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Learning Spaces and Self-Efficacy in Undergraduate Statistics

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LEARNING SPACES AND SELF-EFFICACY IN UNDERGRADUATE STATISTICS

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Education at the University of Kentucky

By

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2017

ABSTRACT OF THESIS

LEARNING SPACES AND SELF-EFFICACY IN UNDERGRADUATE STATISTICS

Learning environment research has typically focused on factors other than the physical environment (e.g., student/teacher relationships, organizational structure). This study investigated the relationship between the physical classroom environment and entry-level undergraduate statistics students' (*N* = 844) academic beliefs and performance. Students were taught in either a technology-enhanced active learning classroom or a traditional lecture hall. This study investigated how undergraduate students in an entry level statistics course a) perceived the importance of the physical learning environment, b) conveyed expectations for and experiences of active engagement within that environment, and c) self-reported their personal capability judgments. Data were analyzed by examining mean differences, correlations, and regression. The nested data structure was accounted for using hierarchical linear modeling. Results indicated that, at the end of the semester, students rated the physical learning space as less important to their learning than they did at the beginning, although perceived importance was not influenced by classroom setting. The relationship between classroom type and active engagement expectation/experience offered mix results. Students learning in traditional classrooms reported higher statistics self-efficacy than did those in technology-enhanced statistics classrooms. End-of-course statistics self-efficacy was significantly related to grades earned.

KEYWORDS: Self-Beliefs, Self-Efficacy, Perceptions, Physical Learning Environment

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Introduction

Classrooms are changing from dark rooms with rows of desks and chalkboards at the front of the classroom to technology-filled, dynamic spaces built to encourage active learning through collaboration, innovation, and technology. As posited by social cognitive theory (Bandura, 1986), environmental factors (e.g., classrooms, learning spaces), behavioral outcomes (e.g., academic performance), and personal characteristics (e.g., beliefs, emotions, cognition) interact through reciprocal influence. Classrooms therefore, play a role in how students feel, think, and learn. Similarly, Israel (2003) stated that "connection is shaped not only by the physical reality of our environment but by the psychological, social/cultural, and aesthetic meanings that place holds for us" (p. x). This psychological attachment to a physical environment has been described as a *sense of place* by environmental psychologists. Nanzer (2004) described sense of place as "the manner in which humans relate to or feel about the environments [in which] they live" (p. 362). An examination of evolving learning spaces is important to investigate how the changing classroom landscapes are influencing student's beliefs and their connection to a learning space.

Stimuli in the physical environment inform students about what they could do or should and, thus, influence the way they regulate their own behavior (Steidle & Werth, 2014). The physical environment is important to learning in part because of the influence it has on psychological processes such as perception, cognitive fatigue, distraction, motivation, affect, and anxiety (Maxwell & Evans, 2002). In general, there is little evidence regarding how the physical environment affects the learning process. According to Durán-Narucki (2008), the quality of the building environment directly leverages the quality of the activities that are held in that space because the physical space is an intrinsic part of developmental and learning processes. Some have contended that the physical environment can be easily manipulated to produce positive changes for student learning (Rivlin & Weinstein, 1984). Others contend that personal factors carry more weight in predicting student learning and performance, although environmental factors do play a role (Bandura, 1997). This study intends to assess the physical classroom space as an observable and latent variable within the context of an undergraduate learning environment. I will investigate how the physical environment is related to students' beliefs (personal factors) and academic outcomes. Findings have the potential to substantiate the need for differing learning spaces within the context of learning statistics in an undergraduate environment.

Theoretical Framework

Social cognitive theory emphasizes the interactive relationship between personal, behavioral, and environmental influences (Figure 1; Bandura, 1989a). For example, the dynamic relationship between personal characteristics and environmental factors helps explain the influence environmental design can have on human thought and action according to the paradigm that the surrounding physical environment cannot be separated from a sense of one's self within it. As Israel (2003) observed, "our sense of self and sense of the environment are intimately and profoundly intertwined" (p. x). The social cognitive theory framework was chosen for this study because of its emphasis on the interplay between environmental influences and personal factors in guiding behavior within learning contexts.

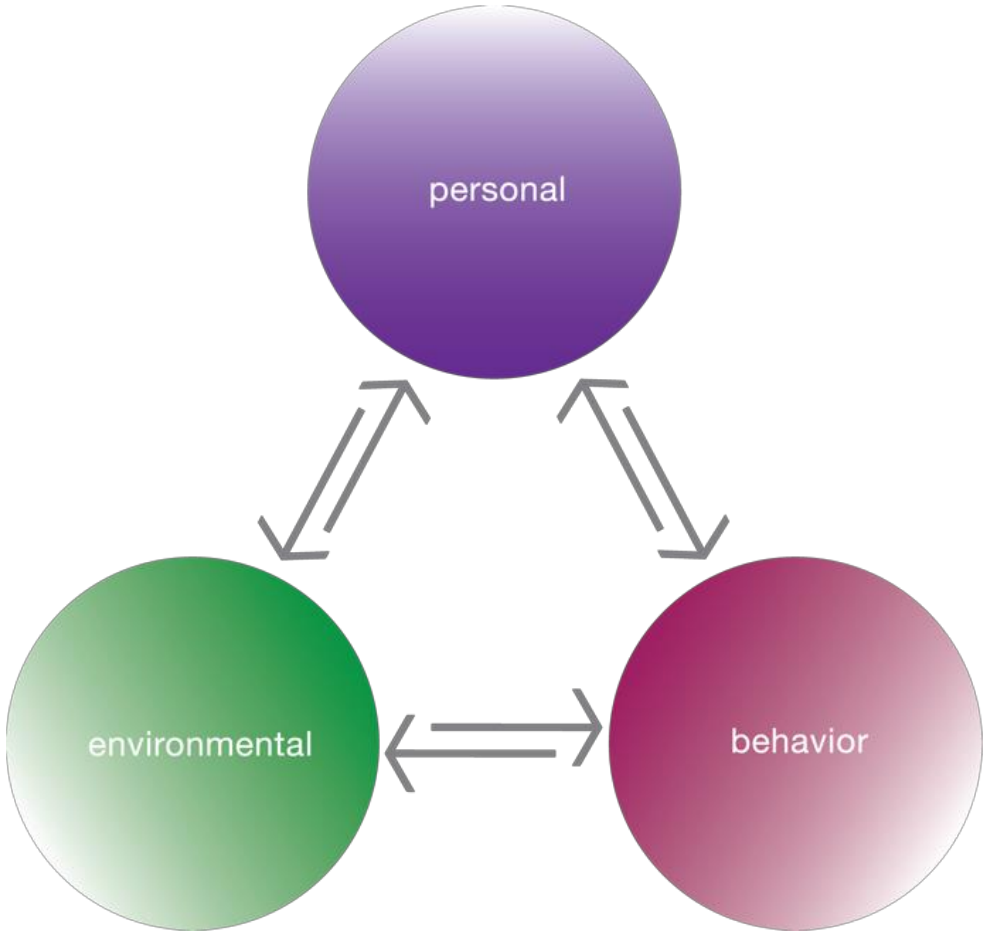

Figure 1. Bandura's (1989a) Social Cognitive Theory Framework

Social cognitive theory places the individual as a vital component in human behavior and motivation (Bandura, 1989a). By contrast, behaviorist theory primarily focuses on the causal relationship of environment and behavior (by altering the environment, the behavior changes; Woolfolk, 2016). Behaviorism was the dominant movement in psychology for the majority of the twentieth century and reinforced the philosophy that people learn by reacting to their environment (Woolfolk, 2016). Although this is compelling, social cognitive theory investigates another essential factor in addition to environment and behavior. When different learners are introduced to the same environment, what causes dissimilar behaviors? The social cognitive theoretical framework suggests that learners have a different sense of their own capabilities within the environment that influence varying outcomes. Past experiences, personal history, and learning approaches might make the environment and performance relationship more complex. “People are both products and producers of their environment” (Bandura, 1989b, p. 4).

Bandura (1997) has suggested that an important factor in determining human behavior is individual’s beliefs in their personal efficacy to perform within a variety of situations. These beliefs answer the question, *Can I do this*? Self-efficacy is central to social cognitive theory because it suggests the exercise of personal control over behavior, or the “generative capability in which cognitive, social, emotional, and behavioral subskills must be organized and effectively orchestrated to serve innumerable purposes” (Bandura, 1997, p. 37). Furthermore, personal efficacy beliefs are created and strengthened by psychological mechanisms (Bandura, 1977). Self-efficacy has been shown to predict retention, understanding, and comprehension of material due to cognitive, motivational, affective, and selection processes (Bandura, 1989a). Human beings actively contribute to their own behavior. A student who has low self-efficacy for learning mathematics could dwell on her self-doubt and find it challenging to motivate herself to complete her goals.

The interaction and reciprocal determinism between personal, behavioral, and environmental factors are integral to agency (Bandura, 1999) and this perspective is central to social cognitive theory. "In this model of reciprocal causation, action, cognitive, affective, and other personal factors, and environmental events all operate as interacting determinants. Any account of the determinants of human action must, therefore, include self-generated influences as a contributing factor" (Bandura, 1989a, p. 1176). Beliefs about one's capabilities can be influenced by the physical nature of the learning environment because "personal agency operates within a broad network of sociostructural influence" (Bandura, 1997, p. 6). The physical nature of space can also communicate implicit messages regarding societal values (Maxwell & Schectman, 2012). For example, a classroom that has outdated text books, worn furniture, and broken lights could be interpreted by students that their education is not valued, and that they are not valuable to society.

