text stand out using and Change the color, size, and alignment of text using the style attribute Create HTML tables	<body> <table style="border-collapse:collapse;"> <thead> <tr> <th colspan="2" style="color:red">Famous Monsters by Birth Year</th> </tr> <tr style="border-bottom:1px solid black;"> <th style="padding:5px;font-style:italic">Famous Monster</th> <th style="padding:5px;border-left:1px solid black;">Birth Year</th> </tr> </thead> <tbody> <tr> <td style="padding:5px;">King Kong</td> <td style="padding:5px;border-left:1px solid black;">1933</td> </tr> <tr> <td style="padding:5px;">Dracula</td> <td style="padding:5px;border-left:1px solid black;">1897</td> </tr> <tr> <td style="padding:5px;">Bride of Frankenstein</td> <td style="padding:5px;border-left:1px solid black;">1944</td> </tr> </tbody> </table> </body> </html>
'**Div'ide and conquer**	<!DOCTYPE html> <html>

One of the most versatile structure tags available to you is the tag. Short for "division," allows you to divide your page into containers (that is, different pieces). This will come in handy when you begin learning CSS in the next unit: you'll be able to style different parts of your website individually! Check out the Result tab. You should see three blocks: one red, one blue, and one green. Each one is its own container.	<head> <title>Result</title> </head> <body> </body> </html>
Link it! Nice work! As you can probably guess, the smart use of s will eventually allow you to create visual HTML objects like sidebars, menus, and more. Just like with images, you can make s clickable by wrapping them in <a> tags.	<!DOCTYPE html> <html> <head> <title>Result</title> </head> <body> </body> </html>
Spantastic While allows you to divide your webpage up into pieces you can style individually, allows you to control styling for smaller parts of your page, such as text. For example, if you always want the first word of your paragraphs to be red, you can wrap each first word in tags and make them red using CSS!	<!DOCTYPE html> <html> <head> <title></title> </head> <body> This text is black, except for the word red! </body> </html>

Span is the man Great! You're really getting the hang of this. These tags can be a little tricky, though, so let's go through one more example. Color is just one attribute you can selectively change with tags; you can also change font size, font family, and any other style attribute you can think of!	<!DOCTYPE html> <html> <head> <title>Result</title> </head> <body> My favorite font is Futura! </body> </html>
Recap Great work! In addition to what you've already learned, you now know how to: Divide up your webpage for easy styling with tags Select pieces of text and change their properties using tags In the next course, we'll see how we can take much of the styling we've been doing—such as controlling font family, font color, and text alignment—and put it in its own separate file. By doing that, we can use tags like and to impart style to our pages without writing style="color:red" every single time!	<!DOCTYPE html> <html> <head> <title>Ye Olde Fancye Booke</title> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> </head> <body> Ye Olde Storye A long time ago there was an intrepid young student who wanted to learn CSS... </body> </html>

APPENDIX D

CSS: An Overview Video Instruction Storyboard

"CSS: An Overview" Video Instruction Storyboard

Module #4: CSS: An Overview Video

Objectives:

1. Understand the basic use of CSS within HTML documents
2. Understand the basic structure of both inline as well as external style sheets
3. Understand the basic syntax of CSS attributes
4. Understand the basics of styling text data
5. Understand the basics of styling borders, links, and text decorations

Audio Narration	Video Animation
Seeing is believing Take a look at the HTML file inindex.html. Pretty standard, right? You know all this stuff: headers, paragraphs, images, lists, and tables. Click on the Result tab: no surprises there. (In fact, it's pretty ugly if you ask us.) The stylesheet.css tab (which we'll teach you how to use in this course) contains all the CSS styling information: where HTML elements should go, what color they should be, how big they should be, and more. We've commented out a crucial line in the index.html file. If you remove the comment (the <!-- in line 4before the text, and the --> in line 6 after the text), you'll be able to see the magic CSS imparts. Don't delete any of the actual <link> tag!	
What CSS is CSS (which stands for **C**ascading**S**tyle **S**heets) is a language used to describe the appearance and formatting of your HTML.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Fancy Fonts</title> </head>

A **style sheet** is a file that describes how an HTML file should look. That's it!
 	
We say these style sheets are**cascading** because the sheets can apply formatting when more than one style applies. For instance, if you say all paragraphs should have blue font, but you specifically single out one paragraph to have red font, CSS can do that! (We'll talk more about cascading in section four.)
	<body>
	 I'm a paragraph written in red font, but one of my words is blue!
	</body>
	</html>
	
	p {
	color: red;
	}
	
	span {
	color: blue;
	}

Why separate form from function?
Great work! Look at you. You're already writing CSS.
 	
There are two main reasons for separating your form/formatting (CSS) from your functional content/structure (HTML):
 	
You can apply the same formatting to several HTML elements without rewriting code (*e.g.* style="color:red":) over and over
 	
You can apply similar appearance and formatting to several HTML pages from a single CSS file
 	
Look at the HTML in index.html. That's a lot of tags! All those words are in regular font, but we want them to be super fancy.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Even Fancier Fonts</title>
	</head>
	<body>
	 Much of this is regular text, but some of it is fancy!
	We can use our newly fancified font to add some
	flair to our website. It'd be a royal pain
	to make each of these span tags fancy individually,
	but it's a cinch with CSS!
	</body>
	</html>
	
	span {
	font-family: cursive;
	}

If it's in, it's out!
We previously showed you how to do **inline styling** with HTML, like so:
 	
 Red font!
This is a less awesome way to style your website for the reasons we just mentioned:
	<!DOCTYPE html>
	<html>
	<head>
	<style>
	p {
	color: purple;
	}

you have to write the same code over and over, and if you want to make a big stylistic change to several elements, you have to change every single style tag. With a single CSS file, you only have to make the change in one place! There are two ways to put CSS in one place. This first is to put your CSS between <style></style> tags, right in the same file as your HTML. These <style> tags go inside the<head></head> of your webpage; check out the example in the editor to the right.	</style> <title>Result</title> </head> <body> Check it out! I'm purple! </body> </html>

Link it up!
But there's an even better way.
 	
You know you should write your CSS in a totally separate file. But how do you make sure your HTML file can see that CSS information?
 	
You do this by putting a <link> tag (as you saw in the first exercise of this course) between the <head>...</head> tags of your HTML page. Your <link> tag needs three attributes:
 	
A type attribute that should always be equal to "text/css"
 	
A rel attribute that should always be equal to "stylesheet"
 	
A href attribute that should point to the web address of your CSS file
	<!DOCTYPE html>
	<html>
	<head>
	<title>Result</title>
	<link type="text/css" rel="stylesheet" href="stylesheet.css">
	</head>
	<body>
	 I want to be SIZE 44 font!
	</body>
	</html>
	
	p {
	font-size: 44px;
	}

In the editor to the right, you'll see two files: index.html andstylesheet.css.	

PSA: Self-closing tags
This brings us to a quick (but noteworthy!) concept in HTML: the**self-closing tag**.
 	
Because nothing ever goes between<link></link> tags, it's okay to use a single set of <>s to be the opening*and* closing tags. You do that like so:
 	
`<link type="text/css" rel="stylesheet" href="CSS file address"/>`
You may have noticed us do something similar with the <img>tag:
 	
`<img src="web address"/>`
Most tags are not self-closing, but we'll point out the self-closing ones to help save you time and typing.
	<!DOCTYPE html>
	<html>
	<head>
	<title>Result</title>
	<link type="text/css" rel="stylesheet" href="stylesheet.css">
	</head>
	<body>
	 I want to be SIZE 44 font!
	</body>
	</html>

Syntax for the wintax
CSS syntax is different from the HTML you're used to, but don't worry: it's easy to pick up! The general format looks like this:
 	
`selector {`
`property: value;`
`}`
A **selector** can be any HTML element, such as , <img>, or<table>. You just take off the <>s! To make a paragraph's text red with CSS, you'd type:
 	
`p {`
`color: red;`
`}`
A **property** is an aspect of a selector. For instance, you can change the font-
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 You're about to style this paragraph with CSS all on your own!
	</body>
	</html>
	
	p {
	color: green;
	}

family, color, andfont-size of the text on your web pages (in addition to many more). A **value** is a possible setting for a property. color can be red, blue, black, or almost any color; font-family can be a whole bunch of different fonts; and so on. You need to end each property-value with a semi-colon (;). That's how CSS knows you're done with one pair and ready for the next.	

One selector, many properties
Great work!
 	
Another cool advantage of CSS is that you can set many properties for one selector. For instance, if you want to set a paragraph's font, font color, and font size, you can simply write:
 	
`p { font-family: Arial; color: blue; font-size: 24px; }`
 	
Remember: end each property-value pair with a semicolon!
 	
Please note: If you have adjusted your browser's zoom, tests involvingfont-size and height will not work correctly. To remedy this, please type Command+0 or Ctrl+0 to reset your view.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 You're about to style this paragraph with CSS all on your own!
	</body>
	</html>
	
	p {
	color: green;
	font-family: Garamond;
	font-size: 24px;
	}

Many selectors, many properties Good work! They say that practice makes perfect, so let's do a couple more. (We'll talk	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/>

even more about selectors in the next course.)	<title>I Know Kung Fu (er, CSS)</title>
	</head>
	<body>
	
	 What's CSS for?
	 CSS is for styling HTML pages!
	 Why use it?
	 It makes webpages look really rad.
	 What do I think of it?
	 It's awesome!
	
	</body>
	</html>
	
	/*You can do this! Write your CSS below.*/
	
	h3 {
	color: red;
	}
	
	p {
	font-family:Courier;
	}
	
	span {
	background-color: yellow;
	}

The importance of semicolons As you start adding more and more property-value pairs for each CSS selector, it's important to remember to put a semicolon (;) at the end of each line. The semicolon tells CSS that one property-value pair is over and it's time to move on to the next one. Without semicolons, it'll become confused and your page won't look right.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> Recent Projects I've started learning HTML and CSS. I hope to create my own website soon! </body> </html>

Also, don't forget: all property-value pairs for a selector are surrounded by curly braces ({}).	h3 {
	font-family: Verdana;
	color: blue;
	}
	
	p {
	font-family: Garamond;
	font-size: 16px;
	}

Color commentary
Great! You're really getting the hang of this.
 	
While it's important to get all your syntax down correctly, it's also a good idea to write **comments** as you go along. Good comments will help remind you why you did something a certain way (or will help someone else out if they're reading your code without you there to explain it).
 	
As you've seen, HTML comments look like this:
 	
<!--I'm a comment!-->
CSS comments, on the other hand, look like this:
 	
*/*I'm a comment!*/*
Remember: the computer doesn't look at comments when figuring out what your HTML and CSS should do, but writing good comments is a good habit you want to pick up!
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 I'm currently red, but I'm about to become black!
	</body>
	</html>
	
	/*
	p {
	color:red;
	}
	
	*/

Check yourself before you wreck yourself You've learned a lot in just a few short lessons. We're impressed! Let's quickly review to make sure you really know your stuff.	<!DOCTYPE html> <html> <head> <!--Add your link tag here!--> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head>

	<body>
	 Change me to Verdana.
	 Change me to Courier.
	 Make me purple!
	</body>
	</html>
	
	/* This is my commment */
	h1 {
	font-family: Verdana;
	}
	
	h3 {
	font-family: Courier;
	}
	
	p {
	color: purple;
	}

Hexawhatnow?
You've got the main ideas—now it's time to dive into the nitty-gritty.
 	
You've noticed that when we've asked you to set color properties using CSS, we've been having you type things like color:red. You may have asked yourself: what if I want maroon? Or fire engine red? Or more of a red-orange? Does CSS know all those words?
 	
The answer is no. It can, however, understand millions of colors in the form of **hexadecimal values**.
 	
You're already extremely familiar with **decimal** values: it's everyday counting! You know when you see a number (*e.g.* 1,432) that each digit can only be the ten values 0 through 9. Because there are
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 I'm maroon!
	 I'm coral!
	 I'm goldenrod!
	 I'm sea green!
	 I'm royal blue!
	 I'm plum!
	</body>
	</html>
	
	h1 {
	color: #8B1C62;
	}
	
	h2 {
	color: #FF7256;
	}

only ten possibilities, we say that regular counting is **base-10**.
 	
Hexadecimal counting is **base-16**. Each digit can be the numbers 0 through 9 **or the letters a through f**! Crazy, right? Check it out:
	h3 {
	color: #FFC125;
	}
	
	h4 {
	color: #54FF9F;
	}
	
	h5 {
	color: #530EE8;
	}
	
	h6 {
	color: #8B668B;
	}

Roses are red...
There are a lot of tools available on the Internet for looking up hexadecimal (or simply **hex**) color values.
 	
Search for "hex color palette" or "hex color picker" with your favorite web browser to find a bunch of options!
 	
Hex values always start with a pound sign (#), are up to six "digits" long, and are **case-insensitive**: that is, they don't care about capitalization. #FFC125 and #ffc125are the same color.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 Roses are red.
	 Violets are blue!
	</body>
	</html>
	
	h3 {
	/*Add your CSS hex color here!*/
	color: #cc6666;
	}
	
	h2 {
	/*Add your CSS hex color here!*/
	color: #8a2be2;
	}

Pixels and ems Great work! We'll do more with colors as you learn more CSS. When we've asked you to adjust font size, we've specified that the unit you should use is px (for "pixels"), like so:	<!DOCTYPE html> <html> <head> <title>Result</title> </head> <body> One em!

