WIP: Utilizing Webcam Technology to Bring Students Into the Field

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Abstract

When possible, field trips are arranged in construction management (CM) educational programs allowing students to observe the conditions and communications typical of jobsite activities. Unfortunately, field trips present numerous challenges. As an alternative, webcam technology can be utilized as a means to provide job site observation without many of the drawbacks experienced with field trips.

A study designed to investigate webcam technologies suitable for use in the university setting; to implement the use of the technology to carry out live field trips at the Purdue University Department of Building Construction Management; and to survey students, professors, and field personnel who experienced the job site to classroom webcam educational activities was conducted during the 2006 – 2007 school year. This initial use of live wireless webcam technology for CM field trips was received with enthusiasm by students, faculty, and the field personnel that worked with the equipment.

Additional study is planned to ascertain the potential for attracting underrepresented populations to CM programs through mentored wireless webcam construction field trips. Project tour guides, selected for their ability to relate to the student participants, will demonstrate career opportunities in the construction industry. Students in two high school programs will participate in "live" two-way connections to mentors in the field, allowing students to interact during the project tours rather than viewing the video passively.

This exploratory study will utilize pre-testing to establish the participants' preferred learning styles and construction career awareness as expressed through career self-efficacy. Post-test analysis of changes in construction career efficacy after participating in wireless webcam field trips will be used to ascertain the degree to which learning style and various wireless webcam interventions influence career self-efficacy. Best practices for successful recruitment using wireless webcam field trips will be developed and disseminated.

Introduction

The construction industry employs about 5.4% of all workers in the United States [1]. According to an estimate by the Bureau of Labor Statistics, employment of construction mangers is projected to grow by 16% between 2006 and 2016 [2]. Despite the employment opportunities available, female students in construction technology education programs seldom represent more than 10% of enrollment [3]. Many projects have identified that women do not feel comfortable in the construction environment. Eisenberg [4] recorded the results of interviews of twenty-eight women working in various areas of construction ranging from tradeswomen to company owners. These stories mirrored OSHA findings, supporting their research [5]. Despite the discomfort expressed in the survey, none of the women discouraged other women from entering the trades because they had successful and fulfilling lives in their careers. In addition, many of the women who entered the trades during that time became owners of construction companies, and were advocates for other women entering construction careers [6].

The most recent enrollment data for Building Construction Management Technology at Purdue University shows that Black or African American individuals make up only 1.4% of students, Asians represent 3.2% of students, and Hispanics represent 2.4% of students. Although accurate statistics for all construction technology programs are not available, anecdotal evidence indicates that the Purdue enrollment is illustrative of the poor representation of ethnic minorities in college level construction technology programs. Employment in construction management job categories is also underrepresented by minorities. Black or African American individuals make up only 2.6% of construction managers and Asians represent only 1.5%. Hispanics who made up over 25% of the construction workforce in 2007 held only 9.2% of construction management jobs [7].

The construction industry is challenged to identify better ways to attract and retain those persons entering the construction management workforce [8],[9]. Further, graduates in CM programs are in demand due to an aging workforce that is retiring and leaving management positions [10],[11],[12]. Several major impediments to attracting broader participation in the industry have been identified. Studies examining the attitudes of high school students toward careers in construction disclose a consistent negative image of the industry and limited exposure to construction activity. The general image of construction is one of hard work, unsafe and dirty conditions. The craft shortage had been likened to a "Dead Man Walking." The perception was that there were no employees because of unsafe conditions [13]. The image the media exploits is that construction is saturated with "construction accidents, professional negligence, poor quality control …" [14]. In the Jobs Rated Almanac construction was rated 249 out of 250, when occupations were analyzed according to six key criteria including environment, income, employment outlook, physical demands, security, and stress; using data from such sources as the U.S. Bureau of Labor Statistics, U.S. Census Bureau, and studies from trade associations and industry groups [15].