Traditionally, the term "learning environment" refers to the psychological or interpersonal climate of the classroom which focuses on relationships between student/teacher, student/student, and the organizational structure of the classroom (Maxwell & Evans, 2014; Weinstein, 1979). The relationship between the physical environment and learning behavior has recently become a topic of inquiry (Maxwell & Evans, 2014). This relationship is important to investigate because, "schools and classrooms are physical entities as well as organizational units and the physical characteristics of a setting can influence both the behavior of its users and the educational program" (Rivlin & Weinstein, 1984, p. 348). Most research focused on the physical environment in educational settings explores objective building quality in relation to behavioral outcomes. Often, physical learning environment research utilizes seating position, classroom design, density, privacy, noise, and windows as data sources to measure objective building quality (Weinstein, 1979). However, some recent research also investigates the construct "sense of place," or the perception of the environment, which conveys social, cultural, and psychological meanings (Hauge, 2007).

The environment does not directly or explicitly influence human behavior. Instead, users perceive the physical learning space in unique ways. It is therefore important to understand how perceptions of the environment might influence other beliefs, such as course expectations and domain specific self-efficacy. In social cognitive theory, personal factors serve as a mediator between the environment and human behavior (Bandura, 1997). "Self-influences affect the selection and construction of environments" (Bandura, 1993, p. 118). As previously stated, the physical environment can influence several psychological processes (perception, cognitive fatigue, distraction, motivation, affect, and anxiety; Maxwell & Evans, 2002), but a more robust study is needed to address the relationships between psychological processes and perceptions of the physical learning space.

One innovative approach to designing a classroom that enhances learner engagement is to allow the physical structure of the classroom enable a student-centered pedagogical approach. In active learning, the teacher's role is to facilitate learning rather than relay knowledge (Park & Choi, 2014). Active learning "essentially occurs when an instructor stops lecturing and students work on a question or task designed to help them understand a concept" (Andrews, Leonard, Colgrove, & Kalinowski, p. 394, 2011). The physical structure of learning spaces shape the interactions (communication, engagement, collaboration, learning) in active learning environments (Vyortkina, 2015). A classroom designed for active learning creates a space that facilitates dynamic interaction between users rather than a traditional lecture hall that strictly facilitates one-sided discourse. In this study, I examine how the physical nature of two different classroom types – one specifically designed to promote active learning – influence students' perceptions and the relationships between personal capability beliefs and academic performance.

Literature Review

Four questions guided this review of literature. First, how is the physical space related to learning? Second, why is the relationship between self-beliefs and learning important? Third, why could student perceptions of the importance of the physical environment on learning be related to self-beliefs? And lastly, why is studying the physical environment important in statistics classrooms? The existing and relevant research offer answers to portions of these inquiries.

Physical Space in Education. Learning theories have historically been used to guide the physical design of education settings. Teachers can adopt certain theories of learning, influencing pedagogy and classroom management. The major tenets in learning theories can then be used to structure the educational environment and the classroom layout as theory would suggest (Getzels, 1974). It is important to therefore assess whether the physical nature of a learning setting contributes to the learning process. For example, Getzels (1974) suggested there are four classifications of the physical classroom setting – rectangular, square, circular, and open. These four types are listed in chronological development, but there is some overlap. All four classroom types are common in American universities.

The rectangular classroom has permanent desks in straight rows and relates to the behaviorist learning theory (Getzels, 1974) with the teacher as the focal point. Behaviorism is a theory of learning that emphasizes that the acquisition of facts, skills, and concepts occurs through drill and guided practice without emphasis on student-to-student interaction and teaching is telling (Woolfolk, 2016). The square classroom refers to an educational environment with no teacher's desk and completely mobile pupils' desks. The learner is presumed to actively organize information guided by the teacher borrowing from the information processing theory, (Woolfolk, 2016). Learning is conceived as a connective, dynamic, and affective process when the learner behaves as an active organism (Getzels, 1974). The circular classroom emphasizes social interaction where learning happens through interpersonal actions and reactions between each person in the classroom. In the circular classroom, everyone faces everyone else (Getzels, 1974). Social constructivism emphasizes a social/group process, so an optimum layout allows peers to face each other because collaboration is the primary learning source that happens through the active construction of knowledge between the group and teacher (Woolfolk, 2016). The open classroom allows for a stimulus-seeking learner, which requires an environment that raises the level of excitement. An open classroom is a large learning space where designated student and teacher desks do not exist and work surfaces and seating options are varied (Getzels, 1974). Bandura's (1989a) social cognitive theory is reflective of the physical layout of this classrom as it suggests a continuous shifting source of knowledge where in both the environment as a whole, interaction with others, and the influence of personal factors shape learning (Woolfolk, 2016). In all four classroom types, learning outcomes, the teacher's, and student's educational roles are influenced by the physical nature of the space. In the present study, two classroom layouts are examined. The technology-enhanced classroom most closely resembles what Getzels (1974) described as the circular classroom because the furniture layout emphasizes student collaboration. The second classroom (traditional) in this study directly resembles what Getzels (1974) described as the rectangular classroom because student desks all face towards the front of the classroom where the teacher stands.

Physical Space and Academic Achievement. Typically, researchers have asked whether the objective quality of the built environment influences student academic performance to investigate a causal relationship. Most empirical research on learning spaces has focused on investigating the relationship between overall building quality and academic achievement or performance. Researchers have investigated this subject in a variety of educational settings. For example, Duran-Narucki (2008) researched Manhattan middle school students' English and mathematics academic performance and overall school building quality. Furthermore, Bowers and Urick (2011) studied how overall school building quality is related to math academic achievement of American high school students. Bowers and Urick (2011) used a national database that records school facility disrepair and building conditions and standardized test scores to investigate the relationship. Duran-Narucki (2008) developed three levels of the built environment that could influence academic performance. The material level, social interaction level, and environmental meaning level were used to illustrate the condition of the school building and the implications each of those levels on student education. Duran-Narucki (2008) found that overall building quality was significantly related to scores in both mathematics and English but Bowers and Urick (2011) did not produce evidence that building quality influences mathematics achievement. However, they did find differences in student and school attributes of facility disrepair and encourages further research to explore the physical space as a mediator and not a direct influence of achievement. Bowers and Urick (2011) suggested investigating the relationship between perceptions of building quality, student motivation and attitudes, and school academic climate. Results of these studies are mixed, indicating that the quality of the built environment cannot be measured by student performance alone.

Perceptions of Physical Space and Self-Beliefs. Bandura (1997) has frequently explained that environments do not always affect behaviors directly. Rather, personal factors such as perceptions and beliefs affect how learning spaces influence the learning process. Behaviors are first affected by what people, think, feel, and believe. For example, when a student enters a classroom for the first time, her initial judgment of the physical attributes can alter how she perceives the class structure and how she expects to engage. If the classroom is equipped with cameras, projectors, monitors, and computers, she may feel anxious because she has never participated in a course that uses this degree of technology. She might be unsure of what will be expected of her. She could have a low sense of self-efficacy because she does not have any prior experience. In turn, this anxiety could lead her to be less eager to engage in the course. Her learning might suffer as a result.

Self-beliefs are important when investigating the physical nature of learning environments because of the meaning students can associate with the spaces in which they learn. Several studies have addressed the meaning students associate with their learning environments. Maxwell (2000) investigated student, teacher, and student parent feelings about the quality of the physical nature of an elementary school and she focused on what attributes of the entire school built environment make people feel welcome and safe, and examined whether the importance of those attributes varies by age. Maxwell found that children as young as nine years old are aware of their physical surroundings. Therefore, this awareness influenced positive and negative perceptions of the built learning environment. Yang, Becerik-Gerber, and Mino (2013) studied undergraduate students' perceptions of physical space in six classrooms at a university and identified the attributes that were most influential on learning. Furthermore, Maxwell and Schectman (2012) investigated the relationship between objective building quality, perception of building quality, and self-perception of 105 sixth through eleventh graders. Each of these studies found that students are not only aware, but able to identify the physical nature of the space in which they learn. In addition, Maxwell and Schectman found that objective physical attributes, perception of the physical space, and self-perception contribute to academic success.

Existing research that measures the physical learning space and personal capability beliefs (attitudes, motivation, affect) has not used Bandura's social cognitive theory framework. Though Maxwell and Schectman measured generalized self-efficacy and perception of school building quality, Bandura's (1989a) theoretical framework was not used. Generalized self-efficacy was defined by Maxwell and Schectman as "the belief that one's efforts will lead to a specific outcome" (p. 26) and emphasized that "although self-efficacy is primarily domain-specific, high self-efficacy in one domain can generalize to an overall sense of self-efficacy" (p. 26). However, Pajares (1996) argued that, "studies that report a lack of relationship between self-efficacy and performance often suffer from problems either in specificity or correspondence" (p. 556). Maxwell and Schectman found a modest relationship between school building quality, perception of school building quality, and participant reported general self-efficacy. These findings do indicate there is a relationship between the physical environment of learning spaces and self-efficacy. However, if the self-efficacy items used in the study had been domain specific, the relationship might have been stronger. This research suggests that physical space can be considered as an important environmental factor within social cognitive theory.

Some have argued that the physical environment influences other psychological processes. For example, Choi, Merrienboer, and Paas (2014) found that the physical learning environment influences cognitive, physiological, and affective processes. For example, the furniture layout in a classroom might increase or decrease the amount of cognitive load on the learner's experience. If this is the case, educators can then physically influence student cognitive load to then improve learning.

Evans and Stecker (2004) investigated existing literature on physical environment stressors (i.e., air pollution, crowding) in relation to student motivation. Three paradigms were reviewed: behavioral responses, learned helplessness, and persistence of tasks. They found that lack of control over environmental stressors produces undesirable behavior and adverse psychological processes. Acute and chronic exposure to uncontrollable environmental stressors contributes to learned helplessness. These recent reviews pointed to the need for further exploration of how the physical learning environment is related to students' beliefs, emotions, and learning.

Statistics Self-Efficacy and Undergraduate Performance. One specific personal belief, *self-efficacy*, is an example of a personal factor that has demonstrated predictive power over an individual's behavior (Bandura, 1997). Self-efficacy is not a global trait, but a domain-specific belief (Pajares, 2009). One domain of interest is statistics self-efficacy, or students' confidence in their ability to learn statistics (Olani, Hoeskstra, Harskam, and van der Werf, 2011). Several research studies have focused on the relationship between statistics self-efficacy and statistics performance, but no studies have simultaneously assessed how the statistics physical learning environment might be related to self-efficacy.