``
p {
  font-size: 10px;
}
``
A pixel is a dot on your computer screen. Specifying font sizes in pixels is great when you want the user to see exactly on their screen what you designed on yours, though it assumes your screens are of similar size.
 	
What if the user is using a screen that's a very different size from yours, though (like a smartphone screen)? Enter **em**s. (Don't confuse these with the tags we use for *emphasis*!)
 	
The font-size unit **em** is a **relative** measure: one em is equal to the default font size on whatever screen the user is using. That makes it great for smartphone screens, since it doesn't try to tell the smartphone *exactly* how big to make a font: it just says, "Hey, 1em is the font size that you normally use, so 2em is twice as big and 0.5em is half that size!"
 	
Check it out: we've set three different paragraphs to the font-sizes 1em, 0.5em, and 2em. For now, use whichever unit (px or em) you're more comfortable with—we just wanted to show you em now so you're not surprised when you see it later.
	Half an em!
	 TWO EM!
	</body>
	</html>

A font of knowledge We've also asked you to change the font-family of certain elements using CSS. You've seen us use the fonts Verdana, Courier, and Garamond. But how many fonts does CSS know?	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body>

The answer is: it depends. Most computers will understand popular fonts like Verdana, Courier, and Garamond, but each individual computer has different fonts installed on it. The good news is that CSS has some built-in defaults meant to ensure your users see what you intend. They are:
 	
serif: A font with little decorative bits on the ends of the strokes that make up letters. Do a search on "serif" to see what we mean.
 	
sans-serif: A plain-looking font, like this one. It doesn't have the little doohickies on the ends of letters like a serif font does.
 	
cursive: A scripty font! It looks like cursive writing.
 	
We'll show you how to import your own fonts in a later course! This will help make sure the person viewing your page has all the fonts you want them to have.
	I'm going to be a serif font when I grow up!
	 I'm going to be a sans-serif font.
	 I'm going to be in cursive!
	</body>
	</html>
	
	/*Add your CSS below!*/
	
	h1 {
	font-family: serif;
	}
	
	h2 {
	font-family: sans-serif;
	}
	
	h3 {
	font-family: cursive;
	}

Backup values You don't have to jump straight to a default value like cursive or sans-serif: you can tell CSS to try several, going from one to the next if the one you want isn't available. For example, if you write: `p { font-family: Tahoma, Verdana, sans-serif; }` CSS will first try to apply Tahoma to your paragraphs. If the user's computer doesn't have that font, it will try Verdana next, and if	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> I'm going to be a serif font when I grow up! I'm going to be a sans-serif font. I'm going to be in cursive! </body> </html> /*Add your CSS below!*/

that doesn't work, it will show a default sans-serif font.	h1 {
	  font-family: Times, serif;
	}
	
	h2 {
	  font-family: Verdana, sans-serif;
	}
	
	h3 {
	  font-family: Vivaldi, cursive;
	}

Review
Great work! You've learned a ton so far. Let's take a quick breather to review.
 	
We've covered:
 	
What CSS is
 	
Why we separate form from function
 	
CSS syntax, including (multiple) selectors, (multiple) property-value pairs, and comments
 	
Details of how colors, font sizes, and font families work
	<!DOCTYPE html>
	<html>
	  <head>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  <title>Free Play!</title>
	  </head>
	  <body>
	  <!--Go bananas!-->
	   this is a new paragraph
	  </body>
	</html>
	
	p {
	  font-family: Tahoma, Verdana, Times;
	  color: #aabbcc;
	  font-size: 2em;
	}

Background color, height, and width Remember our friend , and how we used it to make those multi-colored blocks? Time for you to build your own blocks! (Well, block. Let's not get ahead of ourselves.) There are three properties you'll need to set values for: background-color, which you set to a color or hex value height, which you set to a value in pixels	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> </body> </html> /*Add your CSS below!*/ div { background-color: #cc0000;

width, which is also measured in pixels These exercises will give you a brief overview of the different HTML elements you can select and what some of their property-value pairs are (like the new ones we mention above). We'll cover HTML element selection more in the next course!	height: 100px; width: 100px; }
Bordering on insanity Many HTML elements support the border property. This can be especially useful with tables. The border property in turn supports several values. For example, for a border 2 pixels thick, solid, and red, you'd type `selector { border: 2px solid red; }` Borders: pretty fancy.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title></title> </head> <body> <table> <thead> <th colspan="3">Nine Blocks!</th> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td>

	<td></td>
	</tr>
	</tbody>
	</table>
	</body>
	</html>
	
	/*Add your CSS below!*/
	td {
	height: 50px;
	border: 1px dashed blue;
	}
	
	table{
	border: 1px solid black;
	}

Links and text decoration
Links have a lot of the same properties as regular text: you can change their font, color, size, and so on.
 	
But links also have a property, text-decoration that you can change to give your links a little more custom flair. You're probably used to seeing links that are blue and underlined, right? Well, that's not the way it has to be!
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 The below link goes to Google!
	Google
	</body>
	</html>
	
	a{
	color: #cc0000;
	text-decoration: none;
	}

HTML + CSS = BFFs All right! Final section. Time for some review! You're learning a lot, so from here on out, we'll do more frequent reviews to make sure you've got a handle on all this new material.	<!DOCTYPE html> <html> <head> <title>Result</title> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> </head> <body></body> </html>

Many selectors, many properties
All right! Our HTML bone is connected to our CSS bone.
 	
Next: let's review selectors, properties, and values. Remember, the syntax is
 	
`selector {`
`  property: value;`
`}`
	<!DOCTYPE html>
	<html>
	  <head>
	  <title>Result</title>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  </head>
	  <body>
	    Header 1
	   this is my first paragraph
	  </body>
	</html>
	
	h1{
	  font-family: Verdana;
	  color: #576D94;
	}
	
	p{
	  font-size: 18px;
	  color: #4a4943;
	}

Fall back!
As we've seen, sometimes a user's computer doesn't have the mega sweet fonts we wish it had. For that reason, we give their browser a few fallback choices!
	<!DOCTYPE html>
	<html>
	  <head>
	  <title>Result</title>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  </head>
	  <body>
	    Header 1
	   this is my first paragraph
	  </body>
	</html>
	
	h1{
	  font-family: Verdana, sans-serif;
	  color: #576D94;
	}
	
	p{
	  font-size: 18px;
	  color: #4a4943;
	  font-family: Garamond, serif;
	}

Size and borders	<!DOCTYPE html>

Excellent! Your page is a little bland, though. Let's add a picture with a border.	<html>
	<head>
	<title>Result</title>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	</head>
	<body>
	  Header 1
	 this is my first paragraph
	<img src="http://bit.ly/NnVbxt">
	</body>
	</html>
	
	h1{
	font-family: Verdana, sans-serif;
	color: #576D94;
	}
	
	p{
	font-size: 18px;
	color: #4a4943;
	font-family: Garamond, serif;
	}
	
	img{
	height: 100px;
	width: 300px;
	border: 1px solid #4682b4;
	}

Links and text decoration Great work! We're almost there.	<!DOCTYPE html> <html> <head> <title>Result</title> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> </head> <body> Header 1 this is my first paragraph <img src="http://bit.ly/NnVbxt"> BYUI </body> </html> h1{ font-family: Verdana, sans-serif;

	color: #576D94;
	}
	
	p{
	font-size: 18px;
	color: #4a4943;
	font-family: Garamond, serif;
	}
	
	img{
	height: 100px;
	width: 300px;
	border: 1px solid #4682b4;
	}
	
	a{
	text-decoration: none;
	color: #cc0000;
	}

APPENDIX E

CSS Selectors Video Instruction Storyboard

“CSS Selectors” Video Instruction Storyboard

Module #5: CSS Selectors Video

Objectives:

1. Understand the basic use of CSS Selectors within HTML documents
2. Understand the basic use of CSS Classes
3. Understand the basic use of CSS ID’s

Audio Narration	Video Animation

All HTML elements are selectors
We've used a number of HTML elements as CSS selectors so far: we've styled the HTML tags   with the CSS selector h1, with p, and so on.
 	
You may have guessed this, but if not, we'll say it outright: *any* HTML element can be a CSS selector! You can modify   s, <table>s, and even the entire <body> by selecting ul, table, and body, respectively.
	<!DOCTYPE html>
	<html>
	  <head>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  <title></title>
	  </head>
	  <body></body>
	</html>
	
	body {
	  background-color: #C6E2FF;
	}

Multiple Selectors As you've seen, it's possible to nest HTML elements inside one another, like so: `<div> <div> <p>I like tacos!</p>` So what if you want to grab s that are inside two s, and not *all* s? You select those in the CSS tab like this: `div div p { /*CSS stuff!*/ }`	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> I'm plain old font! Me, too! Me three! Forget you guys. I'm about to be red!

	</body>
	</html>
	
	div div div h3{
	color: red;
	}

One selector to rule them all
There's also a very special selector you can use to apply CSS styling to *every element* on the page: the *selector. For example, if you type
 	
* {
border: 2px solid black;
}
You'll create a two-pixel wide solid black border around *every* element on the HTML page.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 Boxes within boxes!
	
	 Paragraph One
	
	 Paragraph Two
	
	 Paragraph Three
	
	</body>
	</html>
	
	* {
	border: 1px dashed blue;
	}

Rock Your Selectors Great work! Selectors can be a bit tricky, but the more you use them, the more comfortable you'll become.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Strut Your Stuff!</title> </head> <body> I'm about to become a lovely shade of teal. Me, too! I think I'll do the same.

	We're going to become a truly striking scarlet!
	 I was thinking more vermillion.
	 No, crimson!
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	p {
	color: #00E5EE;
	}
	
	div p {
	color: #CC0000;
	}
	
	* {
	border: 1px solid #3A5FCD;
	}

Branching You can think of an HTML document as a tree: elements "branch out" from the main trunk (the <html></html> tags). The first two big branches are <head> and <body>, and branches multiply and become finer as you get to elements like s, <table>s, and text (headers and paragraphs).	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>The Great Tree of HTML</title> </head> <body> P P P Title Div Head Body HTML </body> </html> div { border-radius: 5px;

```
        border: 2px solid #6495ED;
        background-color: #BCD2EE;
        height: 18px;
        text-align: center;
        font-family: Garamond, serif;
}

#p1 {
        display: inline;
        position: relative;
        margin-left: 138px;
}

#p2 {
        display: inline;
        position: relative;
        margin-left: 10px;
}

#p3 {
        display: inline;
        position: relative;
        margin-left: 10px;
}

#div {
        display: inline;
        position: relative;
        margin-left: 70px;
        margin-top: 10px;
}

#title {
        display: inline;
        position: relative;
        margin-left: 50px;
}

#body {
        display: inline;
        position: relative;
        margin-left: 25px;
}

#head {
        display: inline;
```

	position: relative;
	margin-left: 65px;
	}
	
	#html {
	width: 50px;
	position: relative;
	margin-left: 93px;
	}
	
	.space {
	opacity: 0;
	}

Parents, children, and siblings If you think of the <html> tag as the trunk of the tree, you can think of its immediate branches—<head> and<body>—as its **children**. Both tags are children of <html>, and <html> is their **parent** element. Because they are both immediate children of<html> (that is, they are both only one element away), they are **siblings**. Just like a real family, elements have children, grandchildren, great-grandchildren, and so on (though we don't make this distinction with HTML—a child of an element, and all that child's children, are children of the first parent).	<!DOCTYPE html> <html> <!--The root of the tree!--> <head> <!--Child of html, parent of title, sibling of body--> <title></title> <!--Immediate child of head, child of head AND html--> </head> <body> <!--Child of html, parent of p, sibling of head--> <!--Immediate child of body, child of body AND html--> </body> </html>
Swinging from branch to branch All right! Now that you have an idea of how HTML documents are structured, it's time to see how good you are at navigating from branch to branch.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Linkapalooza</title> </head> <body>

	Codecademy!
	
	Learn
	
	Teach
	
	Settings
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	li a {
	text-decoration: none;
	font-family: cursive;
	}

Can you swing it? Good work! Let's try something a little more involved. Remember, you can reach an element that is a child of another element like this: `div div p { /* Some CSS */ }` where in this case, we'd be grabbing any that is nested *somewhere* inside a that is nested *somewhere* inside another . If you want to grab *direct children*—that is, an element that is *directly* nested inside another element, with	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Ultimate Text Challenge</title> </head> <body> Introduction: Cascading with CSS Synopsis: When you set a property of a selector like 'p' to a certain value, that value applies to all p tags.

no elements in between—you can use the >symbol, like so:

```
div > p { /* Some CSS */ }
```

This only grabs <p>s that are nested *directly* inside of s; it won't grab any paragraphs that are, say, nested inside lists that are in turn nested inside s.

```
                If, however, you change that same property to a different value for a more specific instance of p,
                that change will <em>override</em> the 'general rule'.
                </p>
                <ul>
                    <li><p>If you say p { font-family: Garamond}, all 'p's will have the font Garamond.</p></li>
                    <li><p>BUT if you say li p {font-family: Verdana}, 'p's outside of 'li's will be
                    in Garamond, and 'p's INSIDE 'li's will be in Verdana.
                    </p></li>
                    <li><p>The more specific your selectors are, the higher importance CSS gives to the styling you apply!</p></li>
                </ul>
            </div>
            <p>Summary: Greater specificity makes CSS prioritize that particular styling.</p>
        </body>
</html>

/*Add your CSS below!*/
p {
  font-family: Garamond;
}

body > p {
  font-weight: bold;
}

div > p {
  color: #7AC5CD;
}

li p {
  color: #000000;
  text-decoration: underline;
}
```

See it to believe it

Excellent! You've got the hang of this, and you're starting to learn more about cascading.