Collegiate opportunities in construction technology have been expanding, with rising salaries and nearly full employment for graduates of construction engineering, construction technology, and construction management programs throughout the country. In the 2002-03 academic year a total of 3,568 baccalaureate degrees were awarded by accredited construction technology programs throughout the United States [16]. Prediction estimates based on a regression model anticipate an annual increase in demand for construction graduates of approximately 600 per year [10],[11].

In this study, field trip tour guides (Figure 1), selected for their ability to relate to the student participants and who have benefited from career opportunities in the construction industry, will expose students to the construction process to help dispel the negative images of the construction industry and demonstrate the benefits of a construction technology education. Wireless field trips will be utilized because even when construction projects are geographically available, the logistics of student transportation and timing create problems. Project sites may not be accessible to large numbers of students, or may present dangerous conditions for observation. Live wireless webcam technology has been demonstrated as an alternative to traditional construction field trips at Purdue University. This technology allows real time visuals and two-way conversations between field and classroom. The live wireless webcam technology has been received with enthusiasm by students, faculty, and the field personnel that worked with the equipment and has the potential to increase awareness of career opportunities in construction [17]. The “live” two-way audio connection available with the webcam field trips allows students to interact with the project tour guide rather than viewing the video passively. The wireless nature of the equipment overcomes the geographic disconnect between students and construction activity, and the mobile video appeals to the visual and spatial learning styles that are common with construction technology students.

Figure 1 – Wireless Webcam Tour Guide

Through collaboration with the Lafayette Community and Family Resource Center (CFRC), the high school student body of the Jefferson High School in Lafayette, Indiana will serve as the population frame. This populations will provide the opportunity to sample students with various levels of exposure to construction. Sufficient geographic separation from construction activity exists in this settings to measure the influence of wireless webcam field trips when little construction contact is apparent.

Theoretical Base

The visual nature of job site visits has been noted as a reason for including them in construction education [18]. Field visits relate well to the predominant visual learning style identified as a preference of both students and instructors at the Michigan State University's Construction Management Program [19]. This visual learning style tends to be more interesting to students than lecture or discussion [20]. In addition, construction technology students preferred instruction with active participation as a primary mode of teaching [19]. This understanding supports the theory that individuals who prefer kinesthetic, visual, and spatial learning may also prefer work activities that are dynamic, providing visual and spatial interactions as is found in nearly all aspects of construction employment. In the absence of evidence that females and minorities are less likely to prefer kinesthetic, visual, and spatial learning, it makes sense to recruit underrepresented populations through vibrant, visually stimulating activities in hopes of attracting those that prefer these learning styles.

Many learning style models and measurement instruments have been developed over the past 25 years to study the unique ways that students learn. The resulting learning style preferences have been used to advocate accommodations to these style preferences through modified learning environments, learning activities, teaching styles [21], study habits [22], and counseling [23]. This study seeks to utilize learning style preferences as a means to explore aspects of students' self image as applied to career goals and aspirations. Specifically, the study will examine how specific learning style preferences correspond to beliefs about educational and occupational capabilities expressed as self-efficacy.

Developmental theorists view adolescence and young adulthood as a turbulent time and a period in which a sense of integrated self must be developed to succeed in establishing a career as an adult [24],[25]. The research reveals factors such as 1) sense of self-worth 2) parental push or role modeling, 3) aspirations to secure a good job, and 4) desire to make money [26]. Adolescents must search within themselves to provide a firm basis for adulthood [24]. Additionally, social learning theory examines how students explore a college major and the role played by external forces through modeling or socialization [27]. One of the most useful practices in career development research has been the application of self-efficacy theory to the study of educational and vocational behavior [28]. According to this theory, students' beliefs about their educational and occupational capabilities are significantly related to the nature and range of career options they consider [29].

Much of the research regarding career-decision-making has focused on predicting a person's choice by developing a statistical model. Vocational theorists have speculated on the importance of understanding information about the self, the occupation, and one's relationship to the occupation. A client of a career counselor completes a survey to collect personal data. The data are then compared to occupations and interpreted, accordingly. Holland's spatial model [30], Prediger's dimensional model [31], and Gati's classification model [32] are examples of this approach. Problems revealed from these theories are related to naturally occurring perceptions of the occupations and how these perceptions develop over a person's life [33]. Career indecision may be an even greater concern because of trends indicating that people revise their career decisions over their lifespan [34],[35].

