Author: Pellicano, Alexander R.

Title: ***Effectiveness of Activity Based Instructional Strategies in Construction Management Education***

The accompanying research report is submitted to the **University of Wisconsin-Stout**, **Graduate School** in partial completion of the requirements for the

Graduate Degree/ Major: M.S. Construction Management

Research Advisor: Sylvia Tiala, Ph. D.

Submission Term/Year: Spring 2019

Number of Pages: 51

Style Manual Used: American Psychological Association, 6th edition

- ☒ **I have adhered to the Graduate School Research Guide and have proofread my work.**
- ☒ **I understand that this research report must be officially approved by the Graduate School.** **Additionally, by signing and submitting this form, I (the author(s) or copyright owner) grant the University of Wisconsin-Stout the non-exclusive right to reproduce, translate, and/or distribute this submission (including abstract) worldwide in print and electronic format and in any medium, including but not limited to audio or video. If my research includes proprietary information, an agreement has been made between myself, the company, and the University to submit a thesis that meets course-specific learning outcomes and CAN be published. There will be no exceptions to this permission.**
- ☒ **I attest that the research report is my original work (that any copyrightable materials have been used with the permission of the original authors), and as such, it is automatically protected by the laws, rules, and regulations of the U.S. Copyright Office.**
- ☒ **My research advisor has approved the content and quality of this paper.**

STUDENT:

NAME: Alexander R. Pellicano **DATE: 5/10/2019**

ADVISOR: (Committee Chair if MS Plan A or EdS Thesis or Field Project/Problem):

NAME: Sylvia Tiala **DATE: 5/10/2019**

This section for MS Plan A Thesis or EdS Thesis/Field Project papers only

Committee members (other than your advisor who is listed in the section above)

1. **CMTE MEMBER'S NAME:** **DATE:**
2. **CMTE MEMBER'S NAME:** **DATE:**
3. **CMTE MEMBER'S NAME:** **DATE:**

This section to be completed by the Graduate School

This final research report has been approved by the Graduate School.

Director, Office of Graduate Studies: **DATE:**

Pellicano, Alexander R. ***Effectiveness of Activity Based Instructional Strategies in Construction Management Education***

Abstract

Construction Management instructional methods preparing students for their careers are typically passive and reflective in nature. Most often, instructors present traditional lectures on technical and non-technical information while a student's success is measured through written exams pertaining to the topics covered. Often, the success students display in recall exams does not translate to the students' ability to demonstrate the practical application of their newly acquired knowledge. Identifying built examples representing the concepts that students appeared to understand during recall exams is often unsuccessful as well. Something has been lost in translation. Students often complain that there is no clear connection between the technical lectures and the built condition, even as it appears obvious to the more experienced instructors. The knowledge displayed by the students through written examinations appears to be understood as an abstraction, disconnected from the practical design and construction of the same. A literature review will help identify best practices that will help inform instructional methods within Midwestern College's construction management program. The purpose of the study will be to test one of these best practices, and its impact on students' application of visual literacy skills and the practical application of construction concepts.

Table of Contents

List of Tables

Chapter I: Introduction

At a Midwestern college, the Construction Management and Architectural curricula use a combination of instructional methods to prepare students for their careers. There are formal lecture courses for the majority of the coursework. Instructors present lectures on technical and non-technical information and a student's success is measured through written exams pertaining to the topics covered. There are more applied elements of the required coursework in which construction scenarios, or problems, are introduced and students work to identify potential solutions.

Often, the success a student displays in recall exams from the lecture courses does not transfer to the student's ability to integrate this knowledge into a solution in the applied courses. The very same technical topic that appeared to be well grasped in the lecture course appears to be completely foreign when the student attempts to display this knowledge in the larger context of a practical solution. Students' attempts at demonstrating the practical application of their knowledge from the construction management courses are frequently unsuccessful. Identifying built examples, representing the concepts that students appeared to understand during recall exams, is often unsuccessful as well.

Lecture course instructors become frustrated at their apparent ineffectiveness in relaying technical information in a way that students can apply. Something has been lost in translation. Students often complain that there is no clear connection between their technical lectures and the design studio scenarios where they apply their work, even as it appears obvious to the more experienced instructors.

The knowledge displayed by the students through written examinations appears to be understood as an abstraction, disconnected and isolated from the practical design and construction of the same.

Statement of the Problem

Students studying technical aspects of construction processes at Midwestern college often display proficiency during academic testing of technical subject material but cannot apply the same knowledge to design solutions or identify them in built examples. Students are often able to correctly recite specific facts and information about building materials and construction methods in the classroom but find the information, as it is presented, too abstract to apply to actual construction scenarios.

Purpose of the Study

This study begins with a literature review identifying best practices to inform instructional methods within Midwestern College's construction management program. The purpose of this study is to implement one of the identified best practices, and evaluate its impact on students' application of visual literacy skills and their practical application to construction concepts.

Specifically, this study is designed to compare students' performance on a post-test between one group exposed to traditional text-based and lecture-based assignments (Traditional group) compared with students in a second group that complete an applied learning activity (Activity group) incorporating visual literacy skills relative to the built world. The null hypothesis is:

H_0: There is no difference between the performance of students taught using traditional lecture instruction and the performance of students taught using applied visual literacy learning instruction when assessed on a post-test incorporating visual literacy elements.

An alpha level of .05 will be used in hypothesis testing in this study.

Assumptions of the Study

The assumptions of this study are:

1. Administrators, teachers and students at a specific college located in the Midwest (Midwestern College) will be willing participants in this research study.
2. Students' learning preferences play a role in the acquisition and application of construction knowledge.
3. Teaching styles play a role in facilitating the successful utilization of students preferred learning styles.
4. Students' learning preferences and instructors teaching styles align
5. Students in both the traditional teaching group and the activity-based teaching group have similar visual literacy skills.
6. Years of experience in the construction field do not impact students' scores on the pre- and post-test.
7. Students in the Activity group will learn the same amount of information no matter if they were working with peers or individually.

Definition of Terms

The following terms found in this paper are commonly referenced in the construction trades or are used in education research.

Built condition. Depictions, in the form of photographs, sketches, or technical drawings, or direct observation of construction as it was actually built.

Mode. A variety of ways used to represent information such as Verbal (e.g., printed words, spoken words) and non-verbal (e.g., illustrations, photos, video, and animation)

Multimodal. Learning environments that use two or more different modes to represent the information presented.

Limitations of the Study

The limitations of this study are:

1. The sample size used in this study is small. Results will not be generalizable.
2. Assessment instruments used in data collection are classroom assessments. The validity and reliability of the assessment tools has not been determined
3. Due to time constraints, no teaching style/learning style assessments were completed that insured a fit between learner preferences and the method of instructional delivery.
4. The sample size is not large enough to determine the effects of age, gender, language spoken, or construction experience on this study's results.

Chapter II: Literature Review

Construction management students too often fail in their ability to apply their technical knowledge to real construction scenarios. Students can recite technical information accurately but they cannot visualize the practical application of the same knowledge. According to Cline, students express frustration with the delivery of the educational material. They find technical construction concepts to be abstract, especially in lecture courses when they are presented out of context (Cline, 2011). The instructors can't understand why the students aren't able to make the connection between the construction-related concepts and the practical examples of them. There seems to be a disconnect between how students prefer to learn and how instructors prefer to teach. This may be one cause of the students' frustration (Lam et al., 2016). There are other causes as well.

