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The Influence of Construction Management Work Experience on University Students' Academic Achievement

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Abstract
This study compared the academic achievement of students who participated in a cooperative education program with the academic achievement of those students who did not participate. The general hypothesis was that students who gained knowledge through co-op work experience would use that knowledge in subsequent coursework and achieve a higher grade point average (GPA) than students who did not participate in the co-op program. Historical data were analyzed on students who graduated from the building science program at Auburn University from 1996 – 2000. The independent variable was STATUS and the dependent variable of academic achievement was measured by the GPA of five sequential project management classes.

Keywords
Construction education, curriculum, work experience, academic achievement

1. Introduction

1.1 Background of the Issue

Past research studies have used high school class rank, high school GPA, ACT scores, SAT scores, age, and work experience as predictor variables to determine academic achievement in college students (Beecher & Fischer, 1999; Garton, Dyer, & King, 2000). This study focused on one of these variables that is currently being debated in construction management education, namely work experience (Chapin, Roudebush, & Krone, 1997; Hynds & Smith, 2001). The debate focuses not only on work experience, but structured, verifiable, and appropriate *construction management* work experience (Hauck, Allen, & Rondinelli, 2000).

Many college and university construction programs that belong to the Associated Schools of Construction (ASC) are in favor of some type of mandatory construction work experience as part of their undergraduate curriculum. This work experience usually takes the form of a structured internship or participation in a cooperative education (co-op) program. Several ASC construction programs already require a minimum number of verifiable hours of construction work experience in a structured internship as part of the

curriculum (Chapin et al., 1997; Hauck et al., 2000). While none of these programs require co-op participation, the requirement for mandatory construction work experience is growing.

The American Council for Construction Education (ACCE) is the accrediting body for construction programs in higher education. Since 1974, ACCE has accredited 52 baccalaureate degree programs and eight associate degree programs in the United States (ACCE, 2002). As of 2002, ACCE does not require construction management work experience for accreditation. However, many construction industry advisory councils and alumni have supported the idea of making it a required part of construction curricula across the country (Chapin et al., 1997; Hauck et al., 2000; Hynds & Smith, 2001).

Requiring construction management work experience as part of the curriculum may or may not have tangible academic achievement benefits, but implementation of such a requirement will definitely have overhead costs associated with it. Other concerns involve the possibility that internships may become scarce or inappropriate during periods of recession in the construction industry. Also, students will be limited during the internship periods to only construction work opportunities, thus eliminating non-construction work opportunities, volunteering, and taking classes during the summer. Hauck et al. (2000) concluded from their research on Colorado State's mandatory, structured construction internship that "if the purpose is to augment the curriculum, enhance academic learning, and increase the stature of the academic program with the commitment of minimal resources, then implementing an internship program may not deliver the desired results and will not be the best use of those resources" (p. 9).

1.2 Definition of Terms

Cooperative Education at Auburn University – The student must have a minimum cumulative GPA of 2.20 to be accepted into the co-op program. Co-op employers regularly interview on campus to fill co-op positions within their companies that match students' academic and career goals. The co-op student follows a formalized plan for the alternation of full-time classroom study with periods of full-time work experience. The co-op program involves a minimum of four quarters of professional work experience.

Cooperative Education Students (co-op) – Building science students who participated in the cooperative education program administered by Auburn University from fall quarter 1994 – summer quarter 2000.

Non-cooperative Education Students (nonco-op) – Building science students who did not participate in the cooperative education program administered by Auburn University from fall quarter 1994 – summer quarter 2000.

Student Status (STATUS) – The student will be classified as co-op or nonco-op. This is the independent variable for the study.

Grade point average (gpa) – calculated by dividing the total grade points by the total number of credits attempted. Grade points for this study are: a = 4.0, b = 3.0, c = 2.0, d = 1.0, and f = 0.0. Therefore, if a student earns an a, b, c, and d respectively in four different classes during the quarter, the student's gpa would be calculated as follows: gpa = [(4.0 + 3.0 + 2.0 + 1.0) x 3 credits per class] / (3 credits per class x 4 classes) = 2.50

Acceptance into the Building Science Program – The student's classification was changed from pre-building science (1st and 2nd year) to building science (3rd year). Entrance into the program was competitive and was based solely on the student's cumulative GPA after all pre-requisite classes were completed.

Acceptance GPA (AGPA) – The student's cumulative GPA (after completing all prerequisite classes in the pre-building science curriculum) at the time the student was accepted into the building science program on a competitive basis. The acceptance GPA is computed by dividing the total grade points by the total number of credits attempted at Auburn University. This baseline variable, measuring initial academic achievement at the time the student was accepted into the building science program, was used to create four homogeneous groups of students.