As we mentioned, certain selectors will "override" others if they have a greater **specificity value**. ul li p {is more specific CSS than just p {, so when CSS sees tags that are *both*<p> tags *and* happen to be inside unordered lists, it will apply the more specific styling (ul li p {) to the text inside the lists.

There are two selectors that are even more specific than nested selectors like the ones above:**classes** and **IDs**. Check them out in the editor to the right.

```
<!DOCTYPE html>
<html>
	<head>
		<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
		<title>Ultimate Text Challenge</title>
	</head>
	<body>
		<p id="intro">Cascading with CSS</p>
		<div>
			<p>When you set a property of a selector like 'p' to a certain value, that value applies to <em>all</em> p tags.
			If, however, you change that same property to a different value for a more specific instance of p,
			that change will <em>override</em> the 'general rule'.
			</p>
			<ul>
				<li><p>If you say p { font-family: Garamond}, all 'p's will have the font Garamond.</p></li>
				<li><p class="list_item">BUT if you say li p {font-family: Verdana}, 'p's outside of 'li's will be in Garamond, and 'p's INSIDE 'li's will be in Verdana.
				</p></li>
				<li><p class="list_item">The more specific your selectors are, the higher importance CSS gives to the styling you apply!</p></li>
			</ul>
		</div>
		<p id="summary">Greater specificity makes CSS prioritize that particular styling.</p>
	</body>
</html>

p {
	font-family: Garamond, serif;
```

	}
	
	#intro {
	font-weight: bold;
	color: #000000;
	}
	
	div p {
	color: #7AC5CD;
	}
	
	li p {
	font-family: Verdana, sans-serif;
	color: #000000;
	}
	
	.list_item {
	font-family: Vivaldi, cursive;
	}
	
	#summary {
	font-size: 20px;
	color: #000000;
	}

Beyond HTML elements HTML elements can be CSS selectors, but as we saw with the universal selector *, they're not the *only* selectors available. There are two important selectors you can use in addition to the universal selector and HTML elements: **classes** and **IDs**.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> <h3 class="red">I'm an h3 header in the red class!</h3> <h3>I'm just a regular old h3 header.</h3> I'm a paragraph in the red class! I'm just a regular old paragraph. I'm a rogue paragraph! I do what I want! </body> </html>

<table>
<tr>
<td></td>
<td>

```
.red {
        color: red;
}

#rogue {
        color: #FF00FF;
        font-weight: bold;
        font-family: cursive;
}
```

</td>
</tr>
<tr>
<td>

Keeping it classy

Classes are useful when you have a bunch of elements that should all receive the same styling. Rather than applying the same rules to several selectors, you can simply apply the same class to all those HTML elements, then define the styling for that class in the CSS tab.

Classes are assigned to HTML elements with the word class and an equals sign, like so:

```
<div class="square"></div>
<img class="square"/>
<td class="square"></td>
```

Classes are identified in CSS with a dot (.), like so:

```
.square {
   height: 100px;
   width: 100px;
}
```

This allows you to take elements of different types and give them the same styling.

</td>
<td>

```
<!DOCTYPE html>
<html>
        <head>
                <link type="text/css"
rel="stylesheet" href="stylesheet.css"/>
                <title>Result</title>
        </head>
        <body>
                <!--Add your HTML elements
with the class "fancy" below!-->
                <p class="fancy"> Fancy 1
</p>
        <p class="fancy"> Fancy 2 </p>
        <p class="fancy"> Fancy 3 </p>
        </body>
</html>

/*Define your CSS class .fancy below!*/

.fancy {
   font-family: cursive;
   color: #0000CD;
}
```

</td>
</tr>
</table>

ID, please!

IDs, on the other hand, are great for when you have exactly *one* element that should receive a certain kind of styling.

IDs are assigned to HTML elements with the word id and an equals sign:

```
<div id="first"></div>
<div id="second"></div>
<p id="intro"></p>
```

IDs are identified in CSS with a pound sign (#):

```
#first {
   height: 50px;
}

#second {
   height: 100px;
}

#intro {
   color: #FF0000;
}
```

This allows you to apply style to a single instance of a selector, rather than *all* instances.

```
<!DOCTYPE html>
<html>
        <head>
                <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
                <title>Result</title>
        </head>
        <body>
                <!--Add your HTML elements with the ID "serious" below!-->
                <p id="serious"> Serious 1 </p>
        </body>
</html>

/*Define your CSS id #serious below!*/

#serious{
   font-family: courier;
   color: #CC0000;
}
```

Putting it all together

Well done! You're doing great.

Now it's time to put all our newfound knowledge together:

```
<!DOCTYPE html>
<html>
        <head>
                <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
                <title>Result</title>
        </head>
        <body>
                <h2 id="intro">Introduction</h2>
                <h3 class="standout">Classes and IDs in CSS</h3>
```

	Classes and IDs are super easy in CSS. You're using them right now!
	 Regular HTML Selectors
	 If you don't bother with a class or ID, an HTML element just gets the regular CSS styling for that element—or the default styling if you don't specify any particular styling on the stylesheet.
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	
	#intro {
	color: #B83C3A;
	}
	
	.standout {
	color: #F7AC5F;
	font-family: verdana;
	}

Even finer control You've learned about class selectors. Now it's time to learn about **pseudo-class selectors**. A **pseudo-class selector** is a way of accessing HTML items that aren't part of the document tree (remember the tree structure we talked about earlier?). For instance, it's very easy to see where a link is in the tree. But where would you find information about whether a link had been clicked on or not? It isn't there! Pseudo-class selectors let us style these kinds of changes in our HTML document. For example, we saw we could change a link's text-decoration property to make it	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> Codecademy Home Learn Teach Settings

<table>
<tr>
<td>something other than blue and underlined. Using pseudo selectors, you can control the appearance of unvisited and visited links—even links the user is hovering over but hasn't clicked!

The CSS syntax for pseudo selectors is


```
selector:pseudo-class_selector {
   property: value;
}
```

It's just that little extra colon (:).</td>
<td>

</body>
</html>

a:hover {
color: #cc0000;
font-weight: bold;
text-decoration: none;
}
</td>
</tr>
<tr>
<td>Links
There are a number of useful pseudo-class selectors for links, including:

a:link: An unvisited link.
a:visited: A visited link.
a:hover: A link you're hovering your mouse over.

Let's try a few!</td>
<td>
<!DOCTYPE html>
<html>
<head>
<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
<title></title>
</head>
<body>

BYUI
LDS
Google

</body>
</html>

a:link {
text-decoration: none;
color: #008B45;
}

/*a:hover {
color: #00FF00;
} */

a:visited {
color: #EE9A00;
}
</td>
</tr>
</table>

	a:hover {
	color: #cc0000;
	font-weight: bold;
	text-decoration: none;
	}

First child
Another useful pseudo-class selector is first-child. It's used to apply styling to *only* the elements that are the first children of their parents. For instance:
 	
`p:first-child { color: red; }`
Would make all paragraphs that are the first children of their parent elements red.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title></title>
	</head>
	<body>
	
	 I'm the first child!
	 We're not.
	 We're not.
	 We're not.
	 We're not.
	 We're not.
	 We're not.
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	p:first-child {
	font-family: cursive;
	}

Nth child Well done! You can actually select *any* child of an element after the first child with the pseudo-class selector nth-child; you just add the child's number in parentheses after the pseudo-class selector. For example, `p:nth-child(2) { color: red; }` Would turn every paragraph that is the *second* child of its parent element red.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title></title> </head> <body> I'm the first child! We're not. We're not. We're not. We're not.

The element that **is the child** goes before :nth-child; its parent element is the element that contains it.	We're not.
	 We're not.
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	p:first-child {
	font-family: cursive;
	}
	
	p:nth-child(2) {
	font-family: Tahoma;
	}
	
	p:nth-child(3){
	color: #CC0000;
	}
	
	p:nth-child(4){
	background-color: #00FF00;
	}
	
	p:nth-child(5){
	font-size: 22px;
	}

Show it if you know it! Feel like you're really starting to understand this CSS stuff? Prove it!	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> <!--Add your HTML below!--> BYUI LDS Google </body> </html>

	/*Add your CSS below!*/
	
	a:hover {
	  text-decoration: none;
	}
	
	a:first-child {
	  color: #CDBE70;
	}
	
	a:nth-child(3) {
	  color: #FFC125;
	}

Final section breather Great work! So far in this course, you've learned: A wider range of CSS selectors About cascading The universal selector Class and ID selectors Pseudo selectors That's a lot of material. We're done covering new stuff for now—let's go over what you've learned.	<!DOCTYPE html> <html> <head> <title></title> </head> <body></body> </html>

Multiple selectors
Remember how to reach selectors nested inside others? If you have a paragraph inside a div that's inside *another* div, you can get to it like this:
 	
`div div p {`
`  /*Some CSS*/`
`}`
This will style all paragraphs nested inside two divs and will leave all paragraphs that don't meet these criteria alone.
 	
Please note: If you have adjusted your browser's zoom, tests involving font-
	<!DOCTYPE html>
	<html>
	  <head>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  <title></title>
	  </head>
	  <body>
	
	   - Grab me!
	   - Me, too!

size and height will not work correctly. To remedy this, please type Command+0 or Ctrl+0 to reset your view.	Don't grab me!
	</body>
	</html>
	
	/*Add your CSS below!*/
	li p {
	font-size: 30px;
	}

Class selectors
You've also learned how to use class selectors to modify different elements (that is, you can give the same styling to an h3 header, a paragraph, a link, and a table).
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	<!--Add your HTML below!-->
	<h3 class = "fancy"> This is an H3 Header</h3>
	 This is a paragraph
	</body>
	</html>
	
	/*Add your CSS below!*/
	
	.fancy {
	font-family: cursive;
	color: violet;
	}

ID selectors You've also learned about ID selectors, and how they can be used to target a specific element.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> <!--Add your HTML below!--> <h3 class = "fancy"> This is an H3 Header</h3> This is a paragraph this is serious </body> </html>

	/*Add your CSS below!*/
	
	.fancy {
	  font-family: cursive;
	  color: violet;
	}
	
	#serious {
	  font-family: Courier;
	  color: #8C8C8C;
	}

Pseudo selectors
Home stretch! Let's toss in some pseudo-class selector magic to finish this bad boy.
	<!DOCTYPE html>
	<html>
	  <head>
	  <link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	  <title>Result</title>
	  </head>
	  <body>
	  <!--Add your HTML below!-->
	  <h3 class = "fancy"> This is an H3 Header</h3>
	   This is a paragraph
	   this is serious
	   this is my 3rd paragraph
	  </body>
	</html>
	
	/*Add your CSS below!*/
	
	.fancy {
	  font-family: cursive;
	  color: violet;
	}
	
	#serious {
	  font-family: Courier;
	  color: #8C8C8C;
	}
	
	p:nth-child(4) {
	  font-size: 26px;
	}

APPENDIX F

CSS Positioning Video Instruction Storyboard

"CSS Positioning" Video Instruction Storyboard

Module #6: CSS Positioning Video

Objectives:

1. Understand the basic use of the box model for spacing HTML elements
2. Understand how to set the margins, borders, and padding of HTML elements
3. Understand the basic use of the CSS "float" positioning element
4. Understand the basic use of absolute, fixed, and relative positioning of HTML elements

Audio Narration	Video Animation

See it to believe it
 	
All right! Now that you know all about CSS, it's time to learn the last (but certainly not least) major piece of the puzzle: positioning.
 	
Controlling the position of HTML elements allows you incredibly fine control over how your pages look. No longer will your s sit directly on top of one another! (Unless you want them to.)
 	
As we mentioned, elements populate the page in what's known as the **CSS box model**. Each HTML element is like a tiny box or container that holds the pictures and text you specify.
 	
Check out the image in the Result tab: that's what the box model looks like! (We'll cover the details of margins, borders, and padding in the next section.)
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	 The Box Model
	
	 Image courtesy of www.w3.org!
	</body>
	</html>
	
	* {
	border: 1px dashed #0000FF;
	}

Taking up space Cool, right? Each HTML element gets its own box to live in. As you saw, the outermost box of each element went all the way across the page. This is why until now, your HTML elements have been sitting on top of one another: by	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body>

default, they take up the full width of the page.
 	
We can change all this with the first positioning property we'll learn: the **display** property. We'll learn about four possible values.
 	
block: This makes the element a block box. It won't let anything sit next to it on the page! It takes up the full width.
 	
inline-block: This makes the element a block box, but will allow other elements to sit next to it on the same line.
 	
inline: This makes the element sit on the same line as another element, but without formatting it like a block. It only takes up as much width as it needs (not the whole line).
 	
none: This makes the element and its content disappear from the page entirely!
	