Every year, thousands of students are enrolled in a variety of postsecondary education programs across the United States. Several studies have concluded that selection of a college major is derived from career choice [36],[37],[38]. The theory is exemplified by students who are enrolled in structured majors in college such as nursing or construction technology. These students are more decided about their career choices than students who are enrolled in more general majors such as business or communication [39],[40]. Research regarding business, technology, and other professional majors has resulted in the development of instrumentation to study construction management (CM) students [41],[42],[43]. One career study found that students' attitudes were more closely related to tangible (performance-oriented) rather than symbolic (money) attributes [42]. These studies have also produced and validated instrumentation and procedures that demonstrated the effectiveness of various models to assess students' attitudes in a variety of career majors.

Conceptual Framework and Research Questions

The conceptual framework for this study is as follows:

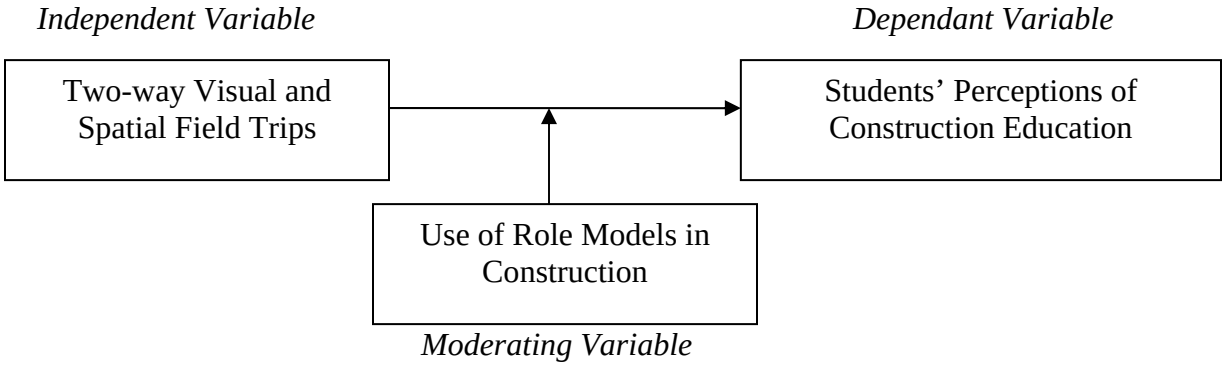

Figure 2 – Conceptual Framework

Career decision has been defined as "the degree to which individuals feel confident, or decided, about their occupational plans" [44]. Gender has been found to be a great influence on career decision making [45],[46]. Researchers have also explored the link

between self-efficacy beliefs, college major, and career choices, particularly in the fields of science and mathematics [47]. Geographic location often limits the exposure of many youth to a variety of jobs and career opportunities. Betz & Hackett have applied self-efficacy to understanding the process of women deciding on a career [28]. One study applying this concept used a one-way video intervention and found that it had some positive effects on the women [48]. This study would follow this intervention model to replicate the use of the career self-efficacy instrument as a measure of career confidence in answering the following research questions.

- Does exposing high school students to presentations conducted by role models active in the construction industry through "live" webcam field trips increase self-efficacy towards a career in construction technology?
- Does exposing high school students to "recorded" field trips conducted by role models active in the construction industry increase self-efficacy towards a career in construction technology?
- Does exposing high school students to presentations conducted by role models active in the construction industry through "live" webcam field trips increase self-efficacy towards a career in construction technology to a greater degree than exposing the students to "recorded" field trips?
- Does informal exposure to construction activity in the community where high school students reside influence students' awareness and interest in employment and educational opportunities in construction technology?
- Are demographic factors a variable in students' awareness and interest in employment and educational opportunities in construction technology?
- Is learning style a predictor of interest in employment and educational opportunities in construction technology?