Expertise Blindness

Instructors can fall prey to expertise blindness, or have what is called an expert blind-spot. Instructors essentially take for granted that their advanced knowledge of the subject matter is common knowledge. Because of this, experts can fail in transferring knowledge to novice students. Studies on this subject have indicated that experts often utilize abstract descriptions rather than basic concrete ones to articulate their advanced knowledge. This can be because of the way the expert has sequentially, over time, encoded their knowledge in progressively sophisticated and abstract ways (Hinds, Patterson, & Pfeffer, 2001). The expert instructor now has difficulty accurately recalling his/her own time as a novice and therefore can no longer relate to the novice experience. Without this ability to effectively empathize with the knowledge level of the novice it is difficult for the expert to adjust their perspective, and subsequent presentation of the material. The expert instructor relies on a more recent, easier to recall, learning period within their own educational evolution and holds that level of knowledge as her/his baseline expectation for the novice (Hinds et al., 2001).

One effective way to combat this negative effect of expertise is to utilize an individual with an intermediate level of expertise to provide a more relatable perspective on the material being studied. In a classroom with diversified experience levels an opportunity exists to capitalize on intermediate levels of expertise through peer-to-peer learning. Students with intermediate level knowledge may be able to transfer the information more effectively to beginning-level students. Beginner level students in turn may be better suited to communicate more effectively with the novice (Hinds et al., 2001).

Learning and Instructional Strategies

Learning and Instructional strategies need to be identified and categorized if they are to be discussed in a meaningful way. Felder and Solomon (2001) categorized learning styles along five dimensions; Active / Reflective, Sensing / Intuitive, Inductive / Deductive, and Visual/ Verbal, and Sequential / Global. These dimensions can be further divided into teaching strategies and learning strategies to distinguish the perspective of the instructor as compared to the student. Felder and Solomon's (2001) dimensions represent opposing ends of a learning phase that can be used to gauge a student's perceived teaching style preference. The same can be used to describe an instructor's preferred teaching style. Does the dominant teaching style of the instructor align most significantly with one of the dimensions? If so, this may cause a disconnect for those learners who benefit from a different teaching style. It is the alignment between the instructor's teaching and the students' learning styles that appears to be most beneficial during instruction (Abdelhamid, 2003). Critical information gets relayed more effectively by reducing the disparity between the instructor's teaching style and students' learning style. For example, the typical teacher-in-charge instructional method would benefit a student who prefers a Reflective, Deductive, Verbal style of instruction (Felder & Solomon, 2001). While this has been shown to be the preferred teaching style of most instructors it is not the preferred learning style of the majority of students. Even more importantly, it should be acknowledged that every student has their own unique mix of optimal learning styles that can change with subject matter and evolve as they mature. Students cannot be neatly pigeon-holed into one category or another. The wide array of preferred learning styles represented by the students in even a single classroom makes it apparent that there is no one optimal instructional method. Each concept must be presented in multiple ways to align with the greatest number of student-preferred learning styles at any given moment in time. This concept of using multiple ways to present material goes by many names, such as teaching around the cycle, or teaching around the circle (Abdelhamid, 2003).

Learning style classification. The classification of learning styles can be done in many ways. This task can be approached by identifying which of the five senses are utilized in the learning process. Do students prefer an external, sensory learning experience via sight, sound, and physical sensation? Or, do students prefer to receive and take in material in an internal, intuitive way, more passively, developing their own insights and coming to their own conclusions (Abdelhamid, 2003)? It is crucial to understand that some students prefer visual versus auditory presentations. Others may prefer inductive versus deductive information organization. The students may process information best through active or reflective engagement. Finally, students may grasp the information in a gradual step-by-step sequential way or globally, in larger conceptual chunks (Abdelhamid, 2003).

Students may prefer visual-based instruction, yet the ability to visualize a three-dimensional (3-D) condition is a skill that confounds many. Given only a text description or even two-dimensional drawings, it is difficult for many individuals to visualize the object or built condition being described. Developing these 3-D spatial skills is critical for students' success in technical fields of study. Honing this ability to visualize is best done through hands-on practical means (Sorby, 1999). Engineering school studies have identified the importance of evaluating first-year student's 3-D spatial skills, and if necessary, intervening to help them improve these skills. Additional coursework and/or help sessions have been shown to greatly improve the success students have in their graphics courses by further developing their spatial skills (Sorby, 1999). Longitudinal studies have concluded that year after year, with consistency, these additional courses can help those with spatial visualization (Sorby & Baartmans, 2000). This difficulty with spatial skills and with 3-D visualization is a factor in the inability of many construction management students to apply their text/lecture-based knowledge to the built world. Therefore, it is critical that construction management students develop these spatial skills in order to identify if built conditions coincide with construction plans, text-based specifications, and building codes. The opportunity to develop students' spatial abilities is a component of many of the courses taken in construction management programs.

Teaching style classification. The other side of the equation is the preference by the instructor for presenting the information. One way to approach the classification of teaching styles is through an analysis of preferred types of teaching materials, the modality of the presentation, how instruction is organized, preferred student interaction, and a sequential versus global perspective toward instruction (Abdelhamid, 2003; Felder & Silverman, 1988).

According to Abdelhamid, instructors tend to rely on a more traditional teaching style. They prefer a more reflective, intuitive, verbal style with a global perspective. Instructors do, however, display a willingness to try new strategies outside of their comfort zones once presented with the findings that their students prefer them (2003).

Instructional strategies. Instructional strategies are only as effective as the combination of the teaching and learning strategies employed (Lam et al., 2016). Utilization of a variety of teaching styles to align with the various preferred learning styles students present in the classroom should result in more effective engagement and students' understanding of construction management concepts.

On a more tangible level, preferred instructional strategies can be identified by distinct activities; such as field trips, group discussions, traditional lectures, game-show simulations, and the use of web-based resources (Lam et al., 2016). An extensive list of these discreet activities can be aggregated back into more generic factors for consideration and study (Lam et al., 2016). Multiple studies found that students prefer an active, student-centered, visual, and step-by-step approach to learning that is also relevant to current industry trends (Abdelhamid, 2003; Harfield et al., 2007; Lam et al., 2016). It should be noted that catering to the mere perception of students' learning style preference does not necessarily equate to actual improvement in student performance (Harfield et al., 2007). It may stand to reason that engagement would be higher if preferred learning styles were addressed in teaching strategies. In at least one study increased performance was cautiously linked to the addition of activity-based teaching strategies, though unaccounted variables were acknowledged (Harfield et al., 2007).

Construction instructor (C.I.) at Midwestern College has observed greater student engagement when student-centered activities are incorporated. For example, to understand the effective use of a tape measure, groups of students were asked to collaboratively field measure and record the dimensions of a small elevator lobby just outside the classroom. Students were instructed to take turns with the various tasks required. This involved two students extending and aligning the tape with the element to be measured, reading the dimension accurately, and another manually recording the results in industry-standard nomenclature on a partial floorplan. The C.I. also encouraged those familiar with this task to assist those less experienced. When utilized, this peer-to-peer, hands-on collaborative field exercise resulted in greater enthusiasm for the subject matter as compared to only reading the required text and experiencing the power point presentation. Students responded well to these activity-based exercises when they experienced the built condition and saw it represented on paper. They started to make the connection between the two in their minds.