	</body>
	</html>
	
	* {
	border: 1px dashed blue;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	/*Add your CSS here!*/
	display: block;
	}
	
	#one {
	background-color: #FF0000;
	}
	
	#two {
	background-color: #0000FF;
	}
	
	#three {
	background-color: #FFD700;
	}
	
	#four {
	background-color: #308014;
	}

Inline-block Good work! If you didn't notice much of a difference, don't worry. Our s were block elements by default; as we specify different display values, they'll start to move around. As mentioned, any element that comes in as a block (say, a paragraph) will automatically take up the full width of the page, no matter how much or how little content you put in.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> </body> </html>

If we specify a display of inline-block, however, our blocks are still blocks, but will be able to sit next to each other on the same line.	* {
	border: 1px dashed blue;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	/*Add your CSS here!*/
	display: inline-block;
	}
	
	#one {
	background-color: #FF0000;
	}
	
	#two {
	background-color: #0000FF;
	}
	
	#three {
	background-color: #FFD700;
	}
	
	#four {
	background-color: #308014;
	}

Inline Did you see that? Your s all moved onto the same line! You can already start to see how this type of positioning can be useful for navigation bars like the one at the top of the main Codecademy page (where you can click "Learn," "Teach," and so on). The inline-block value allows you to put several block elements on the same line. The inline value places all your elements next to one another, but not as blocks: they don't keep their dimensions.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> </body> </html> * { border: 1px dashed blue;

	}
	
	div {
	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	/*Add your CSS here!*/
	display: inline;
	}
	
	#one {
	background-color: #FF0000;
	}
	
	#two {
	background-color: #0000FF;
	}
	
	#three {
	background-color: #FFD700;
	}
	
	#four {
	background-color: #308014;
	}

None!
The good news is, inline places all your elements on a single line. The bad news is that it doesn't maintain their "box"ness: as you saw, all your s got squished to the smallest possible width!
 	
The inline display value is better suited for HTML elements that are blocks by default, such as headers and paragraphs.
 	
Finally, we'll try out the display value none. As you might expect, this prevents the page from displaying the selected element. As you might *not* expect, this removes the selected element from the page *entirely*, including any children and any content. Poof! Gone!
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	* {
	border: 1px dashed blue;
	}
	
	div {

(But not gone forever—changing the display value away from none will bring everything back.)	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	/*Add your CSS here!*/
	display: none;
	}
	
	#one {
	background-color: #FF0000;
	}
	
	#two {
	background-color: #0000FF;
	}
	
	#three {
	background-color: #FFD700;
	}
	
	#four {
	background-color: #308014;
	}

Sketching it out Now that you understand more about the display property and the box model, we can delve into the details of how each individual box behaves. Check out the diagram in the Result tab (it's the one from the first exercise in this lesson). As you can see, each box is made of layers. From the outermost to the innermost: The **margin** is the space around the element. The larger the margin, the more space between our element and the elements around it. We can adjust the margin to move our HTML elements closer to or farther from each other.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> The Box Model Image courtesy of www.w3.org! </body> </html>

The **border** is the edge of the element. It's what we've been making visible every time we set the border property. The **padding** is the spacing between the content and the border. We can adjust this value with CSS to move the border closer to or farther from the content. The **content** is the actual "stuff" in the box. If we're talking about a <p>element, the "stuff" is the text of the paragraph. You'll see abbreviations like **TM**, **TB**, and **TP** in the diagram. These stand for "top margin," "top border," and "top padding." As we'll see, we can adjust the top, right, left, and bottom padding, border, and margin individually.	

Margin
Let's start with our margins. Adjusting our margins not only moves our element relative to other elements on the page, but also relative to the "walls" of the HTML document.
 	
For instance, if we take an HTML element with a specific width (such as our in the editor) and set its margin to auto, this tells the document to automatically put equal left and right margins on our element, centering it on the page.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	* {
	border: 1px dashed black;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	background-color: #308014;

	margin: auto; }

Margin top, right, bottom, left
If you want to specify a particular margin, you can do it like this:
 	
margin-top: */*some value*/*
margin-right: */*some value*/*
margin-bottom: */*some value*/*
margin-left: */*some-value*/*
You can also set an element's margins all at once: you just start from the top margin and go around clockwise (going from top to right to bottom to left). For instance,
 	
margin: 1px 2px 3px 4px;
will set a top margin of 1 pixel, a right margin of 2, a bottom of 3, and a left of 4.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	* {
	border: 1px dashed black;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	background-color: #308014;
	margin-top: 20px;
	margin-right: 50px;
	margin-bottom: 10px;
	margin-left: 5px;
	}

Borders
Well done! You can see how fine-tuning your margins will help you place elements where you'd like them to be on the page.
 	
We've worked with borders before, but it never hurts to have extra practice.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	* {
	border: 1px dashed black;
	}
	
	div {

	height: 50px; width: 100px; border: 4px solid #FF0000; border-radius: 5px; background-color: #308014; margin-top: 20px; margin-right: 50px; margin-bottom: 10px; margin-left: 5px; }

Padding
Good! Let's adjust the padding. Remember, the padding is the space between your border and your innermost layer: the actual content.
 	
Padding can be set in two ways, just like your margins. You can either select them individually, like this:
 	
padding-top: */*some value*/*
padding-right: */*some value*/*
padding-bottom: */*some value*/*
padding-left: */*some-value*/*
Or select them all in one declaration, like this:
 	
padding: value value value value;
You should also know that if you want your padding to be the same for all four sides, you can declare that value only once. padding: 10pxwill give your HTML element 10 pixels of padding on all sides.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	* {
	border: 1px dashed black;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 4px solid #FF0000;
	border-radius: 5px;
	background-color: #308014;
	margin-top: 20px;
	margin-right: 50px;
	margin-bottom: 10px;
	margin-left: 5px;
	padding: 40px;
	}

Negative values Did you see that? Your got huge! That's because the background color is the same for the content and the padding. When you give CSS a positive padding or margin value, it puts that space between the	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body>

element and its reference: for instance, if you have a and you give it a margin-left of 20px, it puts twenty pixels between the left margin of that and the side of the screen. This effectively moves the twenty pixels to the *right*.
 	
If you want to move an element in the other direction, you can give CSS a *negative* value: margin-left: -20pxwill move the element twenty pixels to the *left*.
	
	</body>
	</html>
	
	* {
	border: 1px dashed black;
	}
	
	div {
	height: 50px;
	width: 100px;
	border: 4px solid #FF0000;
	border-radius: 5px;
	background-color: #308014;
	margin-top: -20px;
	margin-right: 50px;
	margin-bottom: 10px;
	margin-left: 5px;
	padding: 40px;
	}

Review
Cool, right? You can move HTML elements clear off the page with negative margins values.
 	
Time for a quick review to make sure you've got a handle on all this margin and padding stuff!
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	/*Add your CSS below!*/
	div {
	height: 50px;
	width: 100px;
	border: 1px solid black;
	background-color: #CC0000;
	margin: 10px 5px 5px 50px;
	padding: 0px 30px 0px 10px;
	}

To the right! Okay! So we know how our individual elements are constructed. But how do we determine where they go on the page?	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/>

One way is to use **floats**. When you float an element on the page, you're telling the webpage: "I'm about to tell you where to put this element, but you have to put it into the **flow** of other elements." This means that if you have several elements all floating, they all know the others are there and don't land on top of each other.
 	
You can think of the HTML page as sort of like a sea, and floating elements as boats on it: all the boats have positions on the sea, and they all see and steer clear of each other.
 	
(Some of the positioning methods we'll learn in upcoming sections *can* accidentally drop elements on top of each other.)
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	div {
	height: 300px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	background-color: #308014;
	/*Add your CSS here!*/
	float: right;
	}

To the left!
Good! As you saw, your div moved over to the right side of the page.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	div {
	height: 300px;
	width: 100px;
	border: 2px solid black;
	border-radius: 5px;
	background-color: #308014;
	/*Add your CSS here!*/
	float: left;
	}

Float for two	<!DOCTYPE html> <html> <head>

As you may have already guessed, we can use floated elements to naturally divide our pages into different sections. Try it!	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	 Check it out! I'm a block of text, but the <div> and I can live in harmony. Boats on a sea, man. Boats on a sea.
	</body>
	</html>
	
	div {
	height: 300px;
	width: 300px;
	border: 2px solid black;
	border-radius: 5px;
	background-color: #308014;
	/*Add your CSS here!*/
	float: right;
	}
	
	p {
	font-family: Verdana, sans-serif;
	font-size: 20px;
	width: 280px;
	/*Add your CSS here!*/
	float: left;
	}

Clearing elements Unfortunately, we sometimes mix large floating elements with non-floating ones, and elements *do* end up on top of each other. See your footer (the blue bit between the two columns)? It's stuck back there because we haven't told it something very important: toclear the other elements on the page! If you tell an element to clear: left, it will immediately move below any floating elements on the left side of the page; it can also clear elements on the right. If you tell it	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> </body> </html> div { border-radius: 5px;

to clear:both, it will get out of the way of elements floating on the left *and* right!	}
	
	#header {
	height: 50px;
	background-color: #F38630;
	margin-bottom: 10px;
	}
	
	.left {
	height: 300px;
	width: 150px;
	background-color: #A7DBD8;
	float: left;
	margin-bottom: 10px;
	}
	
	.right {
	height: 300px;
	width: 450px;
	background-color: #E0E4CC;
	float: right;
	margin-bottom: 10px;
	}
	
	#footer {
	height: 50px;
	background-color: #69D2E7;
	/*Add your CSS here!*/
	clear: both;
	}

Static by default Great work so far! Now that you understand positioning elements with float, let's move on to slightly more complex positioning methods. If you don't specify an element's positioning type, it defaults to static. This just means "where the element would normally go." If you don't tell an element how to position itself, it just plunks itself down in the document.	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> </body> </html> div { border-radius: 5px; border: 2px solid black;

	}
	
	#inner {
	height: 75px;
	width: 75px;
	background-color: #547980;
	/*Add your CSS here!*/
	
	}
	
	#outer {
	height: 1500px;
	width: 150px;
	background-color: #45ADA8;
	position: absolute;
	margin-left: 100px;
	}

Absolute positioning
The first type of positioning is **absolute** positioning. When an element is set to position: absolute, it's then positioned in relation to the first parent element it has that *doesn't* have position: static. If there's no such element, the element with position: absolute gets positioned relative to <html>.
 	
To show you how this works, we've set the #outer div to have absolute positioning. This means that when you position the #inner div, it will be relative to #outer. (If #outer had the default positioning of static, then#inner would get positioned relative to the entire HTML document.)
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	div {
	border-radius: 5px;
	border: 2px solid black;
	}
	
	#inner {
	height: 75px;
	width: 75px;
	background-color: #547980;
	/*Add your CSS here!*/
	position: absolute;
	margin-left: 20px;
	}
	
	#outer {
	height: 1500px;

	width: 150px; background-color: #45ADA8; position: absolute; margin-left: 200px; }

Relative positioning
Good! Did you notice how the #innerdiv moved 20 pixels in from the edge of the #outer div? That's absolute positioning at work.
 	
Relative positioning is more straightforward: it tells the element to move relative to where it would have landed if it just had the default static positioning.
 	
If you give an element relative positioning and tell it to have a margin-top of 10px, it doesn't move down ten pixels from any particular thing—it moves down ten pixels from where it *otherwise would have been*.
	<!DOCTYPE html>
	<html>
	<head>
	<link type="text/css" rel="stylesheet" href="stylesheet.css"/>
	<title>Result</title>
	</head>
	<body>
	
	</body>
	</html>
	
	div {
	border-radius: 5px;
	border: 2px solid black;
	}
	
	#inner {
	height: 75px;
	width: 75px;
	background-color: #547980;
	/*Add your CSS here!*/
	position: relative;
	margin-left: 200px;
	
	}
	
	#outer {
	height: 1500px;
	width: 150px;
	background-color: #45ADA8;
	position: absolute;
	margin-left: 100px;
	}

Fixed positioning Perfect! See? This positioning stuff's not so hard. Finally, **fixed** positioning anchors an element to the browser window—you can think of it	<!DOCTYPE html> <html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title>

as gluing the element to the screen. If you scroll up and down, the fixed element stays put even as other elements scroll past.	</head>
	<body>
	
	</body>
	</html>
	
	div {
	border-radius: 5px;
	border: 2px solid black;
	}
	
	#inner {
	height: 75px;
	width: 75px;
	background-color: #547980;
	/*Add your CSS here!*/
	position: fixed;
	margin-left: 200px;
	
	}
	
	#outer {
	height: 1500px;
	width: 150px;
	background-color: #45ADA8;
	position: absolute;
	margin-left: 100px;
	}

The story so far Great work—you've learned a lot about CSS positioning! We've covered: The CSS box model Display values, including block, inline-block, inline, and none Margins, borders, and padding Positioning elements with float Giving elements absolute, relative, and fixed positioning	<!DOCTYPE html> <html> <head> <title></title> </head> <body></body> </html>
Navigation bar, where are you?	<!DOCTYPE html>

Check out the website we've started in the Result tab. Do you recognize it? It's the demo we showed you in the first CSS lesson! It doesn't look quite the same, though. This is because much of the crucial display and positioning CSS we used has been removed. Your job? Add it back in!	<html> <head> <link type="text/css" rel="stylesheet" href="stylesheet.css"/> <title>Result</title> </head> <body> - Home - About Me - Plans for World Domination - Contact About Me I am the angriest puppy in the world. This has been scientifically proven in several clinical trials. <table> <th colspan="3">My Bros</th> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td><img src="http://2.bp.blogspot.com/_jZHHRfnq9F8/

	Sw5Kb1D2EhI/AAAAAAAAKkE/fuaDErPNDvU/s1600/Puppy+Training.jpg"/></td>
	<td></td>
	<td></td>
	</tr>
	<tr>
	<td></td>
	<td><img src="http://24.media.tumblr.com/tumblr_m825unsFjm1qldzl2o2_500.jpg"></td>
	<td></td>
	</tr>
	</table>
	
	 Send me an e-mail!
	
