"Real-World" Approach To Construction Education: Phase 1 -- Construction Graphics

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INTRODUCTION

What happens when successful professional construction company practices are directly integrated into an established four-year construction education program? Hopefully, the result will be a highly skilled and educated construction professional prepared to respond to the ever changing fast-paced world of construction. This desired result can be accomplished by creating an academic program that simulates a "real-world" construction environment within an academic setting. In essence, throw away the traditional "lecture and release" approach to higher education and create an experiential, real world "learn by doing" approach to construction education.

This particular construction education concept was initiated by a group of construction faculty from Pittsburg State University with a variety of professional backgrounds in construction, architecture, engineering and construction management with a goal to develop a new academic approach to construction education. The approach is relatively simple. Instructors would no longer focus on traditional lecturing, classroom activities, grading and assignments. Instead, they would focus on leading, guiding and mentoring groups of students in design, operations, methodology and management in a simulated construction company environment. This process would require students at each level, first year through graduate, to become part of a multi-faceted, multi-functional construction design/manage/construct organization inside a university environment. Faculty would become company officers, CEOs, senior project managers, department managers, etc. First year students would assume introductory roles (plan reviewers, as-built and shop drawing developers, quantity takeoff surveyors, etc.). Each year a student would move up to a different more advanced role. Field engineers, material testers and estimators at the second year level. Senior estimators, project engineers, superintendents at the third year level. Project managers, contract managers, etc. at the senior/graduate year. Project teams would be developed from a cross section of the various levels of students. As the semester/year progressed, special workshops and training sessions would be required for the various jobs and responsibilities (legal issues, ethics, safety, CAD, design concepts, etc.). Students needing to attend traditional courses like English, History and Calculus would in essence be attending a meeting for that period of time each day. The students would be required to be "at work" in some sense a minimum of 8-9 hours each day.

The faculty involved in this project recognized the difficulty of incorporating this model into a traditional academic environment in one quantum leap. They decided to start with a freshman level graphics course to assess potential pitfalls, identify successes and failures, and determine student attitudes and interests relative to this construction education approach. The primary concerns of the group for this initial phase included: 1) how well students would function in an environment where grades were determined both subjectively and objectively, and 2) how well the students would learn fundamental concepts.

OBJECTIVES

The primary objectives of the initial phase of this project were:

- to determine the reactions, attitudes and concerns of the participating students regarding a radically different approach to higher education.
- to assess the fundamental competency level of the participating students relative to construction graphical communication.
- to assess the ability of a first year student to adapt to a flexible, simulated-work educational environment versus a traditional structured educational environment.
- to evaluate the perceived successes and failures identified throughout the initial phase.
- to determine the reactions, attitudes and concerns of the participating faculty and associated administrators (chair of the department and construction program coordinator).

The need for radical change in higher education is well documented by numerous studies and current literature. In *The Quality Professor-Implementing TQM in the Classroom*, Robert Cornesky modifies Deming's 7th and 11th point for quality improvement as follows: " Adopt and institute leadership. Your aim should be to help students do a better job." and "Eliminate the traditional, standardized grading system from the classroom. Eliminate management by objectives and numbers. Substitute leadership, making sure that what the students learn, they learn well." Cornesky goes on to say that in order to change student attitudes, behavior and work quality, educational systems need to be changed. These systems being teaching style, organization of materials, assignments and evaluation methods.

Dr. Richard Felder, a recognized authority on effective teaching, suggests that traditional teaching styles do not often match with preferred learning styles. In fact, his studies comparing engineering students' learning style preference, and engineering and engineering technology faculty learning style preference, show that preferences vary considerably between the various groups. Dr. Felder's studies show that undergraduate engineering students prefer a learning style with an emphasis on sensing, visual, deductive and sequential teaching, with no distinct preference between active and reflective teaching methods. In contrast, engineering faculty, in general, prefer intuitive, visual, inductive, reflective and sequential learning styles. Engineering technology faculty tend to prefer sensing, visual, deductive and sequential methods, with no distinct preference between active and reflective methods. Dr. Felder's studies and philosophies support the objectives of this project to assess student perceptions and learning styles compared to provided delivery methods.

With the construction industry demands on graduates of construction programs ever increasing, it is important that students in the program receive "real-world" experiences early and often in their academic career. The importance of integrating practical experience, technical knowledge and interactive communication guided the objectives for the first phase of this project.