The use of recordings of the field trip presentations will be employed in interventions each semester to provide a means of measuring the difference between the effect of the mentored "live" two-way webcam field trips and the influence of mentors through recorded video material without the interaction between mentor and student available in the live field trips. Since selection of a random sample of students in the classroom setting is difficult, it will be necessary to expose an adequate number of students for the sample to be representative of the population. Interventions utilizing a sample of 40 to 50 students each semester over a three year time period are planned to allow a sufficiently large sample of students to be exposed to both live and recorded interventions.

Research Design

This study seeks to synthesize the theoretical concepts of learning styles, career self-efficacy, and the use of mentored interventions through real-time webcam mediated field trips. It is suggested that this theoretical synthesis will lead to a better understanding of the predictors and impediments to student consideration of construction as a career choice, especially as they apply to underrepresented populations. An instrument will be designed and refined over the course of the study to test awareness of construction and

career self-efficacy measures. Methods and effective practices will also be designed and refined to guide webcam mediated interventions within the specific contexts of construction technology recruitment. The innovation of live webcam field trips will be implemented in two high schools to study changes in student awareness and self-efficacy toward construction technology programs and construction craft training, with emphasis place on populations underrepresented in these career paths. A preliminary evaluation of effectiveness will be provided. This exploratory study seeks to begin the synthesis of complex phenomena in hopes of generating knowledge that will support additional evaluation and inform practitioners of an innovative use of existing technology which has the potential to reform practice in Science, Technology, Engineering, and Math (STEM) education recruitment.

Specifically, the study will utilize pre-testing to establish the participants' preferred learning styles and construction career awareness. Mentored webcam field trips utilizing varied tour guide and project characteristics along with post-test analysis of changes in construction career awareness and confidence will be used to ascertain the degree to which learning style is a predictor of construction career choice and the influence of wireless webcam interventions on career self-efficacy.

The commercially available and previously validated LIVES learning style instrument, designed for students ages 14 -18, will be used prior to interventions to establish learning style profiles for participating students. Measurement of construction awareness and career self-efficacy will be made as both pre and post-test measurements using a context based adaptation of the generalized self-efficacy (GSE) scale modified and will be pilot tested in the spring of 2009.

The wireless webcam equipment utilizes a set-top videoconferencing device as the means of communication between jobsite and classroom in combination with short-range microwave wireless audio and video equipment. Low-powered microwave equipment operating on the 5.8 GHz frequency band is used to provide wireless jobsite communication from the mentor's hardhat camera and headset to the field videoconferencing base (Figure 3). Students can view the video and pose questions to the mentor in real-time in any location that is equipped with high-bandwidth Internet through a videoconferencing device and large screen TV or projection system.

Beginning in the fall semester of 2009 three mentored interventions will take place at each of the participating high schools. Two of the interventions will utilize a mentored field trip using live webcam technology. Since weather, internet traffic, and technical problems can impact the quality of these live field trips, two interventions are planned to assure at least one high quality field trip recording will be made each semester. The best quality recording from each semester will be used to provide a non-interactive intervention each semester. Approximately 15 students will participate in each of the interventions for a total of 40 – 50 students during the semester. Over five semesters it is anticipated that approximately 300 students will be exposed to live real-time field trip interventions and approximately 150 students will be exposed to recorded field trips.