	</body>
	</html>
	
	body {
	background-color: #b7d1c4
	}
	
	h2 {
	font-family: Verdana;
	font-weight: bold;
	text-align: center;
	padding-top: 25px;
	padding-bottom: 25px;
	color: #acd1b2;
	}
	
	img {

```
height: 170px;
width: 170px;
box-shadow: rgba(0,0,0,0.2) 10px 10px;

}

#navbar {
/*Add your CSS here!*/
position: fixed;
margin-top: -10px;
left:50%;
margin-left:-254px;
}

#header {
position: relative;
top: -10px;
background-color: #3c4543;
border-top-left-radius: 15px;
border-top-right-radius: 15px;
}

ul{
list-style-type: none;
position: fixed;
margin: -10px;
}

li {
/*Add your CSS here!*/
display: inline;
padding: 5px;
border: 2px solid #000000;
font-family: Futura, Tahoma, sans-serif;
color: #ffffff;
border-radius: 5px 5px;
background-color: #cc0323
}

#left{
/*Add your CSS here!*/
float: left;
width: 45%;
}

p {
```

```
font-family: Tahoma;
font-size: 1em;
}

#right{
/*Add your CSS here!*/
float: right;
width: 45%;
}

table {
border: #000000 1px solid;
background-color: #acd1b2;
float: right;
margin-right: 10px;
border-bottom-right-radius: 15px;
border-bottom-left-radius: 15px;
}

td {
height: 75px;
width: 75px;
}

td img {
height: 75px;
width: 75px;
box-shadow: none;
}

th {
font-family: Verdana;
font-size: 1em;
font-weight: normal;
color: #3c4543
}

#bottom_left{
border-bottom-left-radius: 15px;
}

#bottom_right{
border-bottom-right-radius: 15px;
}

#footer{
```

	/*Add your CSS here!*/
	clear: both;
	position: relative;
	bottom: -20px;
	border-bottom-left-radius: 15px;
	border-bottom-right-radius: 15px;
	height: 75px;
	background-color: #3c4543;
	}
	
	#button{
	border: 2px solid #000000;
	float:left;
	position: relative;
	left: 229px;
	bottom: -20px;
	border-radius: 5px;
	background-color: #cc0323;
	height: 30px;
	width: 150px;
	
	}
	
	#button p{
	position: relative;
	bottom: 10px;
	font-size: 0.8em;
	color: #acd1b2;
	text-align: center;
	}
	
	.bold{
	font-family: tahoma;
	font-weight: bold;
	font-size: 1.2em;
	font-variant: small-caps;
	color: #ffffff;
	}

APPENDIX G

Pretest “Remember” Student Achievement Assessment

WDD 100 – HTML and CSS Assessment

Name: _____

The following questions are a formative assessment just to see how much you know about the basics of HTML and CSS (which may be nothing). It does not count towards your grade in any way so there is no penalty for wrong answers. This assessment will be used to gauge how much you will learn thru this course.

Please do not research answers to questions you do not know, just answer these questions with the knowledge you have now.

1. What does HTML stand for?
    a. Hyper Text Markup Language
    b. Home Tool Markup Language
    c. Hyperlinks and Text Markup Language

2. Choose the correct HTML tag for the largest heading
    a. <head>
    b. <heading>
    c. <h6>
    d. <h1>

3. What is the correct HTML tag for inserting a line break?
    a. <break>
    b. <lb>
    c.

4. Choose the correct HTML tag to make a text bold
    a.
    b. <bold>

5. Choose the correct HTML tag to make a text italic
    a. <italic>
    b.

6. What is the correct HTML for creating a hyperlink?
    a. W3Schools
    b. <a>http://www.w3schools.com
    c. W3Schools.com
    d. W3Schools.com

7. Which of these tags are all <table> tags?
    a. <thead><body><tr>
    b. <table><tr><tt>
    c. <table><tr><td>
    d. <table><head><tfoot>

8. How can you make a numbered list?
    a.
    b. <dl>
    c. <list>
    d.

9. How can you make a bulleted list?
    a.
    b.
    c. <list>
    d. <dl>

10. What is the correct HTML for inserting an image?
    a. <img alt="MyImage">image.gif</img>
    b. <img href="image.gif" alt="MyImage">
    c. <image src="image.gif" alt="MyImage">
    d. <img src="image.gif" alt="MyImage">

11. What does CSS stand for?
    a. Computer Style Sheets
    b. Creative Style Sheets
    c. Colorful Style Sheets
    d. Cascading Style Sheets

12. What is the correct HTML for referring to an external style sheet?
    a. <stylesheet>mystyle.css</stylesheet>
    b. <link rel="stylesheet" type="text/css" href="mystyle.css">
    c. <style src="mystyle.css">

13. Where in an HTML document is the correct place to refer to an external style sheet?
    a. In the <head> section
    b. At the top of the document
    c. At the end of the document
    d. In the <body> section

14. Which is the correct CSS syntax?
    a. body {color: black;}
    b. body:color=black;
    c. {body:color=black;}
    d. {body;color:black;}

15. How do you insert a comment in a CSS file?
    a. // this is a comment //
    b. ' this is a comment
    c. /* this is a comment */
    d. // this is a comment

16. How do you add a background color for all <h1> elements?
    a. h1 {background-color:#FFFFFF;}
    b. h1.all {background-color:#FFFFFF;}
    c. all.h1 {background-color:#FFFFFF;}

17. Which CSS property is used to change the text color of an element?
    a. color
    b. text-color
    c. fgcolor

18. Which CSS property controls the text size?
    a. text-style
    b. font-style
    c. text-size
    d. font-size

19. How do you display a border like this:
    top border = 10 pixels
    bottom border = 5 pixels
    left border = 20 pixels
    right border = 1pixel?
    a. border-width:10px 1px 5px 20px;
    b. border-width:10px 5px 20px 1px;
    c. border-width:10px 20px 5px 1px;
    d. border-width:5px 20px 10px 1px;

20. Which property is used to change the left margin of an element?
    a. padding-left
    b. indent
    c. margin-left

APPENDIX H

Posttest “Remember” Student Achievement Assessment

WDD 100 – HTML and CSS Assessment

Name: _____

The following questions are an in-class assessment just to see how much you know about the basics of HTML and CSS (which may be nothing ☺). It does not count towards your grade in any way so there is no penalty for wrong answers. This assessment will be used to gauge how much you will learn thru this course.

1. How do you add a background color for all <h1> elements?
    a. h1.all {background-color:#FFFFFF;}
    b. all.h1 {background-color:#FFFFFF;}
    c. h1 {background-color:#FFFFFF;}

2. Which property is used to change the left margin of an element?
    a. indent
    b. padding-left
    c. margin-left

3. Choose the correct HTML tag to make a text italic
    a. <italic>
    b.

4. Which of these tags are all <table> tags?
    a. <thead><body><tr>
    b. <table><head><tfoot>
    c. <table><tr><tt>
    d. <table><tr><td>

5. Where in an HTML document is the correct place to refer to an external style sheet?
    a. At the top of the document
    b. In the <head> section
    c. At the end of the document
    d. In the <body> section

6. Choose the correct HTML tag for the largest heading
    a. <h6>
    b. <h1>
    c. <head>
    d. <heading>

7. Choose the correct HTML tag to make a text bold
    a. <bold>

b.

8. What is the correct HTML tag for inserting a line break?
    a.
    b. <break>
    c. <lb>

9. How do you display a border like this:

    top border = 10 pixels
    bottom border = 5 pixels
    left border = 20 pixels
    right border = 1pixel?

    a. border-width:10px 20px 5px 1px;
    b. border-width:10px 1px 5px 20px;
    c. border-width:10px 5px 20px 1px;
    d. border-width:5px 20px 10px 1px;

10. What is the correct HTML for creating a hyperlink?
    a. W3Schools.com
    b. W3Schools
    c. <a>http://www.w3schools.com
    d. W3Schools.com

11. How can you make a numbered list?
    a. <dl>
    b. <list>
    c.
    d.

12. How can you make a bulleted list?
    a.
    b. <list>
    c.
    d. <dl>

13. What is the correct HTML for inserting an image?
    a. <img alt="MyImage">image.gif</img>
    b. <img src="image.gif" alt="MyImage">
    c. <img href="image.gif" alt="MyImage">
    d. <image src="image.gif" alt="MyImage">

14. Which CSS property is used to change the text color of an element?
    a. fgcolor
    b. color
    c. text-color

15. What is the correct HTML for referring to an external style sheet?
    a. <link rel="stylesheet" type="text/css" href="mystyle.css">
    b. <stylesheet>mystyle.css</stylesheet>
    c. <style src="mystyle.css">

16. Which is the correct CSS syntax?
    a. body {color: black;}
    b. body:color=black;
    c. {body;color:black;}
    d. {body:color=black;}

17. How do you insert a comment in a CSS file?
    a. /* this is a comment */
    b. // this is a comment //
    c. ' this is a comment
    d. // this is a comment

18. What does HTML stand for?
    a. Home Tool Markup Language
    b. Hyper Text Markup Language
    c. Hyperlinks and Text Markup Language

19. Which CSS property controls the text size?
    a. text-style
    b. text-size
    c. font-style
    d. font-size

20. What does CSS stand for?
    a. Colorful Style Sheets
    b. Cascading Style Sheets
    c. Computer Style Sheets
    d. Creative Style Sheets

APPENDIX I

"Apply" Student Achievement Assessments

The objectives of the first lesson are that students will be able to:

1. Demonstrate how to structure a basic HTML document including the HEAD and BODY sections
2. Demonstrate the basic operation of the paragraph, heading and title HTML tags
3. Demonstrate how to include images in an HTML document
4. Demonstrate how to create hyperlinks within an HTML document

The assessment for this lesson is worth 10 points and is detailed below

Lesson 1 – Assessment

(10 points) Start creating the main page for your chosen web site. You will do this by creating an HTML file.

1) Develop the basic text you would like to appear on the main screen. This includes
   a) (1 point) Title of your Web page
   b) (3 points) Headings and Paragraphs
   c) (2 points) Links to other web pages
2) (3 points) Obtain the images you would like to appear on the main screen and put html tags linking them in your html file. Note you must have at least 1 image on your main page.
3) (1 point) Name the completed HTML file "index.html".
4) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

The objectives of the second lesson are that students will be able to:

1. Demonstrate the basic structure of an ordered list in HTML
2. Demonstrate the basic structure of an unordered list in HTML

3. Demonstrate the basics of styling fonts including size, color and family
4. Demonstrate the basics of other styling features including background color, text alignment, and emphasis tags

The assessment for this lesson is worth 10 points and is contained below

Lesson 2 - Assessment

(10 points) Continue creating the main page for your chosen web site. You will do this by updating the HTML file you created in the last lesson. For this assignment,

1) (2 points) Create at least 1 ordered list on your main page. This list can contain any relevant information you desire.
2) (2 points) Create at least 1 unordered list on your main page. This list can contain any relevant information you desire.
3) (1 point) Change the size of the font in your HTML document using the font-size style attribute
4) (1 point) Change the color of the font in your HTML document using the color style attribute
5) (1 point) Change the font family in your HTML document using the font-family style attribute
6) (1 point) Change the background color of any text in your HTML document
7) (1 point) Bold at least one word on your HTML document
8) (1 point) Italicize at least one word on your HTML document
9) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

The objectives of the third lesson are that students will be able to:

1. Demonstrate the basic structure of HTML tables
2. Demonstrate the basic structure of both rows and columns of HTML tables
3. Demonstrate the basics of HTML table headers
4. Demonstrate the basics of styling HTML tables

5. Demonstrate the basics DIV and SPAN tags

The assessment for this lesson is worth 10 points and is contained below

Lesson 3 – Assessment

(10 points) Continue creating the main page for your chosen web site. You will do this by updating the HTML file you created in the last lesson. For this assignment,

1) (3 points) Add a table to your HTML document that has at least 3 rows and 3 columns.
2) (3 points) Make sure the table has both a <thead> section and a <tbody> section. Style the table any way you would like to
3) (2 points) Add at least one tag to your HTML document. Style the contents within the any way you want.
4) (2 points) Add at least one tag to your HTML document. Style the contents within the any way you want.
5) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

The objectives of the fourth lesson are that students will able to:

1. Demonstrate the basic structure of both inline as well as external style sheets
2. Demonstrate the basic syntax of CSS attributes
3. Demonstrate the basics of styling text data
4. Demonstrate the basics of styling borders, links, and text decorations

The assessment for this lesson is worth 10 points and is contained below

Lesson 4 – Assessment

(10 points) Continue creating the main page for your chosen web site. You will do this by updating the HTML file you created in the last lesson. For this assignment,

1) (4 points) Remove the style attributes from your HTML file and put those attributes into a separate style sheet. Link the stylesheet to your HTML file.
2) Make sure you style
    a) (2 points) The text in one of your paragraphs
    b) (2 points) The borders of your table
    c) (2 points) Hyperlinks
3) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

The objectives of the fifth lesson are that students will be able to:

1. Demonstrate the basic use of CSS Selectors within HTML documents
2. Demonstrate the basic use of CSS Classes
3. Demonstrate the basic use of CSS ID's

The assessment for this lesson is worth 10 points and is contained below

Lesson 5 – Assessment

(10 points) Continue creating the main page for your chosen web site. You will do this by updating the HTML file you created in the last lesson. For this assignment,

1) (4 points) Make sure you use at least one CSS Class and put those attributes into a separate style sheet.
2) (4 points) Make sure you use at least one CSS ID and put those attributes into a separate style sheet.
3) (2 points) Link the stylesheet to your HTML file.
4) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

The objectives of this lesson are that students will be able to:

1. Demonstrate the basic use of the box model for spacing HTML elements
2. Demonstrate how to set the margins, borders, and padding of HTML elements
3. Demonstrate the basic use of the CSS "float" positioning element
4. Demonstrate the basic use of absolute, fixed, and relative positioning of HTML elements

The assessment for this lesson is worth 10 points and is contained below

Lesson 6 - Assessment

(10 points) Continue creating the main page for your chosen web site. You will do this by updating the HTML file you created in the last lesson. For this assignment,

1) (3 points) Use the box model and position at least one element by setting the margins, borders, or padding of an element
2) (4 points) Use one or more of the following positioning elements to position something on your web page: fixed, absolute, and/or relative
3) (3 points) Use the float positioning element to position something on your web page.
4) (no points – only used to gauge relative difficulty of assignment) How long did it take you to complete this assignment?