Disparity Between Perceived Effectiveness of Instructional Strategies

The incompatibility of preferred learning styles of students and the instruction style of professors stems from the perceived effectiveness of the various styles (Lam et al., 2016). Students report preferring a student-centered, active, teaching environment (Lam et al., 2016). The majority of professor's report employing a one-way style of presenting the information in which the students sit passively and receive the information in a lecture format (Abdelhamid, 2003). Further, students have indicated that this disparity causes them to lose motivation in learning and hinders their ability to do so (Abdelhamid, 2003).

When presented with evidence of the disparity between perceived preference of learning and teaching styles, instructors are grateful for the knowledge and are willing to adjust their teaching style to align with the learning preferences of their students (Abdelhamid, 2003). The discovery of the disparity is an eye-opening experience for the instructor and offers the opportunity to improve.

C.I. at Midwestern College has observed the difference in student engagement when student centered activities are included. These activities appeared to awaken the student's enthusiasm for the subject matter and encouraged the instructor as well. However, they were time-consuming and often were done at the expense of introducing other topics due to time constraints.

Strategies for Improving Instructional Effectiveness

Learning style preference varies from individual to individual. As such no one style will fit all (Abdelhamid, 2003). Once this is accepted it becomes clear that concepts must be presented in various formats to align with as many student learning styles as possible. By moving away from a dominantly instructor-led method of teaching to a more student-centered approach, engagement and performance improvement is possible (Harfield et al., 2007).

Creating a student-centered learning environment, with active participation is preferred by the student (Lam et al., 2016). According to Abdelhamid, materials should be presented in various forms, with visual formats being the preferred media. Students indicate a preference for a collaborative classroom in which they lead the discussion and debate amongst themselves, with the instructor as facilitator (Harfield et al., 2007). This can take many forms from simple interactive discussions, to group projects, to game show simulations and to in-class contests (2003).

As students take more ownership of the learning process, the instructor's role often changes to that of facilitator (Harfield et al., 2007). While instructors will continue to feed more new material and concepts into the teaching process, their primary function is in gently steering the direction in which the students are headed and managing the discussions and activities.

There is a particularly apropos model for this ideal relationship, that of master and apprentice. Apprenticeship is a familiar teaching environment in many of the construction trades. In a class such as blueprint reading, instructors have found the apprenticeship model to be a useful instructional style (Cline, 2011). While the instructor does need to relay new information to the students on a regular basis, such as explanation of symbols, terminology, and drawing conventions, the real learning happens when the students actively perform the task of blueprint reading. They need to spend an abundance of time practicing it and that is where the real learning happens. It is an active learning model where students are physically doing the work of turning the pages and relating one image to a table, or to a schedule on another page. By doing this in a group setting, students can share their discoveries and benefit from each other's findings. The collaboration between students can also help combat instructor's expertise blindness by allowing the more experienced students to instruct the novice students on more equal terms.

C.I at Midwestern College sought to incorporate more collaborative, student-centered activities that facilitated students' comprehension of instructional materials and the visual identification of concepts in the built condition. Quantifying the effectiveness of active learning activities may help the instructor justify the expansion of a selected instructional method even at the expense of traditional lecture time.

Cline (2011) utilized a qualitative analysis tool, based on a concept introduced first by Pratt (1998), in which teaching perspectives are identified by an individual's core belief system. These teaching perspectives are: social reform, nurturing, transmission, apprenticeship, and developmental. Teachers in Pratt's study identified most dominantly with the transmission perspective, often with a bit of remorse. Teachers also identified with other perspectives to a lesser degree. Examples are cited in which instructors tried for a more interactive student-centered perspective, such as apprenticeship, but often fell back into the transmission perspective for one reason or another. Teachers' disappointment in themselves was expressed when this happened (Cline, 2011). What this shows is that instructors are willing to utilize a more active, student-centered approach to teaching. This is ideal given that it aligns with the preference most often expressed by the students (Abdelhamid, 2003). The problem arises when adversity creates a change in the ideal lesson plan and teachers revert to a passive, transmission style, to simply get through the material in the allotted time. Through the identification and practice of using additional, effective, teaching strategies, instructors can be instilled with the confidence and ability to maintain a multimodal approach to the teaching-learning process.

Quantifying the effectiveness of teaching from a perspective that allows more student-centered activities & collaboration should help encourage instructors to broaden their instructional strategies. C.I at Midwestern College has reported having to make value judgments between time spent reviewing material and time spent on student-centered activities. In the context of a 3-hour class session, most in-class student-centered activities take well over an hour to complete. Time spent conducting a student-centered activity replaced the lecture time required to review a chapter from the course text. A definitive indication that student-centered activities is time well-spent, even if only as a complementary exercise, would justify the use of student-centered instructional methods.

In addition to presenting course concepts in the most effective styles to align with learners perceived preferences, the structure of the presentation can be forward thinking as well.

Lam (2016) grouped similar teaching strategies into factors and studied their effectiveness. Factor one was heavily reliant on technology devices such as wikis, blogs, mobile phones, digital cameras, and the like. Factor two included field trips, cooperative learning strategies, case method teaching, lecture, and tutorial. Factor three included student role play, integrated website use, and game show simulations. Factor four sought to make the material relevant to current industry trends and topics including inviting guest speakers and utilizing popular film and video vignettes to stimulate critical/creative thinking. Factor five included student driven strategies such as group discussion, in-class contests, brief student presentations, and short in-class writing assignments. Factor five was shown to be perceived as the most effective by students (Lam, 2016). This reinforces the idea that students favor the student-centered, active style of learning. What also emerged is students' perceived value of material and technology use relevant to today. Students clearly want to feel that what they are learning will have immediate utility in the workplace. This provides instructors with a strategy for encouraging students to discover and identify the application of construction principles in the built condition. In order to more effectively relay construction management concepts to students, there are clear strategies provided in the literature that create a road map for instructors of how to get there.

Instructors need to be aware of their dominant teaching style and work towards becoming multi-faceted and nimble in their approach so that they can present material in a variety of ways utilizing an assortment of tools. This will allow instructors to connect with as many of their students as possible. Institutions need to provide training in the various teaching/learning styles and instructors need to take advantage of such training and implement it. The literature indicates a student-centered, active style, that utilizes current technology, the latest industry trends, and collaboration as preferred by most students. However, while that may be the most widely indicated preference, instructors must continue to vary their approach so that the introspective, passive learner who prefers to discover information internally will be accommodated as well. According to the literature, information should be predominantly presented in a step-by step sequential fashion, with an occasional eye on the "big-picture". Information should be put it into the larger context. These strategies are the essence of teaching around the circle (Abdelhamid, 2003).

Creating additional teaching modules that incorporate student preferences and address instructors' known shortcomings in traditional passive instruction can help students find success. The addition of a student-centered activity into lessons that encourages peer-to-peer collaboration and aims to improve visualization skills may be beneficial. Requiring the students to utilize their immediate built environment as a case-study makes the exercise all the more relevant. Asking the students to capture their findings and share it with their peers with the latest technology available to them has been shown to be attractive to the student as well.