- *Group 1 (G1)* – This group consists of students who had an acceptance GPA (AGPA) between 2.20 and 2.49.
- *Group 2 (G2)* – This group consists of students who had an acceptance GPA (AGPA) between 2.50 and 2.99.
- *Group 3 (G3)* – This group consists of students who had an acceptance GPA (AGPA) between 3.00 and 3.49.
- *Group 4 (G4)* – This group consists of students who had an acceptance GPA (AGPA) between 3.50 and 4.00.

Project Management GPA (PM GPA) – The student's GPA based on ***five sequential project management*** courses: estimating I, estimating II, construction scheduling, project management, and contracting business. The building science PM GPA is computed by dividing the student's total grade points by the total number of building science project management class credits attempted. This is the dependent variable measuring academic achievement for the study.

1.3 Research Question & Hypotheses

Research Question: *Was there a difference in academic achievement, as measured by GPA, between co-op students and nonco-op students who graduated from the building science program at Auburn University from 1996 to 2000?* The following null hypotheses were developed for this study and a .05 level of significance was used based on previous studies done in this field (Appelt, 1991; Burton, 2000; Hauck et al., 2000; Ullrich, 1988).

Null hypotheses 1 through 4 investigated the difference between co-op students' and nonco-op students' *PM GPA* within the four homogeneous baseline groups G1 through G4.

- Hypothesis 1: There is no difference in the mean scores within group G1, as measured by *PM GPA*, between co-op students and nonco-op students at the .05 level of significance.

- Hypothesis 2: There is no difference in the mean scores within group G2, as measured by *PM GPA*, between co-op students and nonco-op students at the .05 level of significance.

- Hypothesis 3: There is no difference in the mean scores within group G3, as measured by *PM GPA*, between co-op students and nonco-op students at the .05 level of significance.

- Hypothesis 4: There is no difference in the mean scores within group G4, as measured by *PM GPA*, between co-op students and nonco-op students at the .05 level of significance.

2. Literature Review

The focus of this study was to compare the academic achievement of building science students at Auburn University who participated in a cooperative education program with the academic achievement of those students who did not participate. Cooperative education research is a relatively young field with empirical studies starting in the 1960s (Lyons & Hunt, 1961; Smith, 1965). While the academic benefits of participating in cooperative education may seem obvious to some, researchers have conducted numerous studies over the past 40 years in an effort to describe, quantify, and provide evidence of such benefits.

Chapin, Roudebush, and Krone (1997) conducted a survey concerning the use of cooperative education within the 88 member schools of the Associated Schools of Construction. In this study, the definition of cooperative education also included internships and work-study programs. While the benefits of cooperative education in this study were descriptive, opinion-based, and self-reported, some of the written comments from the questionnaire give a clue as to what construction educators believed about students' co-op experience:

- Students come back more motivated.
- Most demonstrate improved classroom performance as a result of the experience.
- Changes the quality of the performance in capstone course required at the end of the senior year.
- Provides direction to student. Helps motivate students when returning to classroom.
- When the experiences provide responsibility, the student matures in his discipline.
- Brings relevance to the students' classes.
- Students familiarize themselves with real-life situations. Tests reflect such situations. All curriculum tests reflect practical applications.
- Employers offer higher salaries to graduates with real experience.
- Graduates with co-op experience obtained higher entry-level salaries and were promoted much faster (Chapin et al., 1997, pp. 114-116).

These claims are based on anecdotal evidence because of the lack of empirical studies involving construction students and co-op education. However, many of these comments from construction educators reflect the same benefits that cooperative education researchers have studied over the years: (1) career maturity, (2) higher starting salaries for graduates, (3) academic achievement, (4) initial employment, and (5) motivation.

In their review of cooperative education literature, Ricks, Cutt, Branton, Loken, and Van Gyn (1993) took a critical look at previous cooperative education research studies. Ricks et al. (1993) stated that:

> The cooperative education literature tends to demonstrate what is *believed* about cooperative education that is similarly defined, rather than what has been substantiated in cooperative education research. The literature contains many assertions, and sometimes postulates, that have not yet been adequately tested (p.11).

Therefore, when reviewing the literature about academic benefits associated with participation in a cooperative education program we are not surprised to find contradictory results and conclusions from four decades of research. Many empirical studies were conducted without taking into consideration initial differences between co-op students and nonco-op students when measuring outcomes after co-op participation (Ricks et al, 1993).