APPENDIX J

"Create" Student Achievement Assessment

WDD 100 – Introduction to Web Design and Development- Project Grading Rubric

CATEGORY	Excellent (100%)	Good (90%)	Satisfactory (70%)	Needs Improvement (50%)	Actual Grade
Organization (20%)	Organization of site is very user friendly: • Inviting Opening Page • Easy to navigate • Intuitive, logical links between pages that function properly	Organization of site is mostly user friendly: • Understandable Opening Page • Somewhat easy to navigate • Most links between pages are logical and work properly	Organization of site is somewhat user friendly: • Vague Opening Page • Occasionally get lost navigating between pages • Some broken links	Organization of site is not appealing: • Confusing Opening Page • Difficult to navigate through pages • Many broken links	
Presentation (20%)	Presentation of content is very appealing: • Layout is clear and easy to follow • Background and text work well together • Graphic elements add to the purpose	Presentation of content is mostly appealing: • Layout is clear • Text is easy to read against background • Graphic elements mostly add to the purpose	Presentation of content is somewhat appealing: • Layout is clear • Text is somewhat readable • A few graphic elements add to the purpose	Presentation of content is not appealing: • Layout is unclear and difficult to follow • Text is difficult to read against background • Graphic elements don't refer to the purpose	
Number of Web Pages (20%)	A minimum of 3 pages are included in the web site (main page and at least 2 child-pages)	2 pages are included in the web site	1 pages are included in the web site	A partial page is included in the web site	
Quality of Content (10%)	All information on the web page is accurate and complete based on the overall theme/purpose of the web page.	Almost all the information on the web page is accurate and complete based on the overall theme/purpose of the web page.	Much of the content on the web page is accurate and complete but there is missing content based on the stated theme/purpose of the web page.	There are several inaccuracies in the content provided OR many of the objectives were not met. Not enough content, very incomplete.	
Spelling and Grammar (10%)	There are no spelling or grammatical errors in the page.	There are a few spelling and/or grammatical errors in the page.	There are several spelling and/or grammatical errors in the page.	There are many spelling and/or grammatical errors in the page.	
Final Report (20%)	Report includes all details including Introduction, Description and Conclusion (see detailed requirements above)	Report contains almost all content required (see detailed requirements above).	Report contains most of the content required (see detailed requirements above).	Report is missing significant content.	
Final Score					

APPENDIX K

SPSS Data Sets

Remember Test Data Set with Missing Data Removed

Observe PreTest	***Observe PostTest***	***Perform PreTest***	***Perform PostTest***
15	95	45	100
20	75	50	95
60	75	35	100
55	75	35	55
0	100	60	90
65	80	15	75
65	90	45	85
25	75	50	95
30	50	60	95
25	85	55	95
40	70	35	90
45	95	45	95
30	90	70	95
70	80	30	85
25	85	25	80
20	70	40	85
65	100	40	95
50	95	20	85
0	85	35	80
15	85	35	90
35	80	30	90
50	75	50	85
50	95	70	85
40	90	55	95
35	95	55	100
25	75	30	85
25	70	45	95
		35	90
		30	65
		30	80

Apply MANOVA Test Data Set

Treatment	***Lesson 1***	***Lesson 2***	***Lesson 3***	***Lesson 4***	***Lesson 5***	***Lesson 6***
Observe	10	8	10	10	10	10
Observe	10	10	8	10	10	10
Observe	10	10	0	0	6	10
Observe	10	6	8	0	0	10
Observe	10	10	10	10	10	6
Observe	10	10	10	10	10	6
Observe	10	10	10	10	10	10
Observe	10	10	10	10	10	10
Observe	8	10	10	6	10	6
Observe	10	10	10	10	10	10
Observe	10	10	10	10	10	10
Observe	10	10	10	10	10	0
Observe	10	10	10	10	10	10
Observe	10	10	10	10	10	10
Observe	8	10	10	10	10	10
Observe	10	8	10	10	10	10
Observe	10	10	10	10	7	10
Observe	7	9	8	10	8	3
Observe	10	9	8	10	10	10
Observe	10	9	8	10	10	10
Observe	10	10	8	8	10	10
Observe	10	10	8	10	6	6
Observe	10	10	10	8	10	10
Observe	10	8	10	10	10	7
Observe	9	6	8	10	10	10
Observe	10	9	8	10	10	10
Observe	10	10	6	8	8	3
Observe	10	9	8	10	10	10
Observe	10	10	8	8	10	10
Observe	10	9	8	10	10	10
Observe	8	10	8	6	10	10
Observe	10	8	8	10	10	10
Perform	10	10	10	10	10	6
Perform	8	10	10	10	10	0
Perform	10	10	10	10	10	10
Perform	10	8	8	10	10	0

Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	8	10	10	10	10	6
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	8	10	10	10	6	10
Perform	10	10	10	10	10	10
Perform	10	10	10	10	10	10
Perform	9	8	8	10	10	6
Perform	10	9	6	10	10	7
Perform	8	10	5	10	10	3
Perform	8	9	8	6	10	3
Perform	10	10	8	8	10	7
Perform	8	8	8	8	6	6
Perform	10	9	8	10	10	6
Perform	10	10	8	10	10	7
Perform	8	9	7	6	2	3
Perform	10	9	8	8	10	7
Perform	10	9	8	8	10	6
Perform	10	9	8	10	10	6
Perform	10	10	8	10	10	10
Perform	9	8	8	10	6	10
Perform	9	6	9	10	10	10

Create T Test Data Set

Observe Create Test	***Perform Create test***
95	100
100	100
95	95
100	95
85	100
100	95
100	95
95	90
95	95
95	95
100	95
95	90
90	95
100	100
100	100
85	90
100	100
90	100
90	90
100	85
95	90
85	95
85	90
95	100
40	60
90	90
75	95
100	100
100	100
100	90
90	85
95	

Original Efficiency MANOVA Test Data Set
(Note: Shaded boxes represent missing data items)

	Lesson1Time	***Lesson2Time***	***Lesson3Time***	***Lesson4Time***	***Lesson5Time***	***Lesson6Time***
Observe	60	60	120	60	45	90
Observe	40	40	60	20	20	120
Observe		30				
Observe	40		75			90
Observe	60	60	60	60	60	120
Observe	60		30		5	45
Observe	60	60	60	60	90	240
Observe	90	40	60	50	70	100
Observe	150	120	120	60	120	120
Observe	60	45	180	35	60	210
Observe	120					180
Observe	75			50		
Observe		120	60		40	300
Observe	60	120		180	90	45
Observe		60	60	10		60
Observe	120	180	90	60	45	60
Observe	60	55	60	75	60	60
Observe	90	120	180	120	120	180
Observe	240	180	150	150	90	90
Observe	270	240	240	150	180	660
Observe	195	180	180	240	360	360
Observe	180	180	150	180	180	120
Observe	240	180	360	180	180	300
Observe	180		180			
Observe	50		40	20	30	50
Observe	120	150	150	120	130	180
Observe	120	120	120	120	120	120
Observe	330	180	120	180	120	660
Observe	150	120	180	90	150	180
Observe	180	120	60	120	120	120
Observe	240	180	150	120	60	60
Observe	180	60	60	120	120	120
Perform	360	300	240	240	300	420
Perform	60		240	360		
Perform	120	120				120

Perform	60			15		
Perform	60	30	60	30	45	240
Perform	60	30	180	15	120	300
Perform		180	60		240	180
Perform		30	20			40
Perform	50		45		55	
Perform	60	120	120	180	180	
Perform	120	45	60	45	20	75
Perform	120	120		120	90	180
Perform	60	20	30	60	30	30
Perform	60	120	90	120	120	120
Perform		180	120	120	180	360
Perform	90	60	75	60	60	135
Perform	90	60	60	60	45	90
Perform	240	180	240	180	180	240
Perform		60	120	105	90	120
Perform	180	300	240	240	180	180
Perform	240	180	180	135	90	180
Perform	300	240	240	360	240	
Perform	240	120	120	135	120	120
Perform	180	180	300	180	150	120
Perform	360	360	240	420	300	540
Perform		420	180	480		540
Perform	240	210	150	240	210	210
Perform	360	240	390	195	240	480
Perform	300	210	180	180	160	300
Perform	180	150	120	180	180	240
Perform	240	210	180	180	120	210

Efficiency MANOVA Test Data Set with Missing Data Rows Deleted

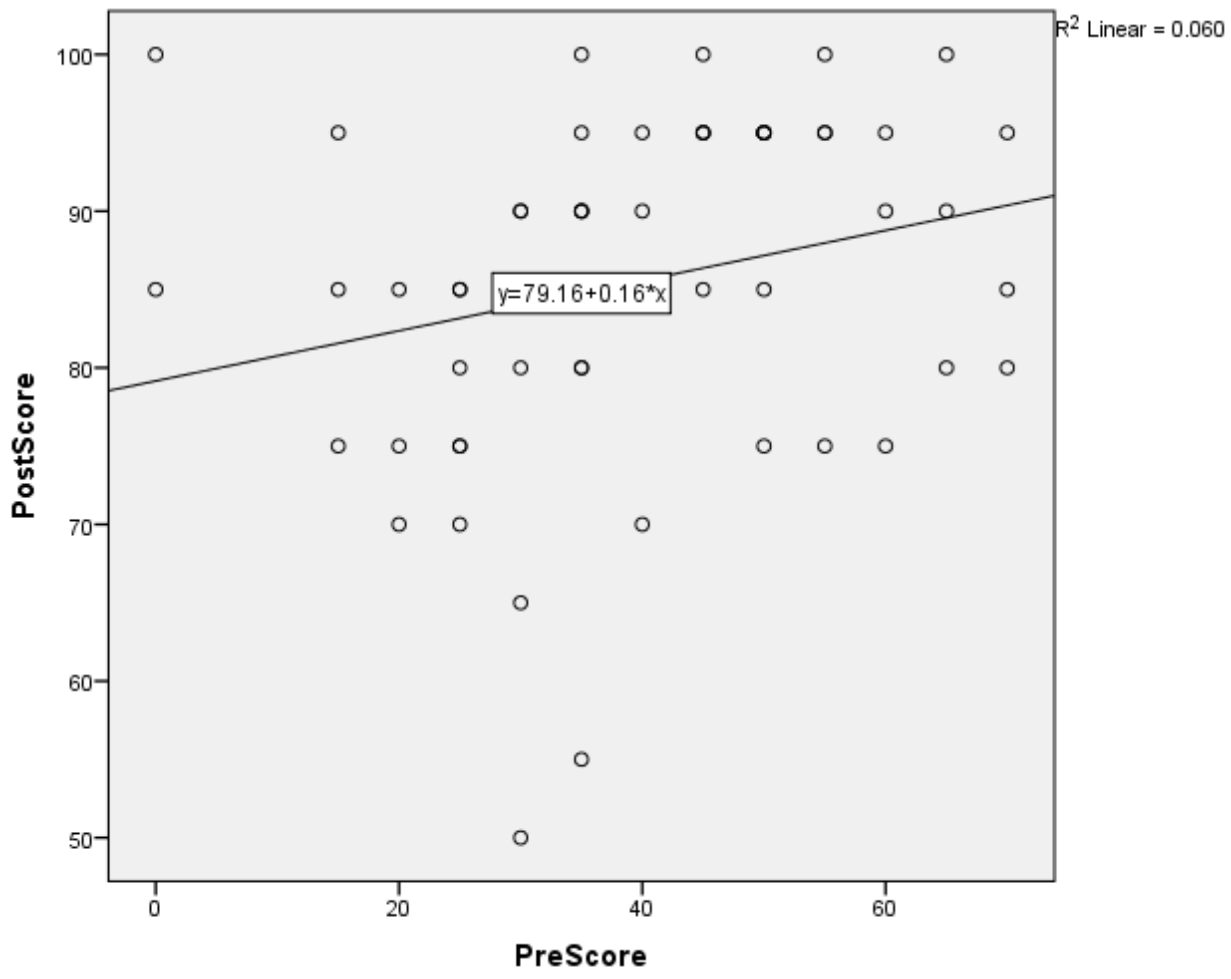
Treatment	***Lesson1Time***	***Lesson2Time***	***Lesson3Time***	***Lesson4Time***	***Lesson5Time***	***Lesson6Time***
Observe	60	60	120	60	45	90
Observe	40	40	60	20	20	120
Observe	60	60	60	60	90	240
Observe	60	60	60	60	60	120
Observe	90	40	60	50	70	100
Observe	150	120	120	60	120	120
Observe	60	45	180	35	60	210
Observe	120	180	90	60	45	60
Observe	60	55	60	75	60	60
Observe	90	120	180	120	120	180
Observe	240	180	150	150	90	90
Observe	270	240	240	150	180	660
Observe	195	180	180	240	360	360
Observe	180	180	150	180	180	120
Observe	240	180	360	180	180	300
Observe	120	150	150	120	130	180
Observe	120	120	120	120	120	120
Observe	330	180	120	180	120	660
Observe	150	120	180	90	150	180
Observe	180	120	60	120	120	120
Observe	240	180	150	120	60	60
Observe	180	60	60	120	120	120
Perform	360	300	240	240	300	420
Perform	60	30	60	30	45	240
Perform	60	30	180	15	120	300
Perform	120	45	60	45	20	75
Perform	60	20	30	60	30	30
Perform	60	120	90	120	120	120
Perform	90	60	75	60	60	135
Perform	90	60	60	60	45	90
Perform	240	180	240	180	180	240
Perform	180	300	240	240	180	180
Perform	240	180	180	135	90	180
Perform	240	120	120	135	120	120
Perform	180	180	300	180	150	120
Perform	360	360	240	420	300	540