Chapter III: Methodology

Instructor, C. I. at Midwestern college, has observed that construction management students often lack the ability to apply their newly acquired technical knowledge to real-world settings. Students can demonstrate an understanding of the technical facts but too often cannot relate that to actual construction scenarios and built examples. Previous research has shown that students prefer an active, student-centered, visual, and step-by-step approach to learning that is relevant to current industry trends (Abdelhamid, 2003; Harfield et al., 2007; Lam et al., 2016). Each student is unique in their specific preferred learning techniques and thus a multimodal instructional approach will have the greatest positive impact on the widest range of students. This is in contrast to the dominant teaching style of the current course instructor which tends to be more passive. It is this disparity that is believed to contribute to students' inability to transfer knowledge from theoretical knowledge to practical application of concepts.

This study compared a module that incorporates "best practices" indicated in the literature review utilizing a student-centered exercise. This activity-based exercise, allowed peer-to-peer collaboration, and required the use of technology and devices that are relevant to current students. The focus of this learning activity was to have students seek out and identify specific examples of construction elements in their built environment that were described in the associated text. Once found, students captured images of the examples in the built world, wrote a brief description about their image and posted their findings to an online discussion board.

Finally, students' performance on a post-test between the one group exposed to traditional text-based and lecture-based assignments (Traditional group) was compared with students in a second group that completed an applied learning activity (Activity group) incorporating visual literacy skills relative to the built world. The null hypothesis was:

H_0: There is no difference between the performance of students taught using traditional lecture instruction and the performance of students taught using applied visual literacy learning instruction when assessed on a post-test incorporating visual literacy elements.

An alpha level of .05 was used in hypothesis testing in this study.

Subject Selection and Description

Student participants enrolled in an architecture and construction management program at Midwest College were chosen as a convenience sample for this study. All of the students were enrolled in a building code and specification course during the Spring of 2019. The students enrolled in this course typically had a wide range of education and industry experience. This ranged from newly graduated high school seniors to experienced tradesmen seeking to move to managerial positions. One of the goals of this class was to enable students to understand building code concepts and apply this knowledge to the identification of applicable built conditions. An additional goal was to develop students' ability to analyze built structures in the real world for compliance with the applicable building codes. For context, demographics of student participants were captured and described in this paper.

Instrumentation

A demographic survey, included in Appendix A, was used to identify participants' age, gender, the language most often spoken, whether students considered themselves knowledgeable in construction, and the years of construction experience for each participant.

The evaluation instruments used in this study included: an identical pre-test and a post-test (See Appendix B); an established traditional passive homework assignment for the eight students in the control (Traditional) group (See Appendix C); and a newly created activity-based homework assignment for the nine students in the treatment (Activity) group (See Appendix D).

Students' utilization of a digital camera or mobile phone camera was required to capture images for the activity-based assignment and was not provided. Midwestern College's web-based learning management system (Blackboard) was required to be used by the Traditional group to access the activity-based homework assignment. Blackboard was also used by each of the students in the Activity group to post their submission for the activity-based homework assignment. These items are described in the following paragraphs.

All students were assigned an identical reading assignment from the course text; *Building Codes Illustrated, A Guide to Understanding the 2018 International Building Code, 6th Ed.* (Ching 2018). All students were presented with the same lecture on the relevant material. The established traditional homework assignment was one that the students were expected to complete independently and required them to answer various egress-related questions using a simple schematic floorplan that was provided. Applicable building code sections from the *2018 International Building Code (IBC)*, Chapter 10, Means of Egress were the focus (International Code Council, 2017). A web link to the building code was provided through Blackboard. The alternative activity-based homework assignment was completed by students in the Activity group either independently or collaboratively with other peers and required each student to seek out examples of 14 specific egress components. Each student was then expected to upload these images with a brief description to a discussion board in the learning management system utilized by Midwest College.

An identical pre-test and post-test (Appendix B) were used to measure the effects of the teaching method in both the Traditional and Activity teaching/learning groups. The test focused on a specific building code topic which was commercial egress stairs and exit doors. The test was paper based and utilized three images. The first two images were isolated depictions of a built commercial egress stairway and a commercial exit door. The students were asked to identify various stair and door components using a fill-in-the-blank format keyed to 18 specific elements shown in the supplied pictures. The third image was a case-study photo of a completed exit door and stairway. The students were asked to identify two potential code deficiencies using only what was graphically available in the photo. The maximum total possible score on the pre/post-test was 20.

Data Collection Procedures

The following sequence of events was used over the course of the study to collect data.

1. All students were assigned to read the course text relating to the subject matter of egress as is required for this course.
2. In preparation for administering the study, the class roster was randomly divided evenly into two groups using the method that follows. A number was assigned to each student in the roster and then a random number generator was used to create two lists. Group one was designated as the traditional (control) group. Group two was designated as the activity (treatment) group.
3. On the day of the study all students were issued a packet that included:
   - The consent form that included a description of the study, the risks and benefits, and the right to withdraw.
   - The demographic survey that included a student-generated anonymous identifier used in matching pre-test and post-test results. The anonymous identifier was generated by each student as they combined their 2-digit birth month and the first three letters of their mother's maiden name (for example: 06-POD).
   - The pre-test with a space to include each student's anonymous identifier.

4. All students were asked to read the consent form and sign it if they were willing to participate in the study. Students then answered questions on the demographic survey where they identified their age, gender, language most spoken, and years of construction experience. The demographic survey was distributed, completed, and collected during the class.
5. The pre-test was administered to all participating students. This test was completed during the regularly scheduled class.
6. The standard textbook -based lecture was presented by the instructor to all students as is typically done for this course.
7. Half of the students, representing the traditional group, were issued the established traditional passive/reflective homework exercise to complete for the following week and dismissed.
8. Half of the students, representing the active group, were instructed to complete the alternative, activity-based, learning module.
9. At the next class meeting, the following week, a post-test, identical to the pre-test, was administered to all students by the instructor. The post-test included space for the students to include their anonymous identifier.

Data Collection

Demographic data collected from student responses to survey questions was aggregated to provide an overview of this study's participants. The categories of participant's age, gender, language most often spoken, years of construction experience, and whether or not they considered themselves knowledgeable in construction was analyzed. The intent of using this strategy was to collect and aggregate data in order to look at factors that may influence participant's performance.

Information about the age of the participants was collected to determine if a diversified range of ages are present in the groups being studied. Various age ranges might be a consideration for preference of technology use in their preferred learning styles. Age diversification may also play a role in the value of peer-to-peer learning.

Gender identification information was collected to identify the proportion of males versus females in the two groups. Literature on the subject of spatial visualization identified gender as a potential factor in the level spatial visualization skills.

Language most spoken by the participants of the study was collected to consider any impact that being a non-English speaker may have in activity–based learning, the use of technology in learning, spatial visualization, and peer-to-peer learning.

Years of construction experience by the participants of the study was collected to consider the diversity of experience levels within each group and between the two groups. Diversity of experience would logically play a role in peer-to-peer learning opportunities. Peer-to-peer learning amongst a diversified range of construction experience levels within a group would potentially help to mitigate the effects of any expertise blindness on the part of the instructor as well.

An independent samples t-test was selected to evaluate differences between the traditional group's and the independent group's pre-test scores and post-test scores. In both cases the independent categorical variable was either the pre-test scores on the pre-test or the post-test scores when comparing groups on the post-test. The Social Science Statistics T-Test Calculator for Two Independent Means found at https://www.socscistatistics.com/tests/studentttest/default.aspx was used to run the analysis. For both t-tests the alpha level was set at 0.05.