Students who feel more confident in their statistics capabilities perform better (Finney & Schraw, 2003). There is a stronger relationship between self-beliefs and performance when self-efficacy items are closely aligned to the task and performance that is being measured (Choi, 2005). McGrath, Ferns, Greiner, Wanamaker, and Brown (2014) investigated the relationship between anxiety, statistics self-efficacy, and performance in an advanced statistics course. Student self-efficacy was positively correlated with course performance and negatively correlated with anxiety. However, according to Olani et al, (2011), existing research that analyzes statistics self-efficacy and performance offers mixed results. Positive changes, negative changes, or no changes have been found in various studies when analyzing pre-to-post course changes in statistics personal capability beliefs.

Purpose of the Study

For many undergraduate students, statistics is the first mathematics domain course taken at the university level. Students likely enter with preconceptions about mathematics and their capabilities in that domain, even if they know little about what learning statistics entails. As they enter the classroom, the physical nature of the space might evoke certain emotional responses or cognitive appraisals of their ability. It is important to consider statistics self-efficacy as a possible mediator between the built environment and academic outcomes.

The purpose of this study was to explore statistics students' perceptions of their physical classroom environments and to examine the relationship between these perceptions and students' academic beliefs and performance. This study explored the relationship between the physical environment and personal factors within the framework of social cognitive theory by investigating several variables: course expectations, physical environment perceptions, and statistics self-efficacy.

This investigation is guided by the following research questions:

RQ1. How important do students find the physical learning space at the beginning and the end of the semester?

RQ2. At the beginning of the semester, do students who are learning in a technology-enhanced classroom differ from students learning in a traditional classroom in terms of how important they rate the physical classroom space?

RQ3. Do students' rating of the importance of the physical classroom space differ at the beginning and end of the semester?

RQ4A. Do students who are learning in a technology-enhanced classroom differ from students learning in a traditional classroom in terms of their active engagement expectations at the beginning of the semester?

RQ4B. Do students who are learning in a technology-enhanced classroom differ from students learning in a traditional classroom in terms of their actual active engagement experiences (as reported at the end of the semester)?

RQ5. Is there a difference in the end-of-course statistics self-efficacy reported by students who learned statistics in a technology-enhanced classroom and those who learned in a traditional classroom (after controlling for pre-course statistics self-efficacy)?

RQ6. What is the relationship between statistics self-efficacy at each time point and final grade in the course?

Method

Context of the Study

To study the relationship between the physical learning environment and self-efficacy, I sought interior environments that incorporate traditional classrooms and active learning spaces. For the intent of this study, traditional classrooms are classified as an environment with forward facing furniture and the teacher at the front of the classroom. An "active learning" classroom is classified as an environment with no front or focal point and an atypical furniture layout.

Two entry-level statistics courses were selected for this study. The courses are taught by different instructors with a common curriculum and work book. Course 1 and Course 2 are quantitative foundation courses. In addition to diverse physical attributes of the classrooms, I sought courses that serve a diverse group of undergraduate students. These courses are part of the core curriculum at the university and therefore enroll students from diverse disciplines. Course 1 emphasizes statistical reasoning and literacy. Course 2 emphasizes statistical method and conceptual understanding. The director of this program developed a common pedagogy and curriculum in attempt to standardize what content is taught, when it is taught, and how it is taught. Each instructor was assumed to adopt an active learning approach that encourages student engagement to teach undergraduate statistics. The director of the courses provided insight to the information that would be taught in the course for the development of survey items.

Classes took place in five physical classrooms (R1, R2, R3, R4, R5). R1, R2, and R3 have the same physical components: The classrooms are technology-enhanced, six-person, D-shaped tables, with no front (see Figure 2 and Figure 3). R1 accommodates 132 students, and R2 and R3 accommodate 30 students each. R4 is a 90-person lecture hall with bolted stadium seating (Figure 4). R5 is a 90-person flat classroom with sled desks (Figure 5). Both R4 and R5 have a front of the classroom where the teacher primarily stands.

Course 1 consists of nine sections and approximately 850 students in technology-enhanced active learning classrooms. This course is taught by six different instructors; three instructors teach multiple sections. Course 2 consists of five sections and approximately 530 students in one technology-enhanced active learning classroom and two traditional lecture-style classrooms. Course 2 is taught by three different instructors, one of whom teaches three sections.

Figure 2. Room 1: Technology-Enhanced Classroom: 132 Seats

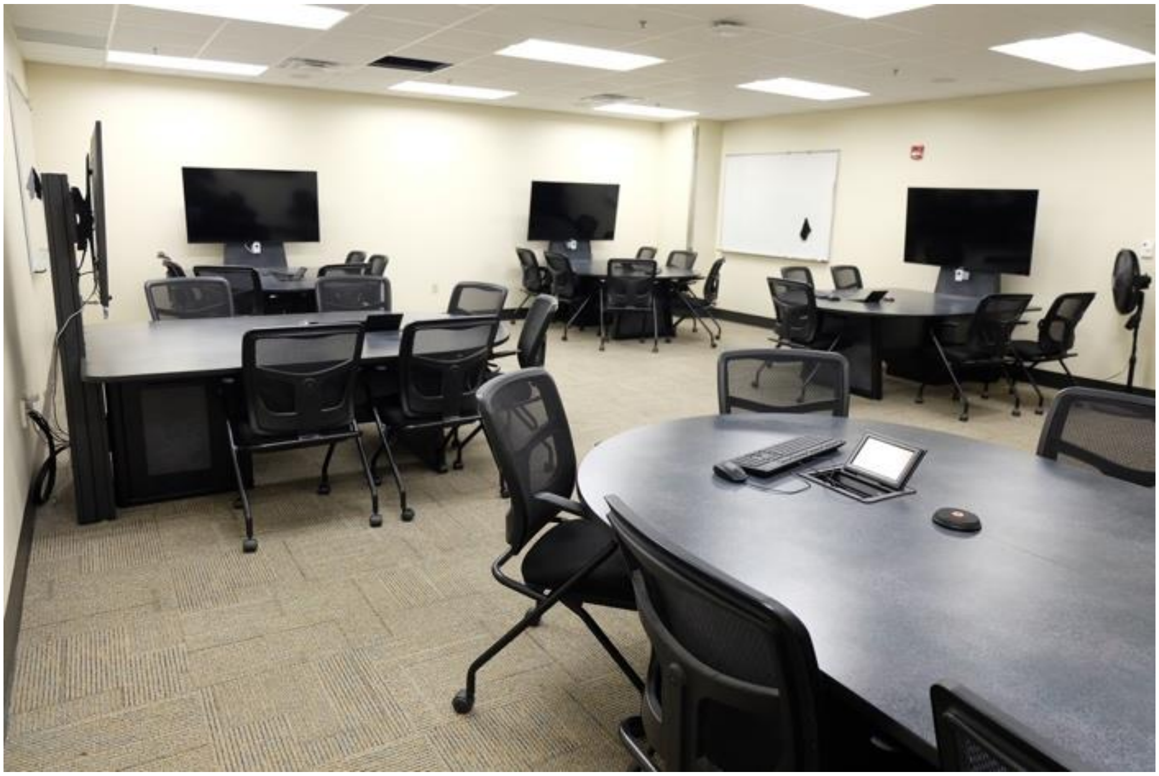

Figure 3. Room 2: Technology-Enhanced Classroom: 30 Seats

Figure 4. Room 4: Traditional Classroom: 90 Seats

Figure 5. Room 5: Traditional Classroom: 90 Seats

Participants

The participants in this study were 844 entry-level statistics students ($n_{Course1}$ = 673, $n_{Course2}$ = 171). This sample was representative of the undergraduate student population at the institution in that 59.1% identified as female and 82.7% identified as White. The mean age was 19.79, and 54.9% were in their sophomore year of college. Students represented different undergraduate majors enrolled during the fall 2016 semester in an entry-level statistics course (Course 1 and Course 2). These courses were selected because many sections are offered in unique physical classroom environments supported by active learning technology while others are offered in traditional lecture formats.

Procedure

Surveys were administered during the first week of the semester and during the last two weeks of the semester. Within the first week of the fall semester, students completed a baseline survey (pre). The baseline survey (post) included several scales that assessed students' formal mathematics background, course expectations, perceptions of the physical environment, statistics self-efficacy, self-efficacy for self-regulation, and general demographic information. Within the final two weeks of the fall semester, students completed an end-of-course survey. The end-of-course survey included items that assessed course experience, physical environment perception of importance, statistics self-efficacy, self-efficacy for self-regulation, and general demographic information. Only students with signed consent forms were included in the study. This study was approved by the internal review board at the institution.

Faculty teaching two entry-level statistics courses were contacted before the semester began to explain the purposes of the study. All instructors provided access to their students and their students' grades. Questionnaires were administered by paper and pencil method. Each phase took students approximately 15 minutes to complete. Baseline (pre) and end-of-course (post) surveys for both courses can be found in Appendices A, B, C, and D. Student course grades were collected from instructors at the end of the semester.

Data Sources

This research study is primarily focused on investigating students' perception of the importance of the physical learning space, expectations/experiences related to active engagement in the course, statistics self-efficacy, and final course grades. Not all variables assessed on the baseline and end-of-course surveys were analyzed. Only those relevant to the aims of this study are described below.

Perceived Importance of the Physical Environment. A single item was created to measure how important students feel the physical classroom space is to their learning. Students were asked to rate their level of agreement to the following item: "The physical classroom space is important to my learning," on a scale from 1 *(disagree)* to 4 *(agree)*. This item was included on both the baseline (pre) and end-of-course (post) surveys.