Perform	240	210	150	240	210	210
Perform	360	240	390	195	240	480
Perform	300	210	180	180	160	300
Perform	180	150	120	180	180	240
Perform	240	210	180	180	120	210

APPENDIX L

SPSS Results

Remember ANCOVA Test Results



Univariate Analysis of Variance

Between-Subjects Factors

		N
Treatment	Observe	27
	Perform	30

Descriptive Statistics

Dependent Variable: PostScore

Treatment	Mean	Std. Deviation	N
Observe	82.78	11.547	27
Perform	87.83	10.059	30
Total	85.44	10.990	57

Levene's Test of Equality of Error Variances[a]

Dependent Variable: PostScore

F	df1	df2	Sig.
3.638	1	55	.062

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PreScore + Treatment

Tests of Between-Subjects Effects

Dependent Variable: PostScore

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Corrected Model	661.470[a]	2	330.735	2.927	.062	.098	5.853	.548
Intercept	54842.940	1	54842.940	485.291	.000	.900	485.291	1.000
PreScore	298.268	1	298.268	2.639	.110	.047	2.639	.358
Treatment	253.924	1	253.924	2.247	.140	.040	2.247	.313
Error	6102.565	54	113.010					
Total	422850.000	57						
Corrected Total	6764.035	56						

a. R Squared = .098 (Adjusted R Squared = .064)

b. Computed using alpha = .05

Estimated Marginal Means

Estimates

Dependent Variable: PostScore

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Observe	83.183[a]	2.061	79.051	87.315
Perform	87.469[a]	1.954	83.552	91.386

a. Covariates appearing in the model are evaluated at the following values: PreScore = 39.21.

Pairwise Comparisons

Dependent Variable: PostScore

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Observe	Perform	-4.286	2.860	.140	-10.019	1.447
Perform	Observe	4.286	2.860	.140	-1.447	10.019

Based on estimated marginal means

a. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: PostScore

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	253.924	1	253.924	2.247	.140	.040	2.247	.313
Error	6102.565	54	113.010					

The F tests the effect of Treatment. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

Apply MANOVA Test Results

General Linear Model

Between-Subjects Factors

		N
Treatment	Observe	32
	Perform	31

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
Lesson1	Observe	9.6875	.78030	32
	Perform	9.4516	.85005	31
	Total	9.5714	.81744	63
Lesson2	Observe	9.3125	1.11984	32
	Perform	9.3871	.95490	31
	Total	9.3492	1.03423	63
Lesson3	Observe	8.6875	1.94169	32
	Perform	8.8065	1.35202	31
	Total	8.7460	1.66528	63
Lesson4	Observe	8.8750	2.58719	32
	Perform	9.4839	1.15097	31
	Total	9.1746	2.02038	63
Lesson5	Observe	9.2188	2.04363	32
	Perform	9.3548	1.81748	31
	Total	9.2857	1.92126	63
Lesson6	Observe	8.6562	2.62260	32
	Perform	7.3871	3.07330	31
	Total	8.0317	2.90144	63

Box's Test of Equality of Covariance Matrices[a]

Box's M	48.189
F	2.052
df1	21
df2	13655.167
Sig.	.003

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + Treatment

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter
Intercept	Pillai's Trace	.995	2042.864[b]	6.000	56.000	.000	.995	12257.183
	Wilks' Lambda	.005	2042.864[b]	6.000	56.000	.000	.995	12257.183
	Hotelling's Trace	218.878	2042.864[b]	6.000	56.000	.000	.995	12257.183
	Roy's Largest Root	218.878	2042.864[b]	6.000	56.000	.000	.995	12257.183
Treatment	Pillai's Trace	.084	.858[b]	6.000	56.000	.532	.084	5.146
	Wilks' Lambda	.916	.858[b]	6.000	56.000	.532	.084	5.146
	Hotelling's Trace	.092	.858[b]	6.000	56.000	.532	.084	5.146
	Roy's Largest Root	.092	.858[b]	6.000	56.000	.532	.084	5.146

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Lesson1	3.071	1	61	.085
Lesson2	.447	1	61	.506
Lesson3	.272	1	61	.604
Lesson4	5.216	1	61	.026
Lesson5	.148	1	61	.702
Lesson6	1.501	1	61	.225

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Treatment

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[g]
Corrected Model	Lesson1	.876[a]	1	.876	1.318	.255	.021	1.318	.204
	Lesson2	.088[b]	1	.088	.081	.777	.001	.081	.059
	Lesson3	.223[c]	1	.223	.079	.779	.001	.079	.059
	Lesson4	5.837[d]	1	5.837	1.440	.235	.023	1.440	.219
	Lesson5	.292[e]	1	.292	.078	.781	.001	.078	.059
	Lesson6	25.363[f]	1	25.363	3.116	.083	.049	3.116	.412
Intercept	Lesson1	5767.860	1	5767.860	8676.165	.000	.993	8676.165	1.000
	Lesson2	5505.992	1	5505.992	5071.212	.000	.988	5071.212	1.000
	Lesson3	4818.889	1	4818.889	1711.874	.000	.966	1711.874	1.000
	Lesson4	5307.171	1	5307.171	1309.395	.000	.955	1309.395	1.000
	Lesson5	5432.038	1	5432.038	1449.712	.000	.960	1449.712	1.000
	Lesson6	4052.855	1	4052.855	497.860	.000	.891	497.860	1.000
Treatment	Lesson1	.876	1	.876	1.318	.255	.021	1.318	.204
	Lesson2	.088	1	.088	.081	.777	.001	.081	.059
	Lesson3	.223	1	.223	.079	.779	.001	.079	.059
	Lesson4	5.837	1	5.837	1.440	.235	.023	1.440	.219
	Lesson5	.292	1	.292	.078	.781	.001	.078	.059

	Lesson6	25.363	1	25.363	3.116	.083	.049	3.116	.412
Error	Lesson1	40.552	61	.665					
	Lesson2	66.230	61	1.086					
	Lesson3	171.714	61	2.815					
	Lesson4	247.242	61	4.053					
	Lesson5	228.566	61	3.747					
	Lesson6	496.574	61	8.141					
Total	Lesson1	5813.000	63						
	Lesson2	5573.000	63						
	Lesson3	4991.000	63						
	Lesson4	5556.000	63						
	Lesson5	5661.000	63						
	Lesson6	4586.000	63						
Corrected Total	Lesson1	41.429	62						
	Lesson2	66.317	62						
	Lesson3	171.937	62						
	Lesson4	253.079	62						
	Lesson5	228.857	62						
	Lesson6	521.937	62						

a. R Squared = .021 (Adjusted R Squared = .005)
b. R Squared = .001 (Adjusted R Squared = -.015)
c. R Squared = .001 (Adjusted R Squared = -.015)
d. R Squared = .023 (Adjusted R Squared = .007)
e. R Squared = .001 (Adjusted R Squared = -.015)
f. R Squared = .049 (Adjusted R Squared = .033)
g. Computed using alpha = .05

Estimated Marginal Means
Treatment

Estimates

Dependent Variable	Treatment	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Lesson1	Observe	9.688	.144	9.399	9.976
	Perform	9.452	.146	9.159	9.744
Lesson2	Observe	9.313	.184	8.944	9.681
	Perform	9.387	.187	9.013	9.761
Lesson3	Observe	8.688	.297	8.094	9.281
	Perform	8.806	.301	8.204	9.409
Lesson4	Observe	8.875	.356	8.163	9.587
	Perform	9.484	.362	8.761	10.207
Lesson5	Observe	9.219	.342	8.535	9.903
	Perform	9.355	.348	8.660	10.050
Lesson6	Observe	8.656	.504	7.648	9.665
	Perform	7.387	.512	6.362	8.412

Pairwise Comparisons

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
Lesson1	Observe	Perform	.236	.205	.255	-.175	.647
	Perform	Observe	-.236	.205	.255	-.647	.175
Lesson2	Observe	Perform	-.075	.263	.777	-.600	.450
	Perform	Observe	.075	.263	.777	-.450	.600
Lesson3	Observe	Perform	-.119	.423	.779	-.964	.727
	Perform	Observe	.119	.423	.779	-.727	.964
Lesson4	Observe	Perform	-.609	.507	.235	-1.623	.406
	Perform	Observe	.609	.507	.235	-.406	1.623
Lesson5	Observe	Perform	-.136	.488	.781	-1.112	.839
	Perform	Observe	.136	.488	.781	-.839	1.112
Lesson6	Observe	Perform	1.269	.719	.083	-.169	2.707
	Perform	Observe	-1.269	.719	.083	-2.707	.169

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.084	.858[a]	6.000	56.000	.532	.084	5.146	.311
Wilks' lambda	.916	.858[a]	6.000	56.000	.532	.084	5.146	.311
Hotelling's trace	.092	.858[a]	6.000	56.000	.532	.084	5.146	.311
Roy's largest root	.092	.858[a]	6.000	56.000	.532	.084	5.146	.311

Each F tests the multivariate effect of Treatment. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

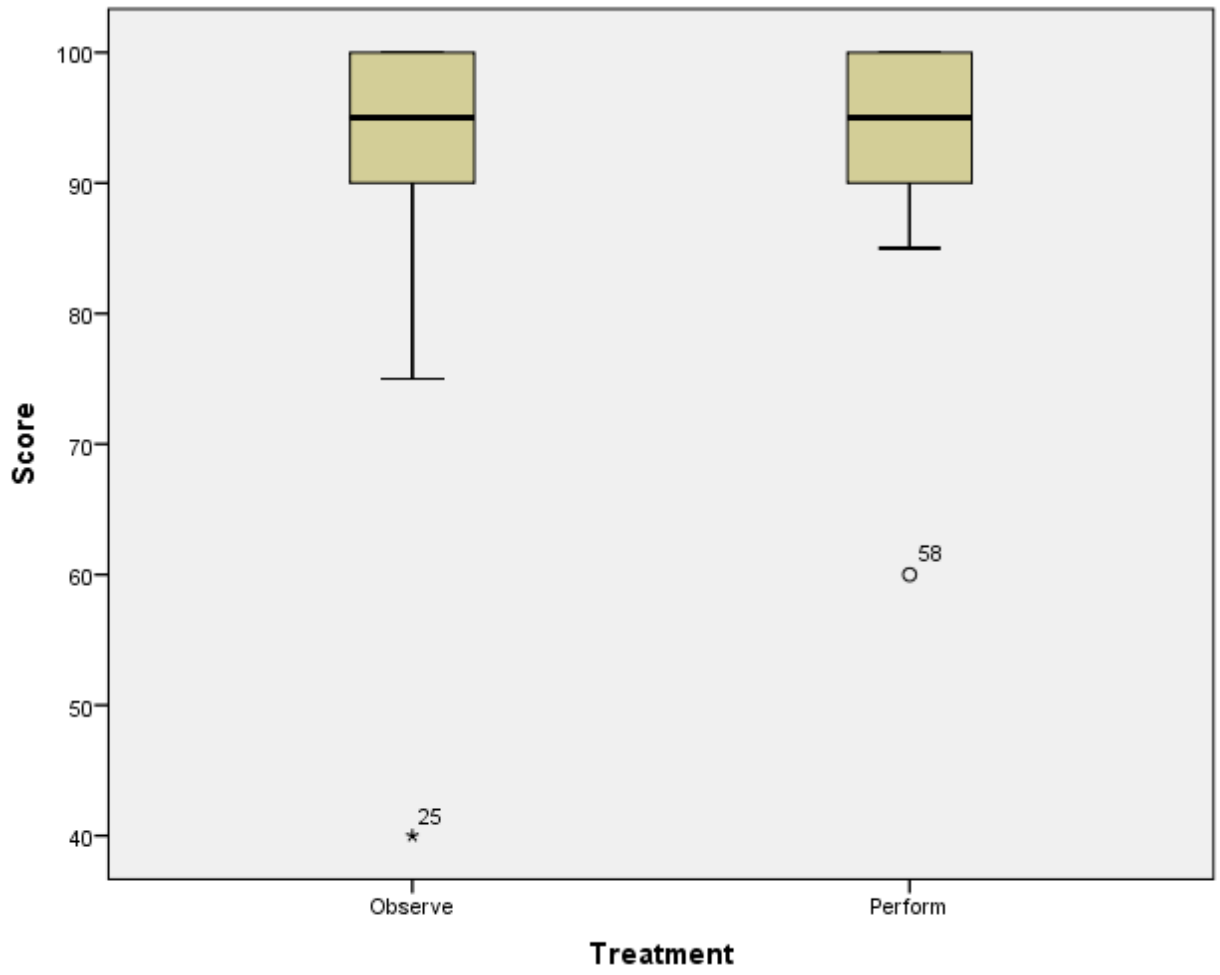
Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Lesson1	Contrast	.876	1	.876	1.318	.255	.021	1.318	.204
	Error	40.552	61	.665					
Lesson2	Contrast	.088	1	.088	.081	.777	.001	.081	.059
	Error	66.230	61	1.086					
Lesson3	Contrast	.223	1	.223	.079	.779	.001	.079	.059
	Error	171.714	61	2.815					
Lesson4	Contrast	5.837	1	5.837	1.440	.235	.023	1.440	.219
	Error	247.242	61	4.053					
Lesson5	Contrast	.292	1	.292	.078	.781	.001	.078	.059
	Error	228.566	61	3.747					
Lesson6	Contrast	25.363	1	25.363	3.116	.083	.049	3.116	.412
	Error	496.574	61	8.141					