Summary

To conduct this research project, student's enrolled in an architecture and construction management program at Midwest College were targeted. All students were given the consent form and offered the opportunity to participate in this project. Those that did agree to participate were given a demographic survey and a pre-test to complete. The survey and pre-test had a space for a student generated unique anonymous identifier that would be used to match the survey and pre / post-test scores to each participant.

All students were assigned to read the required textbook chapter on the subject of egress and emergency exiting. All students were also presented with the traditional lecture on egress and emergency exiting. Up to this point in the course, all students had been subjected to identical passive/reflective traditional teaching methods.

The students were then randomly assigned to two separate groups, a traditional group, and an active group. The Traditional group participated in a traditional passive/reflective homework exercise to complete for the following week while the remaining half of the students, participated in an alternative, activity-based exercise to complete for the following week.

During the following week a post-test was administered to the study participants and collected. The post-test was identical in form to the pre-test. With this post-test, the participants completed their role in this study and the data collection process.

The demographic data was organized to provide background information of the participants. Descriptive statistics described the study participants. Both descriptive statistics and a t test were to be used to compare the test results of the participants assigned to the Traditional and Activity groups.

Chapter IV: Results

Students enrolled at Midwestern College in the Architecture and Construction Management program were the subjects of this research. These students were enrolled in a class dealing with building codes, specifications, and contracts during the spring of 2019. All students were asked to read the established text book material on the subject of egress. Students were presented with a traditional lecture on the subject as well. After agreeing to participate, all participants were asked to complete a demographic survey (Appendix A) and a pre-test (Appendix B) related to their knowledge of an egress topic. The participants were randomly divided into a Traditional group and an Activity group. Over the course of the following week the Traditional group completed the established traditional egress exercise. The established traditional egress exercise (Appendix C) was one that the students were expected to complete independently and required them to answer various egress related questions using a simple schematic floorplan that was provided. The Activity group was assigned an alternative student-centered activity-based exercise (Appendix D) and were allowed to collaborate with their peers to complete it.

At the next class meeting the C.I. at Midwestern College administered the post-test.

Participant Demographics

Participant responses from the demographic survey were used to describe study participants. Participants were asked their gender, age, the language that was most often spoken, if they considered themselves knowledgeable in construction, and their years of onsite construction experience. Table 1 through Table 5 below lists the responses of the participants to the survey questions.

Demographic analysis consisted of tabulating demographic data of the students represented in both the traditional and activity groups. The first question pertained to gender. The number of students who identified as either male, female, transgender, non-binary, or preferring not to answer, was tabulated for both the Traditional group and the Activity group.

The age of the participants of each group was summarized into the following ranges; under 18 years old there were zero in the Traditional group and zero in the Activity group, 18-20 years old there were four in the Traditional group and one in the Activity group, 21-23 years old there were zero in the Traditional group and four in the Activity group, 27-29 years old there was one in the Traditional group and zero in the Activity group, 30-32 years old there was one in the Traditional group and zero in the Activity group, and 33 years and older there was one in the Traditional group and two in the Activity group.

Table 1

Age

Age Range	Traditional Group	Activity Group
18-20	4	1
21-23	0	4
24-26	1	2
27-29	1	0
30-32	1	0
33+	1	2

Overall the Traditional group was a younger group compared to the Activity group. Half of the Traditional group was in the 18-20 age range, while only one member of the Activity group was in this range. The majority of the members of the Activity group were in the 21-23 age range. More age ranges were represented in the Traditional group. The only age range not represented by the Traditional group was the 21-23 age range. Comparatively, the Activity group didn't have any members in both the 27-29 age range and the 30-32 age range.

The language most spoken by each participant of each group was summarized into the following categories; English, Arabic, and Spanish. Language most spoken in the Traditional group was; English with seven, Arabic with zero, and Spanish with one. Language most spoken in the Activity group was; English with seven, Arabic with two, and Spanish with zero.

Table 2

Language Most Spoken

Language	Traditional Group	Activity Group
English	7	7
Arabic	0	2
Spanish	1	0

The majority of both groups reported English as their language most spoken. Both groups had equal numbers of members reporting that English was the language most spoken at seven. The Traditional group did not have any members reporting that Arabic was their language most spoken. The Activity group did not have members reporting that Spanish was their language most spoken.

The gender identification by each participant of each group was summarized into the following categories; Male or Female. Gender identification in the Traditional group was; Male with seven, Female with one. Gender identification in the Activity group was; Male with seven, Female with two.

Table 3

Gender

Gender	Traditional Group	Activity Group
Male	7	7
Female	1	2

The majority of both groups reported their gender identification as male. Both groups did have female representation. The Activity group had more female representation with two members as compared to just one member identifying as female in the Traditional group.

The number of years of onsite construction experience reported by the participants of each group was summarized into the following ranges; none was reports by two in the Tradition group and four in the Activity group, for 0-3 years there was two in the Traditional group and two in the Activity group, for 3-6 years there was two in the Traditional group and two in the Activity group, for 6-9 years there was two in the Traditional group and zero in the Activity group, for 15-18 years there was zero in the Traditional group and one in the Activity group. None of the participants reported more than 18 years of construction experience.

Table 4

Years of Field Experience

Year Range	Traditional Group	Activity Group
0	2	4
0-3	2	2
3-6	2	2
6-9	2	0
15-18	0	1

The Traditional group had equal distribution of members in the year ranges from 0 years of field experience up to nine years of experience. The Traditional group had two members in each of the four ranges over that span. The Activity group had more members reporting zero years of field experience with four members as compared to only two members of the Traditional group reporting zero years of field experience. The Activity group had the member with the most reported years of field experience; one member in the 15-18 year range.

Identification as knowledgeable about construction by each participant of each group was summarized into "Yes" or "No" categories. Six participants in the Traditional group reported; "Yes", and two reported "No". Six participants in the Activity group reported;" Yes" and three reported "No".

Table 5

Identify as Knowledgeable About Construction

Y/N	Traditional Group	Activity Group
Y	6	6
N	2	3

Equal members of both groups identified themselves as knowledgeable about construction. The majority of overall participants in the study and the majority of member of each group reported themselves as knowledgeable about construction.

Comparing Group Performance

This researcher started analyzing the performance differences for both the Traditional and the Activity groups during the study. The analysis began with descriptive statistics for both groups when the pre-test was given and when the post-test was given. The traditional group had eight participants while the activity group had nine participants.