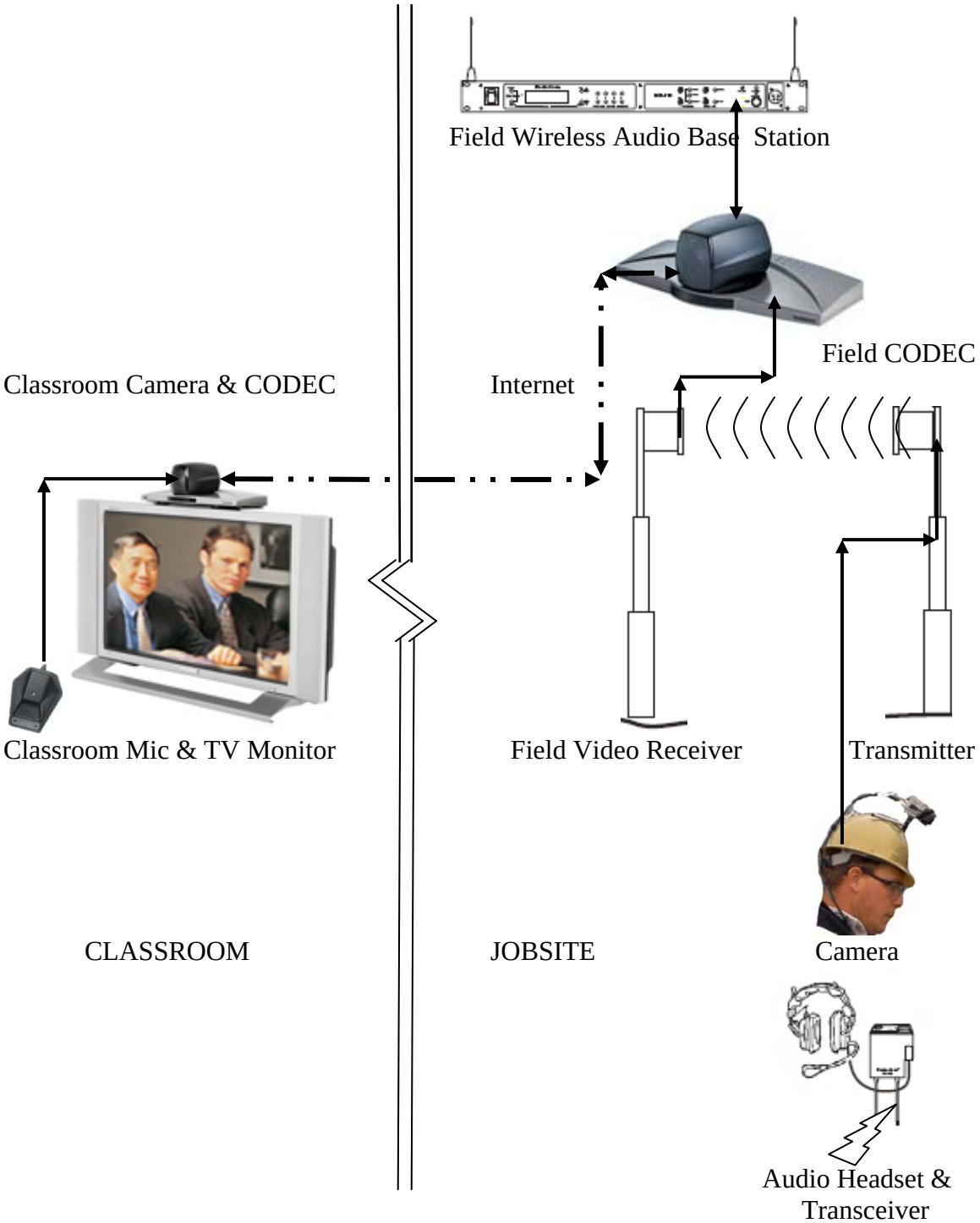

Figure 3 – Wireless Webcam Equipment Flowchart

In addition to students, counselors and teachers will be asked to participate in the wireless webcam field trips. They will be asked to complete pre-test and post-test survey instruments (teaching style and construction career awareness) to ascertain a similar

profile to that which is being collected from the students. In addition, they will be interviewed and asked to participate in the review of effective practice documents developed for school use.

Effective practices for successful recruitment using live wireless webcam field trips will be developed and disseminated. Effective practices will be composed of three major components. The first component will apply to planning and implementing the mentored field trip. Guidance and planning materials will be created to assure that projects visited, mentor selection, mentor training, and topics covered for each field trip provide an accurate and effective demonstration of career opportunities in construction. The second effective practices component will apply to use of the webcam technology. This component will be specific to construction jobsite implementations; nevertheless, it will be valuable to other disciplines as well. The third component will apply to student preparation for webcam interventions. These effective practices will deal with suggestions for counselors and teachers in proper administration of the presentation environment and any suggestions for preparatory or follow-up activities.