The F tests the effect of Treatment. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

Create T-Test Results



T-Test

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Score	Observe	32	92.50	11.430	2.021
	Perform	31	93.55	7.767	1.395

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Score	Equal variances assumed	1.033	.313	-.424	61	.673	-1.048	2.470	-5.987	3.891
	Equal variances not assumed			-.427	54.743	.671	-1.048	2.455	-5.969	3.873

Efficiency MANOVA Results

General Linear Model

Between-Subjects Factors

		N
Treatment	Observe	22
	Perform	19

Descriptive Statistics

	Treatment	Mean	Std. Deviation	N
Lesson1	Observe	147.0455	81.10339	22
	Perform	192.6316	106.44989	19
	Total	168.1707	95.30055	41
Lesson2	Observe	121.3636	60.75285	22
	Perform	158.1579	101.14910	19
	Total	138.4146	82.98674	41
Lesson3	Observe	132.2727	73.28560	22
	Perform	165.0000	94.73648	19
	Total	147.4390	84.44763	41
Lesson4	Observe	107.7273	56.37306	22
	Perform	152.3684	98.01316	19
	Total	128.4146	80.61823	41
Lesson5	Observe	113.6364	71.86598	22
	Perform	140.5263	83.81353	19
	Total	126.0976	77.82603	41
Lesson6	Observe	194.0909	168.85212	22
	Perform	222.6316	137.13708	19
	Total	207.3171	153.74938	41

Box's Test of Equality of Covariance Matrices[a]

Box's M	32.878
F	1.302
df1	21
df2	5328.278
Sig.	.160

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.
a. Design: Intercept + Treatment

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.809	24.035[b]	6.000	34.000	.000	.809
	Wilks' Lambda	.191	24.035[b]	6.000	34.000	.000	.809
	Hotelling's Trace	4.241	24.035[b]	6.000	34.000	.000	.809
	Roy's Largest Root	4.241	24.035[b]	6.000	34.000	.000	.809
Treatment	Pillai's Trace	.115	.733[b]	6.000	34.000	.626	.115
	Wilks' Lambda	.885	.733[b]	6.000	34.000	.626	.115
	Hotelling's Trace	.129	.733[b]	6.000	34.000	.626	.115
	Roy's Largest Root	.129	.733[b]	6.000	34.000	.626	.115

a. Design: Intercept + Treatment
b. Exact statistic

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Lesson1	2.090	1	39	.156
Lesson2	5.583	1	39	.023
Lesson3	1.830	1	39	.184
Lesson4	3.809	1	39	.058
Lesson5	1.336	1	39	.255
Lesson6	.129	1	39	.722

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Treatment

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Lesson1	21186.429[a]	1	21186.429	2.415	.128	.058
	Lesson2	13802.334[b]	1	13802.334	2.057	.159	.050
	Lesson3	10919.734[c]	1	10919.734	1.552	.220	.038
	Lesson4	20317.167[d]	1	20317.167	3.306	.077	.078
	Lesson5	7371.782[e]	1	7371.782	1.224	.275	.030
	Lesson6	8304.639[f]	1	8304.639	.346	.560	.009
Intercept	Lesson1	1176318.137	1	1176318.137	134.102	.000	.775
	Lesson2	796568.188	1	796568.188	118.723	.000	.753
	Lesson3	900953.880	1	900953.880	128.081	.000	.767
	Lesson4	689697.654	1	689697.654	112.237	.000	.742
	Lesson5	658591.294	1	658591.294	109.343	.000	.737
	Lesson6	1770460.736	1	1770460.736	73.671	.000	.654
Treatment	Lesson1	21186.429	1	21186.429	2.415	.128	.058
	Lesson2	13802.334	1	13802.334	2.057	.159	.050
	Lesson3	10919.734	1	10919.734	1.552	.220	.038

	Lesson4	20317.167	1	20317.167	3.306	.077	.078
	Lesson5	7371.782	1	7371.782	1.224	.275	.030
	Lesson6	8304.639	1	8304.639	.346	.560	.009
Error	Lesson1	342101.376	39	8771.830			
	Lesson2	261669.617	39	6709.477			
	Lesson3	274336.364	39	7034.266			
	Lesson4	239654.785	39	6144.994			
	Lesson5	234903.828	39	6023.175			
	Lesson6	937250.239	39	24032.057			
Total	Lesson1	1522825.000	41				
	Lesson2	1060975.000	41				
	Lesson3	1176525.000	41				
	Lesson4	936075.000	41				
	Lesson5	894200.000	41				
	Lesson6	2707750.000	41				
Corrected Total	Lesson1	363287.805	40				
	Lesson2	275471.951	40				
	Lesson3	285256.098	40				
	Lesson4	259971.951	40				
	Lesson5	242275.610	40				
	Lesson6	945554.878	40				

a. R Squared = .058 (Adjusted R Squared = .034)
b. R Squared = .050 (Adjusted R Squared = .026)
c. R Squared = .038 (Adjusted R Squared = .014)
d. R Squared = .078 (Adjusted R Squared = .055)
e. R Squared = .030 (Adjusted R Squared = .006)
f. R Squared = .009 (Adjusted R Squared = -.017)

Estimated Marginal Means

Treatment

Estimates

				95% Confidence Interval	
Dependent Variable	Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Lesson1	Observe	147.045	19.968	106.656	187.434
	Perform	192.632	21.487	149.171	236.092
Lesson2	Observe	121.364	17.464	86.040	156.687
	Perform	158.158	18.792	120.148	196.168
Lesson3	Observe	132.273	17.881	96.104	168.441
	Perform	165.000	19.241	126.081	203.919
Lesson4	Observe	107.727	16.713	73.922	141.532
	Perform	152.368	17.984	115.993	188.744
Lesson5	Observe	113.636	16.546	80.168	147.104
	Perform	140.526	17.805	104.513	176.540
Lesson6	Observe	194.091	33.051	127.239	260.943
	Perform	222.632	35.565	150.695	294.568

Pairwise Comparisons

Dependent Variable	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
						Lower Bound	Upper Bound
Lesson1	Observe	Perform	-45.586	29.332	.128	-104.917	13.744
	Perform	Observe	45.586	29.332	.128	-13.744	104.917
Lesson2	Observe	Perform	-36.794	25.654	.159	-88.684	15.095
	Perform	Observe	36.794	25.654	.159	-15.095	88.684
Lesson3	Observe	Perform	-32.727	26.267	.220	-85.858	20.403
	Perform	Observe	32.727	26.267	.220	-20.403	85.858
Lesson4	Observe	Perform	-44.641	24.551	.077	-94.300	5.017
	Perform	Observe	44.641	24.551	.077	-5.017	94.300
Lesson5	Observe	Perform	-26.890	24.306	.275	-76.054	22.274
	Perform	Observe	26.890	24.306	.275	-22.274	76.054
Lesson6	Observe	Perform	-28.541	48.551	.560	-126.745	69.663
	Perform	Observe	28.541	48.551	.560	-69.663	126.745

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.115	.733[a]	6.000	34.000	.626	.115
Wilks' lambda	.885	.733[a]	6.000	34.000	.626	.115
Hotelling's trace	.129	.733[a]	6.000	34.000	.626	.115
Roy's largest root	.129	.733[a]	6.000	34.000	.626	.115

Each F tests the multivariate effect of Treatment. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Univariate Tests

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Lesson1	Contrast	21186.429	1	21186.429	2.415	.128	.058
	Error	342101.376	39	8771.830			
Lesson2	Contrast	13802.334	1	13802.334	2.057	.159	.050
	Error	261669.617	39	6709.477			
Lesson3	Contrast	10919.734	1	10919.734	1.552	.220	.038
	Error	274336.364	39	7034.266			
Lesson4	Contrast	20317.167	1	20317.167	3.306	.077	.078
	Error	239654.785	39	6144.994			
Lesson5	Contrast	7371.782	1	7371.782	1.224	.275	.030
	Error	234903.828	39	6023.175			
Lesson6	Contrast	8304.639	1	8304.639	.346	.560	.009
	Error	937250.239	39	24032.057			

The F tests the effect of Treatment. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Efficiency Independent Samples T-Test Results

Lesson 1

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson1	Observe	29	131.7241	78.91311	14.65380
	Perform	26	170.3846	107.01330	20.98703

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson1	Equal variances assumed	4.70	.04	-1.54	53	.13	-38.66	25.18	-89.16	11.84
	Equal variances not assumed			-1.51	45.63	.14	-38.66	25.60	-90.20	12.87

Lesson 2

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson2	Observe	26	115.3846	59.56380	11.68142
	Perform	28	159.8214	103.76685	19.61009

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson2	Equal variances assumed	5.99	.018	-1.91	52	.06	-44.44	23.26	-91.12	2.25
	Equal variances not assumed			-1.95	43.63	.06	-44.44	22.83	-90.45	1.58

Lesson 3

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson3	Observe	27	110.93	56.70	10.91
	Perform	28	152.86	90.56	17.11

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson3	Equal variances assumed	5.47	.02	-2.05	53	.045	-41.93	20.46	-82.97	-.89
	Equal variances not assumed			-2.07	45.59	.045	-41.93	20.30	-82.80	-1.07

Lesson 4

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson4	Observe	26	101.15	60.47	11.86
	Perform	27	171.67	120.96	23.28

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson4	Equal variances assumed	5.40	.02	-2.67	51	.01	-70.51	26.43	-123.57	-17.46
	Equal variances not assumed			-2.70	38.55	.01	-70.51	26.13	-123.38	-17.65

Lesson 5

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson5	Observe	25	92.2000	50.43725	10.08745
	Perform	26	144.0385	80.36192	15.76027

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson5	Equal variances assumed	6.08	.02	-2.75	49	.01	-51.84	18.88	-89.77	-13.91
	Equal variances not assumed			-2.77	42.29	.01	-51.84	18.71	-89.59	-14.08

Lesson 6

Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
Lesson6	Observe	27	137.7778	84.21965	16.20808
	Perform	26	221.9231	143.68770	28.17948

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Lesson6	Equal variances assumed	5.16	.03	-2.61	51	.01	-84.15	32.20	-148.80	-19.49
	Equal variances not assumed			-2.59	40.06	.01	-84.15	32.51	-149.84	-18.45

APPENDIX M

Transcript of Discussion Board

Discussion Board Transcript that Shows Diffusion of Treatment Effect

Question: "Is it bad to skip the video and go straight to codecademy to learn each lesson?"

In response to this question, the following exchange occurred:

Answer 1 – "I would highly suggest not skipping the video, even if you are doing super well and understand everything, these videos give you great directions that are simple and clear. I think that in the end it will make your life easier not to skip it. That way you also don't miss anything while doing your project!"

Answer 2 – "I have watched all of the videos and have completed all of the Codeacademy lessons and have learned great information from both. I would suggest keep watching the videos. I think they both are great. You can also go back and look parts up on the video if you are in the middle of something and forget what you need to do."

Answer 3 – "If it seems like the videos are a little long or go to slow for you, you can speed them up to 1.5-2x faster. Then it's only a 15-20 min video instead of 30! On the bottom bar of the video on the right there is "1x". Click the "1x" and you can change the speed to faster or slower. I included a picture of it too!"

Answer 4 – "I found the videos to be super helpful. Sometimes I would just open my website and watch the video at the same time. Found it to be great."