Course Active Engagement Expectations and Experiences. Fifteen items were created to assess student course expectations at the beginning of the semester. On the end-of-course survey, these items were reworded to assess students' experiences in the course. For example, "I expect to be an active learner in this class" (pre) and "I was an active learner in this class" (post) were developed to track whether student expectations at the beginning of the semester were fulfilled at the end of the semester. For the purposes of this research study, I focused on four items at each phase that related to active engagement: "I [expect to be/was] an active learner in this class," "I [expect to participate/participated] during class time in this course," "I [expect to use/used] technology a great deal in this course," and "I [expect to work/worked] with others in this course." Participants rated their level of disagreement/agreement to each statement on a scale from 1 (*disagree*) to 4 (*agree*). A preliminary exploratory factor analysis was conducted to examine the dimensionality of the items. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were first calculated to determine if these items could be measured as one construct. A KMO value less than .5 indicates that a factor analysis is not appropriate for use with the data (Cerny & Kaiser, 1977). Bartlett's test of sphericity was also used to check whether every item was correlated adequately with other items for factor analyses to be conducted (Cerny & Kaiser, 1977).

Results of the preliminary psychometric analyses indicated a lack of evidence that these four items reflect one construct, as the KMO was 0.533 and Bartlett's test of sphericity was significant, 1184.72, $p < .001$. Therefore, total score analyses were abandoned and items were analyzed separately. A non-significant test ($p < .05$) indicates the items are not appropriate for further factor factor analysis. Therefore, total score analyses were abandoned and items were analyzed separately.

Statistics Self-Efficacy. Eleven statistics self-efficacy items were adapted from Finney and Schraw's (2003) Statistics Self-Efficacy Scale to be appropriate for Course 1 and Course 2 content. Syllabi from each course were used to ensure that items were closely aligned with course content. Statistics self-efficacy items were included on the baseline and end-of-course surveys.

Preliminary analyses (KMO & Bartlett's test of sphericity) were conducted to analyze the psychometric properties of the statistics self-efficacy items, and to determine the appropriateness of using exploratory factor analysis. These analyses were run separately for the students in Course 1 and Course 2 because some items differed between courses according to relevant material derived from course syllabi.
Results indicated that these items should be analyzed as a unidimensional scale. KMO was 0.948 (Course 1) and 0.931 (Course 2), and Bartlett's test of sphericity was significant, 7516.783, $p < .001$ (Course 1), 4301.844, $p < .001$ (Course 2). Factor loadings for items in each course-specific scale are presented in Table 1 (Course 1) and Table 2 (Course 2). Since the test is significant ($p < .05$), this would indicate that the variables are correlated. Seven of the eleven items included were the same for both Course 1 and Course 2 surveys (see Appendices A, B, C, & D). Statistics self-efficacy items included, "How confident are you that you can decide if two variables are correlated?" and "How confident are you that you can form a statistical hypothesis?" Students rated their level of confidence on a scale from 1 (*not at all confident*) to 4 (*completely confident*). Each scale comprised eleven items for Course 1, $\alpha = .940$ and Course 2, $\alpha = .917$, and ML estimation route was used.

Course Grades. Final course grades were collected from the instructors at the end of the semester. This variable will be used to measure student academic performance. Final grades were provided on a 0-100 scale.

Table 1

Factor Loadings for Unidimensional Model for Statistics Self-Efficacy Scale, Course 1

Items	Factor
1. Differentiate between an experiment and observational study?	.761
2. Explain the importance of the placebo effect?	.740
3. Determine what is confounding in an experiment?	.820
4. Distinguish statistical significance from practical significance?	.817
5. Articulate at least two different types of sampling?	.834
6. Form a statistical hypothesis?	.818
7. Ask questions about another student's ideas?	.666
8. Identify the central problem, issue, or question in a statistics problem?	.828
9. Justify your solution to a statistics problem in writing?	.802
10. Decide if two variables are correlated?	.820
11. Distinguish between a population, parameter, and a sample statistic?	.799

Table 2

Factor Loadings for Unidimensional Model for Statistics Self-Efficacy Scale, Course 2

Items	Factor
1. Identify the scale of measurement for a variable?	.706
2. Interpret the probability value (p-value) from a statistical procedure?	.766
3. Identify the factors that influence power?	.663
4. Distinguish statistical significance from practical significance?	.814
5. Explain what the numeric value of the standard error is measuring?	.818
6. Form a statistical hypothesis?	.780
7. Ask questions about another student's ideas?	.571
8. Distinguish between a Type I and a Type II error in hypothesis testing?	.728
9. Justify your solution to a statistics problem in writing?	.770
10. Decide if two variables are correlated?	.754
11. Distinguish between a population, parameter, and a sample statistic?	.772

Data Analyses

The sampling method of this study resulted in nested data (students nested within class sections); therefore, hierarchical linear modeling (HLM) was determined to be the most appropriate technique for initially answering Research Questions 3, 5, and 6. Research Questions 1, 2, and 4A/B do not require the HLM method because descriptive analyses are sufficient. Prior to analyzing the nested data, it was important to determine if HLM was needed due to significant variation in second level variables (i.e., classroom sections; Peugh, 2010). The intraclass correlation is the intercept divided by the intercept plus the residual,

$$ICC = (\tau_{00} / \tau_{00} + \sigma^2)$$

where τ_{00} is the intercept and σ^2 is the residual. "The ICC gives a measure of how homogeneous the data are within a Level 2 cluster unit, i.e., how well the data within a unit correlate with each other, compared with between clusters" (Glaser & Hastings, 2011, p. 880). According to Muthèn (1991, 1994), ICC values typically range between .05 and .20 in social science research studies that require HLM. If a significant degree of variation exists among Level 2 variables, then HLM is needed to model the variance within students (Level 1) and the variance across course sections (Level 2). If the ICC falls out of the recommended range, classical test theory methods, such as regression, can be used because variance within Level 1 cannot be attributed to Level 2 (Peugh, 2010). A descriptive statistics report was used to examine if students perceive the physical environment as important or unimportant for learning (RQ1). Mean scores were calculated for the full sample and by professor. Cohen's *d* effect size will be reported for all relevant analyses and SPSS 22.0 software was utilized for all analyses.

A chi-square test of independence was conducted to determine whether there is a statistically significant association between how students reported importance of the physical learning environment at the beginning of the semester (pre) and the classroom in which they are learning (RQ2). This method was chosen due to the categorical nature of both variables (i.e., 4-point scale). In this analysis, the dependent variable is student perceived importance of the physical learning environment scores at the beginning of the semester and the independent variable is classroom type (technology-enhanced or traditional).

The third research question asks if ratings of importance of the physical classroom space differ from the beginning (pre) to end (post) of the semester. A nonparametric Wilcoxon signed rank test (a nonparametric test equivalent to a dependent samples *t* test) was conducted to compare how students reported importance of the physical learning environment on the baseline and end-of-course survey. Because the variable of interest is being treated as ordinal, a nonparametric test, equivalent to paired samples *t* test, was used. Specifically, a Wilcoxon signed rank test was chosen because it accounts for the violated assumption in a dependent *t* test that assumes the data have known differences between the anchors (1 *disagree* and 4 *agree*; Divine, Norton, Hunt, & Dienemann, 2013). This test will substitute mean differences for the actual numerical data to obtain the significance of the difference (Wilcoxon, 1945). In addition to identifying differences in importance of the physical learning environment, this test will enable me to compare pre and post scores in the form of rankings. Separate analyses for the full sample, students learning in technology-enhanced classrooms, and students learning in traditional classrooms were conducted. In these analyses, the dependent variable is student perceived importance of the physical learning environment and the independent variable is time of semester.

Recall that the purpose of Research Questions 4A and 4B was to investigate if eight active engagement items, 4 expectations (pre) and 4 experiences (post) differed for those students learning in a technology-enhanced classroom versus those learning in a traditional classroom. Each item will be examined separately due to the exploratory factor analysis indicating that these items are not measuring one construct. A nonparametric Wilcoxon Mann-Whitney test was calculated for each item and frequencies are reported. A Wilcoxon Mann-Whitney test is a nonparametric alternative to a paired samples *t* test that investigates the mean differences between the same population at two different time points. In these analyses, the dependent variable is students' active engagement expectations/experiences and the independent variable is classroom type.

The last two aims of the study involved statistics self-efficacy. Due to the nested nature of the data, HLM is needed to account for multiple sources of variability (Peugh, 2010) and to answer the fifth research question, "Is there a significant difference in the end-of-course statistics self-efficacy reported by students who learned statistics in a technology-enhanced classroom and those who learned in a traditional classroom (after controlling for pre-course statistics self-efficacy)?" The Level 1 variable was statistics self-efficacy and the Level 2 variable was class section. As with RQ3, the ICC was first calculated. If the ICC suggests that the nested data structure (or amount of variability in statistics self-efficacy due to clusters) is minimal, then individual level analyses will be conducted by means of ANCOVA. The independent variable is classroom type, the dependent variable is post-statistics self-efficacy scores, and the covariate is pre-statistics self-efficacy scores.

RQ6 sought to understand the relationship between statistics self-efficacy and final course grade. Once again, because of the nested nature of the data, HLM analysis was needed to investigate whether a significant amount of variability in final course grades occurred across sections. If the ICC suggests that the nested data structure is minimal, then only individual level analyses will be conducted. Pearson's correlation coefficient was used to initially assess the bivariate relationship between self-reported statistics self-efficacy at the end of the semester and final grade in the course.

A hierarchical linear regression analysis will be used to test whether or not the independent variable (statistics self-efficacy) significantly predicted the dependent variable (final course grade). This will be analyzed for the full sample, traditional classroom participants, and technology-enhanced participants.

Results

The first research question addressed how students in the full sample responded to how important the physical learning space is to their learning at the beginning and end of the semester. Mean scores at pre and post are reported in Table 3 for the full sample, by type of classroom (technology-enhanced or traditional), and by professor. The full sample (N = 844) mean score was higher at the beginning of the semester (M = 3.36, SD = 0.683) than at the end (M = 3.24, SD = .765). The decline of mean scores throughout the semester was representative of all students, except for those learning from one instructor (Professor 4) who taught in a 30-seat technology-enhanced classroom. In this latter instance, the respondent mean score at the beginning of the semester was 3.16 and 3.26 at the end of the semester.