3. Variables

This study used historical student data to measure differences in academic achievement between co-op students and nonco-op students. The independent variable was STATUS (co-op vs. nonco-op) and the dependent variable, academic achievement, was PM GPA (GPA of five sequential project management classes). In addition, a baseline measurement variable of academic achievement was conceptualized to categorize the students into homogenous groups based on their cumulative grade point average when they were accepted into the building science program, AGPA.

Typically the three entry points for new graduates in a construction firm are: (1) junior estimator (2) assistant project manager, and (3) assistant superintendent. If possible, co-op students working for a construction firm are rotated among these three positions in order to give the student a flavor of the work that the company does and the way that they do it. The co-op student would be exposed to professional practice among these three positions during the co-op work experience. It was hypothesized that this exposure to professional practice in the construction industry would have an effect on the project management classes (PM GPA) in the curriculum. Also, grouping these five project management classes together provided a chance for co-op work experience to have an effect on a narrow set of classes, rather than getting lost in the total coursework credits that are used to calculate the student's graduation GPA.

A baseline measurement variable of academic achievement, AGPA, was created to categorize the students into homogenous groups in order to minimize the main threat to the study's internal validity namely, groups that are not comparable. The participants were categorized into four homogenous groups based on their grade point average at the time they were accepted into the building science program (AGPA). The four groups were: G1 (2.20 – 2.49), G2 (2.50 – 2.99), G3 (3.00 – 3.49), and G4 (3.50 – 4.00). This variable was created by calculating the student's cumulative GPA (after completing all pre-requisite classes in the pre-building science curriculum) at the time the student was accepted into the building science program. A t-test procedure was performed on each of the four groups to determine if there was a significant difference between co-op students' and nonco-op students' mean scores. There was no statistical difference, at the .05 level, between co-op students' and nonco-cop students' mean scores of AGPA *within* each of the four groups. Therefore, the statistical analysis supports the study design of grouping the students according to their AGPA to establish a baseline in which to perform future comparisons based on dependent variables of academic achievement.

4. Results

The final data set consisted of 460 building science students. Of the 460 students, 143 participated in the cooperative education program and 317 did not. The data for each student consisted of: STATUS (co-op vs. nonco-op), AGPA (cumulative GPA at time of acceptance), and PM GPA (GPA of five sequential project management building science classes).

An analysis of variance (ANOVA) procedure was performed on the participant data and determined that PM GPA means for co-ops (3.05) and nonco-ops (2.88), within group G2, were significantly different ($F = 5.894$, $p = 0.0161$) at the .05 level of significance (see Exhibit 2). The application of a second ANOVA procedure determined that PM GPA means for co-ops (3.45) and nonco-ops (3.27), within group G3, were significantly different ($F = 5.274$, $p = 0.0238$) at the .05 level of significance (see Exhibit 2). The PM GPA

means for co-ops and nonco-ops, within the other two groups: G1 and G4 were not significantly different at the .05 level of significance (see Table 1).

Baseline groups	PM GPA Co-op	PM GPA Nonco-op	F-value	p-value
G1	2.89	2.65	2.266	0.1350
G2	3.05	2.88	5.894	0.0161*
G3	3.45	3.27	5.274	0.0238*
G4	3.56	3.50	0.284	0.5967

* significant at the .05 level

Table 1. PM GPA means for the groups G1, G2, G3, and G4 according to STATUS.

The results of the statistical analysis for hypotheses 1 through 4 are as follows: Null hypothesis 1 *cannot be rejected,* Null hypothesis 2 ***is rejected,*** Null hypothesis 3 ***is rejected,*** and Null hypothesis 4 *cannot be rejected*.

5. Conclusions

There was a significant difference between co-op students' and nonco-op students' PM GPA mean scores for two of the four groups. Interestingly, the co-op participation ***did not have an effect*** on group G1, comprised of the lowest range of AGPA scores (2.20 to 2.49), nor group G4, with the highest range of AGPA scores (3.50 to 4.00). The co-op participation ***did have an effect*** on the two groups in between the highest and lowest ranges: G2 (2.50 to 2.99) and G3 (3.00 to 3.49). The results seem to suggest that the treatment, co-op participation, did not have an effect on the weakest academic group G1 nor the strongest academic group G4, but rather affected the two groups in between, G2 and G3. The students in group G4 were high academic achievers before they entered the building science program and typically would have been high academic achievers in their coursework whether they participated in the co-op program or not. Conversely, the students in group G1 were low academic achievers before they entered the building science program. These students may have had a much harder time grasping the academic content of the five project management classes and therefore, the co-op participation did not have a large enough influence on their GPAs to be significant. While the co-op students in groups G1 and G4 had higher PM GPA mean scores than the nonco-op students, the difference was not significant.

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