Instrument Design & Validation

The LIVES learning style instrument, a commercially available instrument which is designed to be administered and scored through Internet access, will be used to provide learning style preferences for participating students. The LIVES instrument is an adaptation of the Dunn and Dunn Model of Learning Styles for students 14 -18. The Dunn and Dunn Model first introduced in 1974 is one of many learning style models. Although not specifically designed for use by engineering students as some have attempted [21], it has been subjected to significant analysis to determine validity and reliability [49](Dunn, Griggs, Olsen, Beasley, & Gorman, 1995). In addition, it supplies 20 specific preference elements in the five stimuli categories of Environmental, Emotional, Sociological, Physiological, and Psychological Processing. Although there is not a single learning style dimension or element that is common to all learning style models [21], the Dunn and Dunn Model provides a broad selection of elements for association to construction career orientation.

Self-efficacy theory is a component of Bandura's social cognitive approach to vocational behavior [27]. This theory has been applied to students exploring careers as they inventory their beliefs. Self-efficacy beliefs refer to "people's judgments of their capabilities to organize and execute courses of action required for attaining designated types of performances" [50, p. 391]. Self-efficacy was believed to be the important cognitive influence on career decision-making (CDM). Researchers have explored the link between self-efficacy beliefs, college major, and career choices, particularly in the fields of science and mathematics [47](Lent & Hackett, 1987). The generalized self-efficacy (GSE) scale is a 10-item psychometric scale that was designed to assess optimistic self-beliefs to cope with a variety of difficult demands in life. The scale was originally developed in the German language, but has been adapted to 26 languages, and has been administered to over 17,000 participants in 22 countries [51]. In contrast to other scales that were designed to assess optimism, the GSE explicitly refers to personal

agency, i.e., the belief that one's actions are responsible for successful outcomes. A construction career context based instrument, adapted from the GSE) scale, will be reviewed by staff of the Purdue University Psychometric Investigation Laboratory prior to pilot testing in the spring of 2009

Data Analysis

Responses to the LIVES and career awareness/self-efficacy survey instruments will yield quantitative data for use in analysis of the research questions. These data represent perceptions of a non-probability sample of approximately 450 students (as well as several teachers and counselors). Since the data will be generated from a sample of convenience, the statistical analyses available for use will be limited. The T-test will be used to assess whether the pre-test and post-test self-efficacy scores are statistically different from each other. Descriptive statistics and chi square analysis will allow comparisons to be made based on learning style preferences, career awareness indicators, and demographic data collected. Applicability of specific statistical methods utilized will be reviewed by a staff member of the Purdue Statistical Consulting Service to assure validity of the statistical method for the available sample.

Significant qualitative data will also be collected during this study. This data will consist of project diary notes, responses to open-ended survey questions, and limited interview data. These data will provide a continuing supply of questions for discussion during review of the career interest and self-efficacy instrument and the successive formative steps in developing effective practices documents. Open-ended survey questions will allow the researchers to add richness to conclusions drawn from the quantitative data [52]. A division of qualitative points will be made between equipment and teaching issues, and finally between planning and implementation data. This thematic grouping will assure that all records were examined to provide “full immersion” in the data, and will separate the salient information into categories that are conducive to the formation of effective practices, identifying challenges requiring additional research, and formulating recommendations for future activity with webcam field trips.

Conclusion

This exploratory research is expected to provide evidence of a positive relationship between the use of dynamic, visual and spatial exposure of high school students to construction site activity when moderated by role models and an improved student perception of career opportunities in construction technology. In addition, development of effective practices for successful recruitment using live wireless webcam field trips should result. It is anticipated that the effective practices for wireless webcam field trips developed as part of this study can be adapted for recruitment of students both to college level construction technology programs and to the study of construction crafts. Effective practices should also be adaptable to other disciplines where geography or job conditions limit student exposure to career opportunities. In addition, the study will provide evidence to either correlate or deny a relationship between learning styles and interest in construction careers.

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Biography

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