I next sought to investigate whether students' physical learning environment (technology-enhanced or traditional) might be related to how important they rated their classroom environment to their learning at the beginning of the semester (pre). Results indicated no statistically significant association between classroom type and students' rating of the importance of the physical space, $\chi^2(3) = 2.137$, $p = .509$.

I then considered whether ratings of importance changed across the semester (RQ3). Before testing differences for the full sample, I first investigated whether a significant proportion of variance in perceived importance could be attributed to the specific classrooms students were in. The proportion of variation across sections showed that 0.3% of the variance could be attributed to class section (ICC = .00169 / [0.5268 + 0.00169] = 0.003). Therefore, a paired samples *t* test was sufficient to examine the individual level differences in all students' importance ratings at the beginning and end of the semester. This variable consists of ordinal data, so a nonparametric Wilcoxon signed-rank test was used and results indicated a statistically significant difference between students' ratings of importance at the two points in the semester, $z = -3.933$, $p < .001$. Descriptively, 220 participants responded with a higher rating of importance of the physical space at the beginning of the semester and 148 rated the physical space more important at the end, while 476 showed no change.

Table 3

Importance of Physical Classroom Space on Learning

		Pre	Post
Sample	*n*	*M, (SD)*	*M, (SD)*
Full	844	3.36, (0.68)	3.24, (0.77)
Technology-Enhanced Classroom	673	3.36, (0.67)	3.26, (0.77)
Professor 1	143	3.34, (0.58)	3.31, (0.70)
Professor 2	225	3.35, (0.67)	3.30, (0.77)
Professor 3	85	3.33, (0.73)	3.19, (0.79)
Professor 4	19	3.16, (0.83)	3.26, (0.56)
Professor 5	14	3.64, (0.49)	3.00, (0.56)
Professor 6	187	3.41, (0.70)	3.22, (0.80)
Traditional Classroom	171	3.34, (0.74)	3.18, (0.79)
Professor 1	60	3.35, (0.82)	3.15, (0.69)
Professor 6	54	3.43, (0.60)	3.30, (0.74)
Professor 7	57	3.25, (0.76)	3.09, (0.93)

I next investigated whether students in the two different learning environments differed in their expectations about active engagement at the beginning of the semester and active engagement experiences reported at the end of the semester (RQ4A & RQ4B). Item-level results tend to be unreliable (Kline, 2016), so only descriptive analyses and a Wilcoxon Mann-Whitney test were used to descriptively investigate the association between classroom type and active engagement expectations and experiences. As indicated in Table 4, students learning in a technology-enhanced classroom reported higher expectation and experience ratings when asked about participation during class time than those learning in a traditional classroom, $z = -4.79$, $p < .001$ (pre Item 2) and $z = -4.38$, $p < .001$ (post Item 2). Students learning in a technology-enhanced classroom also reported higher ratings for pre expectation and post experience when asked about working with other students in the course than those learning in a traditional classroom, $z = -7.61$, $p < .001$ (pre Item 4) and $z = -8.76$, $p < .001$ (post Item 4). When asked at the beginning of the semester if they expected to be an active learner during the course, participants' responses showed a significant association between this item (pre Item 1) and classroom type $z = -2.35$, $p < .019$ (pre Item 1). However, there was no statistically significant difference in classroom types and students' responses when asked if they were an active learner in the course at the end of the semester, $z = -0.41$, $p < .683$ (post Item 1). Likewise, when asked at the beginning of the semester if they expect to use technology a great deal in the course, there was a significant association between the expectation item (pre Item 3) and classroom type, $z = -2.71$, $p < .007$ (pre Item 3) but there was not with the experience item, $z = -1.79$, $p < .074$ (post Item 3).

Table 4

Association Between Classroom Type and Active Engagement Expectation (Pre) / Experience (Post) Items

	Technology-Enhanced						Traditional				
Pre/Post Item	Strongly Disagree	Disagree	Agree	Strongly Agree	*M, SD*	Z	Strongly Disagree	Disagree	Agree	Strongly Agree	*M, SD*
I expect to be an active learner in this class.	0.3%	3.3%	38.7%	57.7%	3.54 (0.58)	-2.35*	0.0%	9.4%	40.9%	49.7%	3.40 (0.66)
I was an active learner in this class.	8.4%	22.7%	44.8%	24.2%	2.85 (0.88)	- .41	8.2%	18.1%	51.5%	22.2%	2.88 (0.85)
I expect to participate during class time in this course.	1.0%	4.8%	42.2%	52.0%	3.45 (0.64)	-4.79**	1.2%	17.6%	45.3%	35.9%	3.16 (0.75)
I participated during class time in this course.	7.9%	18.5%	42.8%	30.8%	2.97 (0.90)	-4.38**	14.7%	27.1%	40.0%	18.2%	2.62 (0.95)
I expect to use technology a great deal in this course.	0.9%	12.4%	48.4%	38.3%	3.24 (0.70)	-2.71*	2.3%	20.5%	46.2%	31.0%	3.06 (0.78)
I used technology a great deal in this course.	6.1%	18.0%	38.9%	37.0%	3.07 (0.89)	-1.79	1.2%	17.6%	38.8%	42.4%	3.22 (0.78)
I expect to work with others in this course.	0.6%	3.3%	33.0%	63.1%	3.59 (0.59)	-7.61**	2.4%	12.4%	52.4%	32.9%	3.16 (0.73)
I worked with others in this course.	0.4%	2.2%	22.1%	75.2%	3.72 (0.52)	-8.76**	5.3%	7.0%	46.2%	41.5%	3.24 (0.80)

Note. A non-parametric alternative to independent samples t test, Wilcoxon Mann-Whitney was used.

* $p < .05$, ** $p < .001$

RQ5 posed the question, "Is there a significant difference in the end-of-course statistics self-efficacy reported by students who learned statistics in a technology-enhanced classroom and those who learned in a traditional classroom (after controlling for pre-course statistics self-efficacy)?" To examine possible section-level effects, the proportion of variation in statistics self-efficacy scores across sections was calculated using the ICC equation. Results indicated that about 3% of the variance in statistics self-efficacy scores could be attributed to students' class section (ICC = .0134 / [.412 + .0134] = .032). Given that the Level 2 variance in statistics self-efficacy was minimal, I elected to use an ANCOVA to examine the individual level variance in statistics self-efficacy (Peugh, 2010; Muthèn, 1991, 1994).

Using pre-statistics self-efficacy scores as a covariate, ANCOVA results revealed a statistically significant difference in students' statistics self-efficacy scores at the end of the semester as a function of classroom types (technology-enhanced or traditional), F (1, 343) = 24.446, $p < .001$, $d = 0.501$. Specifically, students who took statistics (Course 2) in a traditional classroom reported higher statistics self-efficacy ($M = 3.15$, $SD = .571$) than did those taking the course in a technology-enhanced classroom ($M = 2.84$, $SD = .663$).

Table 5

Pearson's Correlations Between Final Grade and Statistics Self-Efficacy Scores

			Pre	Post
Course	Classroom Type	*n*	*r*	*r*
Course 1	Technology-Enhanced	486	.10*	.36**
Course 2	All Students	358	.02	.43**
	Technology-Enhanced	187	.10	.45**
	Traditional	171	-.04	.36**

* $p < .05$, ** $p < .001$

I next sought to determine whether there was a relationship between statistics self-efficacy scores and student final grades in the course. Statistics self-efficacy was examined both at the beginning of the semester (pre) and at the end of the semester (post), so I examined both with final grades. I first examined the bivariate correlations between the variables (Table 5). There was a small but statistically significant, positive correlation between statistics self-efficacy scores reported at the baseline and final grades for Course 1, $r = .104$, $p = .024$, but not for Course 2, $r = .017$, $p = .744$. Statistics self-efficacy at the end of the semester was related to grades for both Course 1, $r = .361$, $p < .001$ and Course 2, $r = .434$, $p < .001$, indicating that higher statistics self-efficacy ratings resulted in higher course grades and vice versa. In preparation for regression analysis, I also inspected the distribution of statistics post self-efficacy scores and final grades heuristically with a scatterplot to ensure the linearity of the variables.

Due to the nested nature of the data, the ICC was calculated to determine how much variance in final grades could be accounted for at the second level (classrooms) (Peugh, 2010). Results showed that 7% of the variance could be attributed to variation across sections at Level 2, ICC = .07, $p < .001$. Therefore, HLM was appropriate for examining the final research question (Muthén 1991, 1994). Because the correlations were positive and in the same direction, a fixed effects HLM model was used.

The next step was to determine whether statistics self-efficacy explained students' final course grades. Results of a hierarchical linear regression analysis indicated that self-efficacy significantly predicted grades ($\beta = 3.33$, $p < .001$). The regression slope (Table 6) indicates that statistics grades increased as statistics self-efficacy increased, such that a one-point increase in statistics self-efficacy is associated with a 3.33 increase

Table 6

*Hierarchical Linear Model Analysis for the Full Sample (*N *= 844)*

		All Students	Technology-Enhanced	Traditional
Parameters	Unconditional	Level 1 β	Level 1 β	Level 1 β
Regression coefficients (fixed effects)				
Intercept	83.46 (0.65)**	.507 (0.90)	- 1.280 (0.82)	.976 (1.04)
Statistics Self-Efficacy	--	3.328 (0.54) **	4.601 (0.78)**	2.023 (0.76) **
Variance Components (random effects)				
Residual	79.37 (2.75)**	79.751 (4.29) **	80.836 (6.00)**	77.170 (6.02)**
Intercept	06.73 (2.72) **	7.121 (3.83)	.862 (1.31)	7.624 (4.55)*

Note. Parameter estimates are listed followed by standard errors listed in parentheses.