Table 6

Descriptive Statistics for Traditional Group and Activity Group – Pre/Post Test

	Pre-test Traditional	Pre-test Activity	Post-test Traditional	Post-test Activity
Valid	8	9	8	9
Mean	9.000	7.889	11.19	12.89
Std. Deviation	2.816	3.586	4.088	3.060
Minimum	7.000	2.000	6.000	8.000
Maximum	14.00	12.00	18.00	17.00

N_T =8
N_A=9

The descriptive statistics, shown in Table 6, indicate that the Traditional group had a mean pre-test score of 9.0 while the activity group had a lower mean pre-test score of 7.89 on a test worth 20 points. The opposite was true on the post-test where the activity group's mean post test score was 12.89 while the Traditional group's mean test score was 11.19. Looking at Table 6 one can see that there was an increase in scores from the pre-test to the post-test condition by both groups. This shows that learning, indicated by post-test scores occurred as a result of completion of either the traditional exercise or the activity-based exercise. The Traditional group saw their mean score increase from 9.0 to 11.19, while the Activity group saw a larger increase 7.89 to 12.89. The overall score increase was higher for the Activity group (5) as compared to the Traditional group (2.19). The range of scores shows that the low score (7) for the Traditional group was higher than the low score (2) for the Activity group on the pre-test. This trend reversed in the post test when the low score for the Traditional group (6) was below that of the Activity group's low score of eight (8). The range of scores shows that the high score (14) for the Traditional group was higher than the high score (12) for the Activity group on the pre-test. This trend continued in the post test when the high score for the Traditional group (18) was higher than that of the Activity group's high score of eight (17). In addition to the range of scores, this researcher examined the standard deviation, and thus the variability of student scores, for the Traditional and Activity groups. The standard deviation of the Traditional group increased from the pre-test and post-test (2.82 to 4.09) scores while the Activity group's standard deviation decreased (3.59 to 3.06) between the pre-test and post-test.

This researcher initially indicated that an independent t-test would be used to compare the test results of the Traditional and Activity groups. The researcher questioned this technique due to the low number of respondents. JASP 0.9.2 (https://jasp-stats.org/) was used to run a distribution analysis of the pre- and post-tests for responses from both the Traditional and Activity groups. Figure 1, below, indicates results of the distribution analysis. Neither the pre-test nor the post-test data from either group was normally distributed.

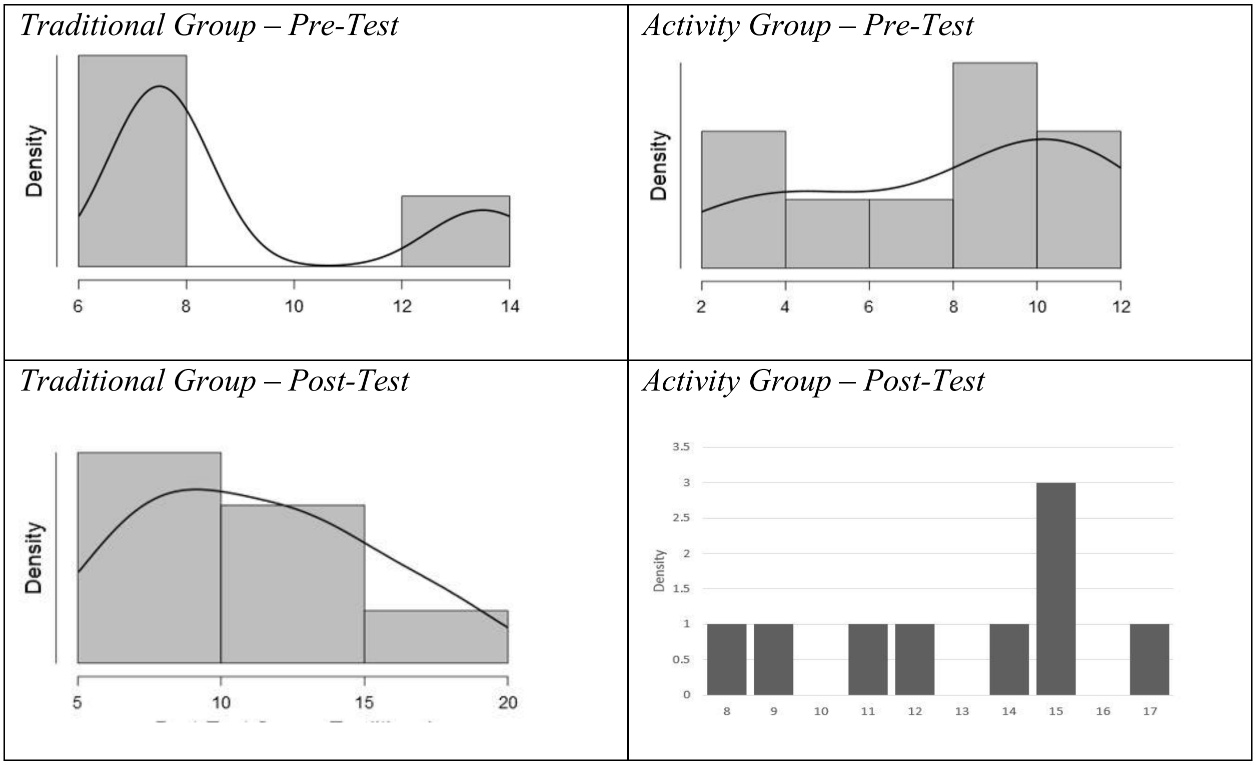


Figure 1. Pre-test and post-test response distributions for traditional and activity groups.

The distribution of the pre-tests for both groups is not a normal distribution. Student responses clustered around a score of six to eight answers correct or around 12 – 14 answers correct.in the Traditional group. Student responses ranged from two to 11.5 in the Activity group. Two students had lower scores of two to four answers correct. Five students scored between eight to twelve answers correct in the Activity group.

The distribution of the post-tests for both groups is not a normal distribution. Student responses ranged from 7 to 18 in the Traditional group with more scores occurring at the lower rather than higher end of this range. The post-test for the Activity group was skewed to the left. Most of the students scored between 14 and 17 answers correct followed by individual participants who scored 12, 11, eight and nine.

Because the pre/post-tests were not normally distributed, this researcher chose to use the non-parametric Mann-Whitney U-Test for data analysis. The Mann-Whitney U-Test Calculator from Social Science statistics website (https://www.socscistatistics.com/tests/mannwhitney /default2.aspx) was used to make the calculations.

The Mann-Whitney U-test comparing the pre-test scores of the Traditional group with the pre-test scores of the Activity group produced the results shown in Table 7.

Table 7

Mann-Whitney U Test Comparing Pre-Test Scores

Mann-Whitney U	33.0
z	-0.24056
p-value	.81034

The test results comparing the pre-test scores indicate that there is not a statistically significant difference in the pre-test scores for the Traditional group when compared with the pre-test scores for the Activity group. The p-value indicates that the probability of getting these results given the existing sample is 81 percent.

A similar Mann-Whitney U-test comparing the post-test scores of the Traditional group with the post-test scores of the Activity group produced the results shown in Table 8.

Table 8

Mann-Whitney U Test Comparing Post-Test Scores

Mann-Whitney U	26.5
z	0.86603
p-value	.3843

The test results comparing the post-test scores indicate that there is not a statistically significant difference in the post-test scores for the Traditional group when compared with the post-test scores for the Activity group. The p-value indicates that the probability of getting these results given the existing sample is 38 percent.

While these scores do not reach statistical significance the difference in p values do indicate that there is a positive trend toward showing that the teaching strategy is trending toward success.

Chapter V: Conclusion and Recommendation

The purpose of this study was to test one best practice from a literature review to help inform instructional methods within Midwestern College's construction management program. Through the literature review, the importance of aligning teaching style preferences with learning style preferences was identified. One of the identified best practices, the use of student-centered activity-based teaching, was implemented as part of the study. Its impact on students' application of visual literacy skills and practical application of construction concepts was evaluated by means of comparing pre/post-test results between two groups. Instructor C.I. at Midwestern college presented the traditional lecture to all students and assigned the established traditional exercise to the Traditional group. C.I gave the same lecture to the Activity group and assigned them an alternative activity-based exercise. A post-test was administered to gauge the impact.