* $p < .05$, ** $p < .001$

in grades, on average. Statistics grades were centered at the grand mean to provide an unbiased estimate of the student-level variance (Peugh, 2010).

Discussion

The overarching intent of this study was to explore the relationship between the physical environment, self-beliefs, and academic outcomes. Specifically, this study investigated how undergraduate students in an entry level statistics course a) perceived the importance of the physical learning environment, b) conveyed expectations for and experiences of active engagement within that environment, and c) self-reported their personal capability judgments. This study was grounded in social cognitive theory and results support the associations between the environmental factors (classroom type), personal factors (perceptions, self-efficacy), and behavioral outcomes (course grades). The results of this study are not experimental findings. Therefore, results are tenable at best. Confounds present in this study are various classroom sizes, time of day, frequency of meetings, and instructor characteristics.

Perceptions of Importance. Overall, the students in this study rated the physical space as important to their learning. This finding is consistent with perceptions of importance measured in a Dutch university context (Beckers, van der Voordt, and Dewulf, 2016). Unlike the study conducted in the Netherlands, this study included two time points, at the beginning and end of the semester. In fact, 56.4% showed no change in their ratings of importance throughout the course of the semester. A sufficient number of students lowered their rating at the end of the semester from their pre-course rating. Their ratings were slightly lower on the post-course survey than on the pre-course survey and the magnitude of these differences was statistically significant. Generally, this shows a stable trend that students perceive that their learning space is important to learning. Most students took the survey on the first day of class, before they had experienced learning in the physical space. It could be that the slightly lower rating at the end of the semester reflected how they felt in the space throughout the semester more accurately than did their initial assessment moments after entering the space for the first time.

Active Engagement. At the beginning of the semester, students expected to be active learners in the class. However, students reported a much lower score at the end of the semester when asked if they were active learners in the class. In other words, students' expectation ratings to be active learners in the course were high at the beginning of the semester and were substantially lowered by the end of the semester. Similar patterns were found when students were asked if they expected to participate during class time in the course. Students reported much higher at the beginning of the semester when asked about their expectations, than students' experience ratings at the end of the semester. Findings indicate that students do have preconceptions about their expected level of active engagement upon entering the course. The drastic change in frequency of those responses indicates that preconceptions about active engagement are changing across the course of the semester.

Comparing Classrooms

Classroom Setting and Importance. Analyses showed that there was no difference in how students in the two settings, technology-enhanced and traditional, perceived the importance of the physical space for their learning. In other words, during the first week of class, whether a student was sitting in the space specifically designed for active learning or sitting in the traditional lecture hall, perceptions of importance of the physical space for their learning did not differ. These findings might have been different if I had examined their ratings of importance at the end of the semester, rather than at the beginning. It may be that after spending four months in a classroom, students sitting in one setting might find the physical space more or less important to their learning than in a different physical setting. This is a recommendation for further research.

In a related analysis, I investigated whether the variability in student ratings might be explained by class section. Little variance can be attributed to the section, suggesting that the majority of the variation in student responses was due to individual differences. However, would students rate importance differently after returning to a traditional classroom following their experiences in a technology-enhanced classroom? Students in this study were only examined during their time in either a technology-enhanced or traditional classroom. They may find that the physical space is indeed important to their learning when returning to learning statistics in a traditional classroom after experiencing the technology-enhanced classroom. More longitudinal research should be done to investigate whether, over time and with more experiences in active learning settings, rankings of the importance of the physical space change.

I examined students' perceptions of importance of the physical space to learning with a single item. It could be that using a variety of items to assess how important the physical space is to students' learning would provide a better measure of this construct in future research efforts (Kline, 2016). In addition, it would be interesting to investigate whether perceptions of importance of the physical space influences academic outcomes.

Classroom Setting and Active Engagement. The active engagement expectation and experience items were developed to investigate if the layout, technology, and furnishings of the classroom space would communicate how students should engage in the course (e.g., active learner, participation, technology use, collaboration). Some of this study's findings suggest that the classroom setting does influence what is communicated to students about their expected behavior in the course and later how they experienced the course. For example, students were asked if they expected to work with others in the course at the beginning of the semester, 63.1% of technology-enhanced classroom participants strongly agreed and only 32.9% of traditional classroom students strongly agreed. At the end of the course, 75.2% of students learning in a technology-enhanced classroom said they strongly agreed and 41.5% of students learning in a traditional classroom strongly agreed with the statement that they worked with others in the course. The large difference in frequencies could be due to students that were learning in a technology-enhanced classroom faced their peers and technology at D-shaped tables, and students in the traditional lecture hall faced the same direction, towards the front of the classroom. Future research could investigate whether there is a relationship between expectations of active engagement and academic outcomes because students that initially expect to be actively engaged in the course, could have higher grades at the end of the semester.

Classroom Setting, Statistics Self-Efficacy, and Final Course Grades. The results of this study show a positive correlation between statistics self-efficacy and final grades in the course. In other words, the higher students' self-reported statistics self-efficacy, the higher their final grade. This result was expected in this study because past domain specific self-efficacy studies have also offered these results (Valentine, DuBois, & Cooper, 2004). This finding is important to this study because students who learned in a technology-enhanced classroom, a classroom designed specifically for active learning statistics, reported lower self-efficacy than students learning in a traditional classroom. In other words, students who learned in the traditional classroom environment had more confidence in their abilities to learn statistics than students who learned in a physical space that was intentionally designed for the activity of learning statistics. This finding was unexpected, it can lead to further investigations and queries.

Supplemental analyses were conducted to investigate the relationship between final course grades and classroom type. The mean final course grade of participants learning statistics in a traditional classroom was higher than the mean final course grade of participants learning statistics in a technology-enhanced classroom. This finding is consistent with existing research in that domain specific self-efficacy predicts course grades (Valentine, DuBois, & Cooper, 2004). Both statistics self-efficacy scores and final course grades were higher for students that learned in a traditional classroom environment, than those learning in a technology-enhanced classroom.

These results beg the question, what could explain the difference in statistics self-efficacy scores and academic performance in different learning contexts? There are several possibilities that could contribute to this finding. First, instructor beliefs and content delivery could be a factor. This could have been the first time an instructor had taught in a classroom of this nature. His belief in his ability to deliver the material in this setting, with an active learning pedagogy, could have been fundamental in the students' experience. Second, the students may have been unfamiliar with the active learning approach to learning statistics. This factor could contribute to lower confidence in students learning in a classroom designed for this type of instruction. For example, the furniture layout in the technology-enhanced classroom limited sightlines from the student to the instructor because there was not a formal front of classroom. If students heavily rely on this visual connection and that was restricted in the technology-enhanced learning space, their self-beliefs and performance could suffer as a result. This is reflective of a study Barron (2003) conducted on interactions between groups and problem-solving outcomes. The study found that the way in which students manage collaborative and interactive spaces is critical to the outcomes of problem-solving (Barron, 2003). Last, the relationship between the meaning students associate with their learning spaces, sense of place, could influence beliefs in their abilities (Barron, 2003). For example, students are likely more familiar with navigating the traditional classroom than the technology-enhanced. Internally, students could associate the traditional classroom with higher learning that could in turn, influence their beliefs in their abilities to learn statistics. This is a foundational study that found there is a relationship between environmental influences, personal factors, and behavioral outcomes. Future research should further investigate the relationship between sense of place and personal capability beliefs.

Concluding Remarks

The present study on learning spaces and self-efficacy in undergraduate statistics was developed for several reasons. Potential benefits to the fields of interior design and educational psychology, the university, and instructors were incentives to conduct this research study. This study contributes to the fields of interior design and educational psychology by identifying relationships between the physical environment, personal beliefs, and academic performance outcomes. Also, some instructors may find the results of this study beneficial to their instructional practices. The design decisions of new classroom spaces that were investigated were developed with an active learning pedagogical theme in mind, resulting in a classroom designed to accommodate thoughtfully constructed curriculum. Lastly, university administrators stand to benefit from the findings of this study. Technology-enhanced active learning classrooms are more costly to construct than traditional lecture halls. This study sought to investigate the relationship between these classroom investments and learner outcomes. Therefore, the research provides insight regarding how physical classroom spaces could best be constructed for learning statistics, a high-need course serving thousands of students annually.

APPENDIX A

Course 1 Baseline Survey

Student Survey: University of Kentucky Learning Spaces

This survey is designed to gather information about students' attitudes about learning in particular classroom spaces at the University of Kentucky. Please answer these questions honestly, **with the physical classroom space around you in mind**. *Your individual responses will not be seen by your instructor. Your survey responses will have no effect on your grade in this course.* There are no right or wrong answers. Thank you for providing us with your honest responses.

Carefully read each statement below and circle the number that best represents your level of disagreement/agreement.		Disagree	Somewhat Disagree	Somewhat Agree	Agree
1.	The physical classroom space is important to my learning.	1	2	3	4
2.	I expect to be an active learner in this class.	1	2	3	4
3.	I expect to participate during class time in this course.	1	2	3	4
4.	I expect this class to be challenging.	1	2	3	4
5.	I expect to enjoy this course.	1	2	3	4
6.	I expect to be successful.	1	2	3	4
7.	I expect to get an instructor's help if needed.	1	2	3	4
8.	I expect to be seen by the instructor in this course.	1	2	3	4
9.	I expect the instructor to know my name.	1	2	3	4
10.	I expect to be comfortable with where I sit in the course.	1	2	3	4
11.	I expect to use technology a great deal in this course.	1	2	3	4
12.	I expect to be out of my comfort zone in this course.	1	2	3	4
13.	I expect to work with others in this course.	1	2	3	4
14.	I expect to feel safe in this course.	1	2	3	4
15.	I expect to be aware of my surroundings in this course.	1	2	3	4
16.	I expect to feel confident when participating in this course.	1	2	3	4

	When thinking about this classroom, <u>how confident are you that you can</u>…	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
17.	Do well in this course?	1	2	3	4
18.	Earn an excellent grade in this course?	1	2	3	4
19.	Learn the material in this course?	1	2	3	4
20.	Master the skills taught in this course?	1	2	3	4
21.	Understand the most difficult concepts taught in this course?	1	2	3	4
22.	Perform well on homework and exams in this course?	1	2	3	4
	When thinking about doing statistics this classroom, <u>how confident are you that you can</u> …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
23.	Differentiate between an experiment and observational study?	1	2	3	4
24.	Explain the importance of the placebo effect?	1	2	3	4
25.	Determine what is confounding in an experiment?	1	2	3	4
26.	Distinguish statistical significance from practical significance?	1	2	3	4
27.	Articulate at least two different types of sampling?	1	2	3	4
28.	Form a statistical hypothesis?	1	2	3	4
29.	Ask questions about another student's ideas?	1	2	3	4
30.	Identify the central problem, issue, or question in a statistics problem?	1	2	3	4
31.	Justify your solution to a statistics problem in writing?	1	2	3	4
32.	Decide if two variables are correlated?	1	2	3	4
33.	Distinguish between a population, parameter, and a sample statistic?	1	2	3	4

What are your general feelings about the physical environment of this UK classroom? (Write below.)

	How confident are you in your ability to …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
34.	Concentrate on your work **in this classroom space**?	1	2	3	4
35.	Remember information that is presented **in this classroom space**?	1	2	3	4
36.	Focus on what the instructor is saying **in this classroom space**?	1	2	3	4
37.	Focus on what your classmates are saying **in this classroom space**?	1	2	3	4
38.	Motivate yourself **in this classroom space**?	1	2	3	4
39.	Participate **in this classroom space**?	1	2	3	4
40.	Get help if you need it **in this classroom space**?	1	2	3	4

	Circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
41.	I have always been successful in classes like this one (e.g., math, statistics).	1	2	3	4
42.	Thinking about this course makes me feel stressed and nervous.	1	2	3	4
43.	I did well on high school assignments in classes like this one.	1	2	3	4
44.	I get depressed when thinking about this course.	1	2	3	4
45.	Doing coursework for this class will take all of my energy.	1	2	3	4
46.	I have done well on difficult assignments in classes like this one.	1	2	3	4
47.	I feel excited when thinking about difficult work in this course.	1	2	3	4
48.	I made excellent grades in high school in classes like this one.	1	2	3	4
49.	I feel stressed-out as soon as I begin thinking about this course.	1	2	3	4
50.	I got an outstanding score on the math section of the ACT.	1	2	3	4

What was your approximate score on the Mathematics portion of the ACT (scale of 1-36)? ______________

How did you do in your high school Math classes? Circle the answer that best applies to you.

Algebra	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Geometry	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Pre-Calculus	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Calculus	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Statistics	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take

Finally, please answer some demographic questions about yourself. Circle or write in your response.

Gender	Female	Male	Other ____________________________		
Age (in years)	____________				
Year in College	Freshman	Sophomore	Junior	Senior	Other _________________________
Ethnicity	African American/ Black	Asian/ Asian American	Caucasian/ White	Hispanic/ Latino(a)	Other _________________________
Where do you live?	On Campus	Off Campus (Lexington)	Off Campus (outside of Lexington)		
Are you currently enrolled in or have you taken UK 101 or 201?	Yes	No			
What is your major?					

Thank you for your time! Have a great semester!

APPENDIX B

Course 2 Baseline Survey

Student Survey: University of Kentucky Learning Spaces

This survey is designed to gather information about students' attitudes about learning in particular classroom spaces at the University of Kentucky. Please answer these questions honestly, **with the physical classroom space around you in mind**. *Your individual responses will not be seen by your instructor. Your survey responses will have no effect on your grade in this course.* There are no right or wrong answers. Thank you for providing us with your honest responses.

Carefully read each statement below and circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
1. The physical classroom space is important to my learning.	1	2	3	4
2. I expect to be an active learner in this class.	1	2	3	4
3. I expect to participate during class time in this course.	1	2	3	4
4. I expect this class to be challenging.	1	2	3	4
5. I expect to enjoy this course.	1	2	3	4
6. I expect to be successful.	1	2	3	4
7. I expect to get an instructor's help if needed.	1	2	3	4
8. I expect to be seen by the instructor in this course.	1	2	3	4
9. I expect the instructor to know my name.	1	2	3	4
10. I expect to be comfortable with where I sit in the course.	1	2	3	4
11. I expect to use technology a great deal in this course.	1	2	3	4
12. I expect to be out of my comfort zone in this course.	1	2	3	4
13. I expect to work with others in this course.	1	2	3	4
14. I expect to feel safe in this course.	1	2	3	4
15. I expect to be aware of my surroundings in this course.	1	2	3	4
16. I expect to feel confident when participating in this course.	1	2	3	4

When thinking about this classroom, how confident are you that you can…	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
17. Do well in this course?	1	2	3	4
18. Earn an excellent grade in this course?	1	2	3	4
19. Learn the material in this course?	1	2	3	4
20. Master the skills taught in this course?	1	2	3	4
21. Understand the most difficult concepts taught in this course?	1	2	3	4
22. Perform well on homework and exams in this course?	1	2	3	4

When thinking about doing statistics this classroom, how confident are you that you can …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
23. Identify the scale of measurement for a variable?	1	2	3	4
24. Interpret the probability value (p-value) from a statistical procedure?	1	2	3	4
25. Identify the factors that influence power?	1	2	3	4
26. Distinguish statistical significance from practical significance?	1	2	3	4
27. Explain what the numeric value of the standard error is measuring?	1	2	3	4
28. Form a statistical hypothesis?	1	2	3	4
29. Ask questions about another student's ideas?	1	2	3	4
30. Distinguish between a Type I and a Type II error in hypothesis testing?	1	2	3	4
31. Justify your solution to a statistics problem in writing?	1	2	3	4
32. Decide if two variables are correlated?	1	2	3	4
33. Distinguish between a population, parameter, and a sample statistic?	1	2	3	4

What are your general feelings about the physical environment of this UK classroom? (Write below.)

How confident are you in your ability to …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
34. Concentrate on your work **in this classroom space**?	1	2	3	4
35. Remember information that is presented **in this classroom space**?	1	2	3	4
36. Focus on what the instructor is saying **in this classroom space**?	1	2	3	4
37. Focus on what your classmates are saying **in this classroom space**?	1	2	3	4
38. Motivate yourself **in this classroom space**?	1	2	3	4
39. Participate **in this classroom space**?	1	2	3	4
40. Get help if you need it **in this classroom space**?	1	2	3	4

Circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
41. I have always been successful in classes like this one (e.g., math, statistics).	1	2	3	4
42. Thinking about this course makes me feel stressed and nervous.	1	2	3	4
43. I did well on high school assignments in classes like this one.	1	2	3	4
44. I get depressed when thinking about this course.	1	2	3	4
45. Doing coursework for this class will take all of my energy.	1	2	3	4
46. I have done well on difficult assignments in classes like this one.	1	2	3	4
47. I feel excited when thinking about difficult work in this course.	1	2	3	4
48. I made excellent grades in high school in classes like this one.	1	2	3	4
49. I feel stressed-out as soon as I begin thinking about this course.	1	2	3	4
50. I got an outstanding score on the math section of the ACT.	1	2	3	4

What was your approximate score on the Mathematics portion of the ACT (scale of 1-36)? ______________

How did you do in your high school Math classes? Circle the answer that best applies to you.											
Algebra	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Geometry	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Pre-Calculus	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Calculus	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take
Statistics	A+	A	A-	B+	B	B-	C+	C	C-	D	F	Did Not Take

Finally, please answer some demographic questions about yourself. Circle or write in your response.					
Gender	Female	Male	Other ___________________________		
Age (in years)	____________				
Year in College	Freshman	Sophomore	Junior	Senior	Other ________________________
Ethnicity	African American/ Black	Asian/ Asian American	Caucasian/ White	Hispanic/ Latino(a)	Other ________________________
Where do you live?	On Campus	Off Campus (Lexington)	Off Campus (outside of Lexington)		
Are you currently enrolled in or have you taken UK 101 or 201?	Yes	No			
What is your major?					

Thank you for your time! Have a great semester!

APPENDIX C

Course 1 End-of-Course Survey

Student Survey: University of Kentucky Learning Spaces

This survey is designed to gather information about students' attitudes about learning in particular classroom spaces at the University of Kentucky. Please answer these questions honestly, **with the physical classroom space around you in mind**. *Your individual responses will not be seen by your instructor. Your survey responses will have no effect on your grade in this course.* There are no right or wrong answers. Thank you for providing us with your honest responses.

Carefully read each statement below and circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
1. The physical classroom space is important to my learning.	1	2	3	4
2. I was an active learner in this class.	1	2	3	4
3. I participated during class time in this course.	1	2	3	4
4. I thought this class was challenging.	1	2	3	4
5. I enjoyed this course.	1	2	3	4
6. I was successful.	1	2	3	4
7. I received an instructor's help when needed.	1	2	3	4
8. I was seen by the instructor in this course.	1	2	3	4
9. I believe the instructor knows my name.	1	2	3	4
10. I was comfortable with where I sat in the course.	1	2	3	4
11. I used technology a great deal in this course.	1	2	3	4
12. I was out of my comfort zone in this course.	1	2	3	4
13. I worked with others in this course.	1	2	3	4
14. I felt safe in this course.	1	2	3	4
15. I was aware of my surroundings in this course.	1	2	3	4
16. I was confident when participating in this course.	1	2	3	4

When thinking about this classroom, how confident are you that you …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
17. Did well in this course?	1	2	3	4
18. Earned an excellent grade in this course?	1	2	3	4
19. Learned the material in this course?	1	2	3	4
20. Mastered the skills taught in this course?	1	2	3	4
21. Understood the most difficult concepts taught in this course?	1	2	3	4
22. Performed well on homework and exams in this course?	1	2	3	4

When thinking about doing statistics in this classroom, how confident are you that you can …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
23. Differentiate between an experiment and observational study?	1	2	3	4
24. Explain the importance of the placebo effect?	1	2	3	4
25. Determine what is confounding in an experiment?	1	2	3	4
26. Distinguish statistical significance from practical significance?	1	2	3	4
27. Articulate at least two different types of sampling?	1	2	3	4
28. Form a statistical hypothesis?	1	2	3	4
29. Ask questions about another student's ideas?	1	2	3	4
30. Identify the central problem, issue, or question in a statistics problem?	1	2	3	4
31. Justify your solution to a statistics problem in writing?	1	2	3	4
32. Decide if two variables are correlated?	1	2	3	4
33. Distinguish between a population, parameter, and a sample statistic?	1	2	3	4

What are your general feelings about the physical environment of this UK classroom? (Write below.)