Conclusions

There wasn't a statistically significant difference in the pre / post-test scores between the two groups. As such, the null hypothesis is supported:

H_0: There is no difference in student performance on a post-test incorporating visual literacy elements between students in traditional lecture and students exposed to applied visual literacy learning activities.

However, analysis of the descriptive statistics of the test scores between the two groups did indicate that there was value to the addition of the activity-based exercise. The descriptive statistics indicated a greater increase in mean scores by the Activity group as compared to the Traditional group. The maximum score increase was higher for the Activity group as compared to the Traditional group as well. The standard deviation for the Traditional group increased between the pre-test and post-test scores while the Activity group's standard deviation decreased. The narrowing of the standard deviation for the Activity group suggests that the Activity group as a whole attained a better grasp of the subject material. This implies that the Activity group students demonstrated an increased understanding of the details of specific egress concepts and practical application of them as a result of the activity-based exercise. Conversely, the Traditional group may have benefitted less from the traditional exercise as indicated by the widening of standard deviation from pre- to post-test scores. The Activity group students were better able to visually identify the concepts in the built condition and determine if the built condition was in compliance with the egress concept.

The demographic statistics indicate that the Traditional group was younger overall than the Activity group, with half of its member falling into the 18-20 age range. If one were to assume that a younger student would have more difficulty with assimilating abstract technical concepts and have more difficulty with spatial visualization skills this may explain the range of their test scores. The Traditional group's scores range from pre- to post test increased. Their pre-test range was 7, and increased to 12 on the post-test. The Traditional group was assigned the traditional exercise that did not offer the opportunity to develop their visualization skills. Perhaps age, combined with the lack of beneficial experience through the activity-based exercise created the wider range of post-test scores for the Traditional group.

Recommendations

The small number of participants presented challenges in statistical analysis. Future studies involving larger populations might result in a normalized distribution of test scores and wider variety of data analysis options.

Given the demonstrated value of aligning teaching styles with learning style preferences, by utilizing a multimodal instructional method, more can be done to improve the state of construction management education at Midwestern College.

Future studies could benefit from the inclusion of a perceived learning style preference survey of the participants. By identifying the target learning style preferences, teaching styles can be modified that best align with them.

Instructors need training and tools that will achieve the goal of aligning with the greatest possible combinations of preferred learning styles of their students. These instructional methods should be predominantly student-centered, activity-based, and multimodal. The teaching activities should offer the opportunity for peer-to-peer collaboration and utilize technology that is relevant to the student. The student should be able to see the immediate utility of the newly acquired knowledge in the construction industry.

Many of the students who participated in the Activity group indicated to the instructor, C.I., that they took advantage of the permission to work with others in completing the additional activity-based assignment. In light of the improved performance of this Activity group on the post-test, this issue of the value of peer-to-peer collaboration is worthy of further investigation.

Additional studies of other activity-based, student-centered, teaching modules may be valuable in identifying specific tools and techniques that would make a worthy addition to an instructor's tool kit for providing instruction that aligns with the greatest possible preferred learning styles of the students they serve.

References

Abdelhamid, T. S. (2003). Evaluation of teacher-student learning style disparity in construction management education. *Journal of Construction Education, 8*(3), 124-145

Abdullah, F. (2006). *An evaluation of Problem Based Learning in architectural education* (Doctoral dissertation, University of Strathclyde).

Ahmed, V., Pathmeswaran, R., & Aouad, G. (2007). A generic framework for the development of standardized learning objects within the discipline of construction management. *Journal for Education in the Built Environment*, *2*(2), 115-135.

Akasah, Z. A., & Alias, M. (2010). Bridging the spatial visualisation skills gap through engineering drawing using the whole-to-parts approach. *Australasian Journal of Engineering Education*, *16*(1), 81-86.

Ching, F. D., & Winkel, S. R. (2018). *Building codes illustrated: A guide to understanding the 2018 international building code*. John Wiley & Sons.

Cline, R. C. AC 2011-1974: Effective construction management teaching strategies. *American Society for Engineering Education*, *22*, 1-11. Retrieved from https://peer.asee.org/17816.pdf

Dunn, R., Honigsfeld, A., Doolan, L. S., Bostrom, L., Russo, K., Schiering, M. S., ... & Tenedero, H. (2009). Impact of learning-style instructional strategies on students' achievement and attitudes: Perceptions of educators in diverse institutions. *The Clearing House: A Journal of educational strategies, issues and ideas*, *82*(3), 135-140.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineering Education*, *78*(7), 674-681.

Felder, R. M., & Soloman, B. A. (2000). Learning styles and strategies. Retrieved from http://www. engr.ncsu.edu/learningstyles/ilsweb. html.

Halawi, L., & McCarthy, R. (2008). Measuring students' perceptions of blackboard using the technology acceptance model: A PLS approach. *Issues in Information Systems*, *9*(2), 95.

Harfield, T., Davies, K., Hede, J., Panko, M., & Kenley, R. (2007). Activity-based teaching for Unitec New Zealand construction students. *Emirates Journal for Engineering Research, 12*(1), 57-63. Retrieved from https://unitec.researchbank.ac.nz/handle/10652/2257

Hinds, P. J., Patterson, M., & Pfeffer, J. (2001). Bothered by abstraction: The effect of expertise on knowledge transfer and subsequent novice performance. *Journal of Applied Psychology*, *86*(6), 1232.

International Code Council. (2017). *2018 International building code.* Retrieved from https://codes.iccsafe.org/content/IBC2018P2

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice-Hall.

Lam, E. W. M., Chan, A. P. C., Chan, D. W. M., & Oladinrin, T. O. (2016). Analysis of the effectiveness of instructional strategies for construction management students. *Journal of Professional Issues in Engineering Education and Practice, 142*(3), 04016001.

Lee, N., Ponton, R., Jeffreys, A. W., & Cohn, R. (2011, April). Analysis of industry trends for improving undergraduate curriculum in construction management education. *In ASC Proceedings of the 47th Annual International Conference, Omaha, NE.*

Marchetti, L., & Cullen, P. (2016). A multimodal approach in the classroom for creative learning and teaching. *Psychological and creative approaches to language teaching*, 39-51.

Park, M., Chan, S. L., & Ingawale-Verma, Y. (2003). Three success factors for simulation based construction education. *Journal of Construction Education*, *8*(2), 101-114.

Pratt, D. D. (1998). *Five perspectives on teaching in adult and higher education*. Melbourne, FL: Krieger Publishing Co.

Sorby, S. A. (2009). Developing 3-D spatial visualization skills. *Engineering Design Graphics Journal*, *63*(2), 21-32.

Sorby, S. A., & Baartmans, B. J. (2000). The development and assessment of a course for enhancing the 3-D spatial visualization skills of first year engineering students. *Journal of Engineering Education*, *89*(3), 301-307.

Appendix A: Demographic Survey

Complete the following questionnaire and pre-test only if you agreed to participate in this research study and signed the preceeding consent form.

Anonymous Identifier: ____
(Birth month + First 3 letters of Mothers Maiden Name, ex: 06-POD)

1. Which gender applies to you?

   - o Male
   - o Female
   - o Transgender
   - o Nonbinary
   - o I prefer not to answer

2. What is your age?

   - o Under 18 years old
   - o 18 – 20 years old
   - o 21 – 23 years old
   - o 24 – 26 years old
   - o 27 – 29 years old
   - o 30 – 32 years old
   - o 33 years or older

3. In what language do you speak most often?

- o English
- o Spanish
- o Polish
- o Other_________________

4. Do you consider yourself knowledgeable in construction materials and methods?

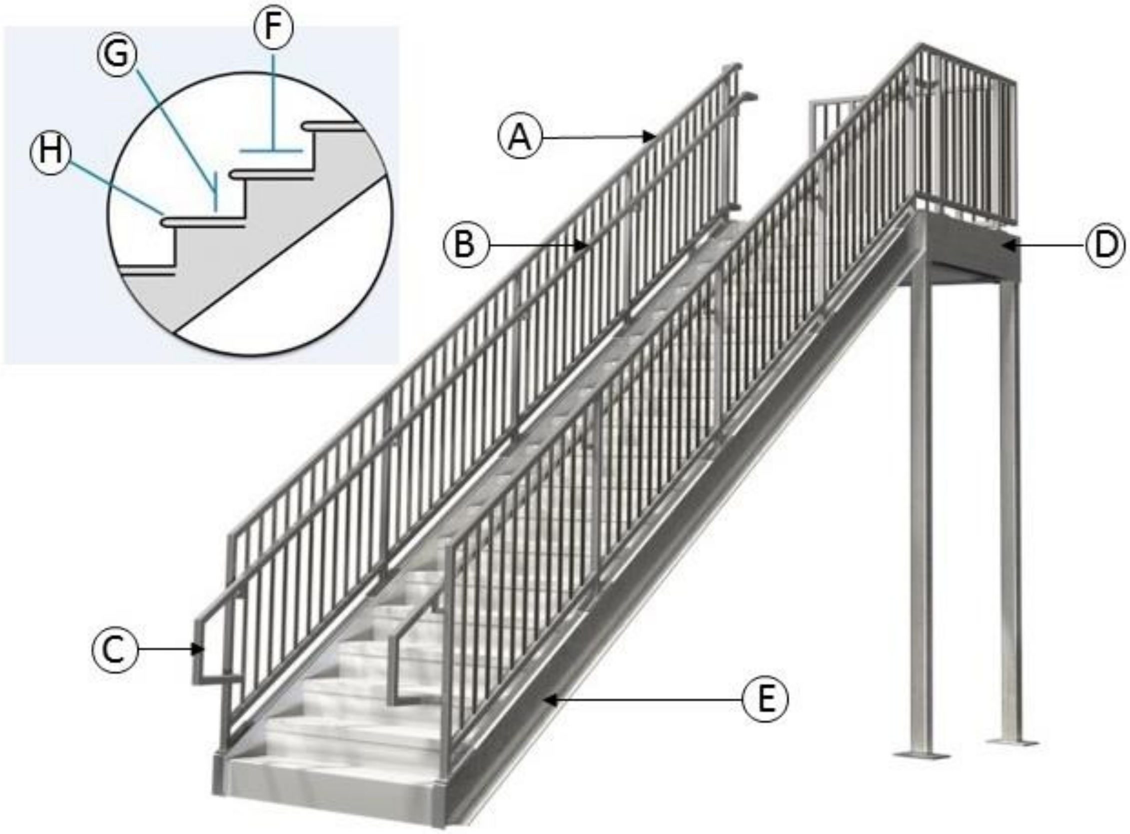
- o Yes
- o No

5. How many years of onsite construction experience do you have?

- o None
- o 0 – 3 years
- o 3 – 6 years
- o 6 – 9 years
- o 9 – 12 years
- o 12 – 15 years
- o 15 – 18 years
- o 18 – 21 years
- o More than 21 years

Appendix B: Pre / Post Test

1. Identify each stair component labelled in the image below.



A. ________________

B. ________________

C. ________________

D. ________________

E. ________________

F. ________________

G. ________________

H. ________________

2. Name as many code controlled characteristics as you can of the example exit door shown below:

1. ________________________________
2. ________________________________
3. ________________________________
4. ________________________________
5. ________________________________
6. ________________________________
7. __________________________________
8. ________________________________
9. ________________________________
10. ________________________________

3. Using only the image below indicate two characteristics of this exit stair that may not be code compliant and why.

Answer 1:

____

____

Answer 2:

____

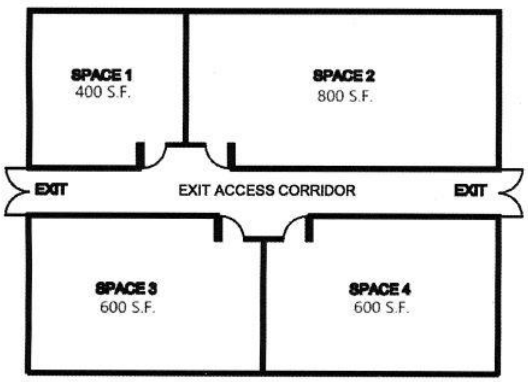
____

Appendix C: Established Traditional Exercise

INSTRUCTIONS: USE THE THE FOLLOWING ASSUMPTIONS, FLOOR PLAN, AND THE CODE SECTIONS LISTED TO COMPLETE THE TABLE BELOW AND ANSWER ADDITIONAL QUESTIONS.

ASSUMPTIONS: PROPOSED BUILDING IS TO BE A SINGLE STORY, OCCUPANY CLASSIFICATION B (BUSINESS). IT WILL NOT BE EQUIPPED WITH SPRINKLERS.

	I.B.C. CODE SECTION	**SPACE 1 EXAMPLE**	SPACE 1	SPACE 2	SPACE 3	SPACE 4
FUNCTION OF SPACE	-	CLASSROOM	LIBRARY READING ROOM	ASSEMBLY CONCENTRATED	CLASSROOM	ASSEMBLY UNCONCENTRATED
ROOM AREA	-	400	400	800	600	600
OCCUPANT LOAD	TABLE 1004.5	400/20 = 20				
REQ'D. # OF EXITS	1006.2.1	1				
REQ'D. EGRESS WIDTH (DOOR) NOTE: PER SECTION 1010.1.1 MIN. DOOR OPENING = 32"	1005.3.2	4" CALCULATED 32" ACTUAL				



PROPOSED BUILDING SCHEMATIC FLOOR PLAN
SCALE: N.T.S.

1) CALCULATE REQUIRED EGRESS WIDTH FOR EXIT ACCESS CORRIDOR [I.B.C. 1020.2]

2) CALCULATE REQUIRED NUMBER OF BUILDING EXITS. [I.B.C. 1006.3.2]

3) WHAT IS THE MAXIMUM "COMMON PATH OF EGRESS TRAVEL" DISTANCE FOR SPACES IN THIS BUILDING [I.B.C. 1006.2.1]

4) WHAT IS THE MAXIMUM "EXIT ACCESS TRAVEL" DISTANCE FOR THE BUILDING I.B.C. TABLE 1017.2

5) IN FILLING OUT THE TABLE ABOVE YOU SHOULD HAVE DISCOVERED THAT ONE OF THE SPACES REQUIRES TWO EXITS (DOORS). SKETCH IN THE ADDITIONAL EXIT (DOOR). [I.B.C. 1007.1.1]

Appendix D: Activity-Based Exercise