How confident are you in your ability to …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
34. Concentrate on your work **in this classroom space**?	1	2	3	4
35. Remember information that is presented **in this classroom space**?	1	2	3	4
36. Focus on what the instructor is saying **in this classroom space**?	1	2	3	4
37. Focus on what your classmates are saying **in this classroom space**?	1	2	3	4
38. Motivate yourself **in this classroom space**?	1	2	3	4
39. Participate **in this classroom space**?	1	2	3	4
40. Get help if you need it **in this classroom space**?	1	2	3	4

Circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
41. I have always been successful in classes like this one (e.g., math, statistics).	1	2	3	4
42. Thinking about this course makes me feel stressed and nervous.	1	2	3	4
43. I did well on high school assignments in classes like this one.	1	2	3	4
44. I get depressed when thinking about this course.	1	2	3	4
45. Doing coursework for this class took all of my energy.	1	2	3	4
46. I have done well on difficult assignments in classes like this one.	1	2	3	4
47. I feel excited when thinking about difficult work in this course.	1	2	3	4
48. I made excellent grades in high school in classes like this one.	1	2	3	4
49. I feel stressed-out as soon as I begin thinking about this course.	1	2	3	4
50. I got an outstanding score on the math section of the ACT.	1	2	3	4

Finally, please answer some demographic questions about yourself. Circle or write in your response.

Gender	Female	Male	Other ____________________________			
Age (in years)	____________					
Year in College	Freshman	Sophomore	Junior	Senior	Other ____________________________	
Ethnicity	African American/ Black	Asian American/ Asian	Caucasian/ White	Hispanic/ Latino(a)	More Than One Race	Other _____________
Where do you live?	On Campus	Off Campus (Lexington)	Off Campus (outside of Lexington)			
Are you currently enrolled in or have you taken UK 101 or 201?	Yes	No				
What is your major?						

Thank you for your time! Have a great winter break! ☺

APPENDIX D

Course 2 End-of-Course Survey

Student Survey: University of Kentucky Learning Spaces

This survey is designed to gather information about students' attitudes about learning in particular classroom spaces at the University of Kentucky. Please answer these questions honestly, **with the physical classroom space around you in mind**. *Your individual responses will not be seen by your instructor. Your survey responses will have no effect on your grade in this course.* There are no right or wrong answers. Thank you for providing us with your honest responses.

Carefully read each statement below and circle the number that best represents your level of disagreement/agreement.	Disagree	Somewhat Disagree	Somewhat Agree	Agree
1. The physical classroom space is important to my learning.	1	2	3	4
2. I was an active learner in this class.	1	2	3	4
3. I participated during class time in this course.	1	2	3	4
4. I thought this class was challenging.	1	2	3	4
5. I enjoyed this course.	1	2	3	4
6. I was successful.	1	2	3	4
7. I received an instructor's help when needed.	1	2	3	4
8. I was seen by the instructor in this course.	1	2	3	4
9. I believe the instructor knows my name.	1	2	3	4
10. I was comfortable with where I sat in the course.	1	2	3	4
11. I used technology a great deal in this course.	1	2	3	4
12. I was out of my comfort zone in this course.	1	2	3	4
13. I worked with others in this course.	1	2	3	4
14. I felt safe in this course.	1	2	3	4
15. I was aware of my surroundings in this course.	1	2	3	4
16. I was confident when participating in this course.	1	2	3	4

When thinking about this classroom, how confident are you that you …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
17. Did well in this course?	1	2	3	4
18. Earned an excellent grade in this course?	1	2	3	4
19. Learned the material in this course?	1	2	3	4
20. Mastered the skills taught in this course?	1	2	3	4
21. Understood the most difficult concepts taught in this course?	1	2	3	4
22. Performed well on homework and exams in this course?	1	2	3	4

When thinking about doing statistics in this classroom, how confident are you that you can …	Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
23. Identify the scale of measurement for a variable?	1	2	3	4
24. Interpret the probability value (p-value) from a statistical procedure?	1	2	3	4
25. Identify the factors that influence power?	1	2	3	4
26. Distinguish statistical significance from practical significance?	1	2	3	4
27. Explain what the numeric value of the standard error is measuring?	1	2	3	4
28. Form a statistical hypothesis?	1	2	3	4
29. Ask questions about another student's ideas?	1	2	3	4
30. Distinguish between a Type I and a Type II error in hypothesis testing?	1	2	3	4
31. Justify your solution to a statistics problem in writing?	1	2	3	4
32. Decide if two variables are correlated?	1	2	3	4
33. Distinguish between a population, parameter, and a sample statistic?	1	2	3	4

What are your general feelings about the physical environment of this UK classroom? (Write below.)

How confident are you in your ability to …		Not at all Confident	Somewhat Confident	Mostly Confident	Completely Confident
34.	Concentrate on your work **in this classroom space**?	1	2	3	4
35.	Remember information that is presented **in this classroom space**?	1	2	3	4
36.	Focus on what the instructor is saying **in this classroom space**?	1	2	3	4
37.	Focus on what your classmates are saying **in this classroom space**?	1	2	3	4
38.	Motivate yourself **in this classroom space**?	1	2	3	4
39.	Participate **in this classroom space**?	1	2	3	4
40.	Get help if you need it **in this classroom space**?	1	2	3	4

Circle the number that best represents your level of disagreement/agreement.		Disagree	Somewhat Disagree	Somewhat Agree	Agree
41.	I have always been successful in classes like this one (e.g., math, statistics).	1	2	3	4
42.	Thinking about this course makes me feel stressed and nervous.	1	2	3	4
43.	I did well on high school assignments in classes like this one.	1	2	3	4
44.	I get depressed when thinking about this course.	1	2	3	4
45.	Doing coursework for this class took all of my energy.	1	2	3	4
46.	I have done well on difficult assignments in classes like this one.	1	2	3	4
47.	I feel excited when thinking about difficult work in this course.	1	2	3	4
48.	I made excellent grades in high school in classes like this one.	1	2	3	4
49.	I feel stressed-out as soon as I begin thinking about this course.	1	2	3	4
50.	I got an outstanding score on the math section of the ACT.	1	2	3	4

Finally, please answer some demographic questions about yourself. Circle or write in your response.

Gender	Female	Male	Other ____________________________			
Age (in years)	____________					
Year in College	Freshman	Sophomore	Junior	Senior	Other ____________________________	
Ethnicity	African American/ Black	Asian American/ Asian	Caucasian/ White	Hispanic/ Latino(a)	More Than One Race	Other _____________
Where do you live?	On Campus	Off Campus (Lexington)	Off Campus (outside of Lexington)			
Are you currently enrolled in or have you taken UK 101 or 201?	Yes	No				
What is your major?						

Thank you for your time! Have a great winter break! ☺

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Renae Mantooth

Vita

Education

2017 Spring (expected) — Master of Science
Educational Psychology
College of Education
University of Kentucky

2014 Spring — Bachelor of Arts
Interior Design
College of Design
University of Kentucky

Research Experience

2016 – 2017 — Research Assistant
P20 Motivation and Learning Lab
UK College of Education

2016 Fall — Research Assistant
Assistant Professor Rebekah Radtke
UK College of Design

Conference Presentations

2017 — **Mantooth, R.**, Love, A. M. A., & Usher, E. L. (2017, April). *Learning spaces and self-efficacy in undergraduate statistics.* Paper presented at the Spring Research Conference, Cincinnati, Ohio.

2017 — Love, A. M. A., Dillon, C. M., **Mantooth, R.**, & Usher, E. L. (2017, April). *Scale development: A how-to guide!* Poster Presented at the Spring Research Conference, Cincinnati, Ohio.

2016 — **Mantooth, R**. & Pritchard, M. J. (2016, March). *Comparing delivery and academic achievement: An overview of achievement in online and on-campus courses.* Paper presented at the Spring Research Conference, Lexington, Kentucky.

Teaching Experience

2017 Spring	Teaching Assistant College of Design University of Kentucky
2016 Fall	Course Development College of Design University of Kentucky
2013 Fall	Undergraduate Teaching Assistant College of Design University of Kentucky

Accolades

2014	Student Employee of the Year Finalist University of Kentucky
2013 + 2014	Experiential Scholarship UK College of Design
2013 + 2014	Education Abroad Scholarship University of Kentucky
2010 – 2014	Dean's List UK College of Design

Professional Appointments

2014 – Present	Space Planner and Facilities Design Coordinator College of Arts and Sciences University of Kentucky
2011 – 2014	Interior Design Intern College of Arts and Sciences University of Kentucky
2014	Interior Design Shadow Experience Ross Tarrant Architects Lexington, KY
2013	Interior Design Shadow Experience Gensler Atlanta, GA

Leadership Experience

2013 – 2014	Senior Representative Interior Design Student Association University of Kentucky
2012 – 2013	Student Ambassador College of Design University of Kentucky
2011 – 2012	Secretary Interior Design Student Association University of Kentucky

Service

2017 Spring	Library Re-Imagination Committee College of Education University of Kentucky
2016 – Present	Volunteer Habitat for Humanity Lexington, KY
2016	Volunteer Art in the Park Grayson County Alliance
2012 – 2014	Volunteer Repair Affair Grayson County Alliance