DESCRIPTION

The first step in this project was to offer two separate sections of Construction Graphics, a traditional first semester construction drawing/blueprint reading course. The control course was taught traditionally. It utilized a traditional construction graphics text, specific assignments, deadlines and tests, and primarily manual drafting methods. Grading and evaluation were very structured and primarily summative. The course utilized a single instructor who had taught the course numerous times and was well versed in basic construction graphic/drafting techniques. Students were selected randomly through the enrollment process.

The trial course was taught with a distinct "real-world" approach. No specific text was required. Instead, a library of graphical information, literature and texts was made available to the students. The classroom was made available to the students on a 24 hour, seven day a week basis. All assignments were designed to provide real-world construction-related experiences. There were no tests given in the course. All evaluation of work was done in a formative manner. Each student maintained a portfolio of projects and they were evaluated by the faculty at the end of the semester. The ongoing formative feedback allowed the students to continue working on the projects to improve them up to the final and only deadline which was the end of the semester. Our focus was for the students to do the work correctly and professionally regardless of how many times they had to do the work. Students were allowed to work manually or with CAD on any and all of their projects. Informal instruction of both techniques was provided throughout the semester. The course was instructed by two instructors and one graduate assistant. One instructor is an architect and construction manager with 30+ years of experience in construction and academia. The other instructor is a graduate of the program with 20+ years of construction experience. They were assisted by a graduate assistant with considerable CAD experience. Students were required to be in the classroom environment during project discussion and presentations, but could come and go as necessary.

PROJECTS

The first project involved the development of a small project on an actual piece of property. Three different sites were selected. One included a new workshop, storage shed and greenhouse located on a well-developed, confined site. The second included an existing garage on a well developed site with a need to convert the garage to a studio apartment and workshop. The third included a new garage on a wide open undeveloped site in a rural setting. The students and instructors visited all three sites taking field notes on existing structures, access, utilities, boundaries, etc. Based on the site visits, the students were asked to select a single project and a partner to work on the project. Each team then presented preliminary designs and sketches (site plan, floor plan, elevation) for the project they selected. The faculty reviewed and approved the conceptual designs and provided feedback as necessary. Approximately two (2) weeks were allowed for this project.

The second project was a small civil project that each student worked on individually. A group of surveying students from the program provided site elevation information for a small site being developed. Each student was required to provide a site topographical drawing and appropriate cross section drawings based on the collected data. During this phase of the course, a workshop

on CAD drafting methods was presented and all students received a minimum of four (4) hours of hands-on CAD. The students were allowed approximately two (2) weeks for this project.

The third project lasted one class period and involved conceptual design and material selection for a central oval design for a new technology center being constructed on the campus. Groups of four students were given two (2) hours to generate a thematic conceptual design, sketch the concept and present the concept with the selected construction material to the class.

The fourth project involved an existing bridge located across a college lake. Each student was required to provide a complete set of "as-built" and detail drawings of the bridge sufficient for a detailed structural evaluation. The students measured all components, determined the material type, evaluated all connections and details necessary to provide the requested documentation.

On the fifth and final project, each student was given a conceptual floor plan and front elevation for a construction company office building. Each student was required to develop a complete set of working drawings (site plan, floor plan, elevations, building section, wall section, electrical, mechanical, etc.) for this project. They were given four to five weeks to complete the project.

As the semester progressed, the faculty and graduate assistant interacted with the students as appropriate. Any lectures or guidelines to the entire class were limited in time and occurrence. Questions were dealt with on an "as-needed" basis. The atmosphere of the course was very flexible, but with high performance demands.

As the course approached the end of the semester, a series of surveys measuring student and faculty perceptions were administered. These surveys were given to both the traditional/control course and the trial course. One survey was administered by the Social Science Research Lab, Wichita State University, in the form of a Student Perception of Teaching Effectiveness II survey. The other student survey was administered by the faculty and provided baseline and student perceived improvement information. A survey of the involved faculty and administrators was conducted verbally and individually relative to overall feedback, recommendations for improvements, etc.

RESULTS

The results of the trial course were in most cases supportive of this approach to construction education. It is important to note that the students surveyed were predominantly 18-19 year old freshmen with limited construction knowledge or backgrounds.

From the "Student Perceptions of Teaching Effectiveness Survey", the students rated the trial course relatively low on a perceived quality index and extremely high on the perceived course demands. In comparison, the traditional/control group had a slightly higher perceived quality index, but a lower perceived course demand. The major differences between the two courses within the perceived quality index component lie in the perceived rapport with students and grading quality categories. In general, the students in the trial course liked the way the faculty interacted with the students in a flexible environment, but they did not like the method of evaluation. Relative to the perceived course demands, students perceived the trial course to be

much more difficult than the traditional/control course. Both groups perceived the overall workload to be high relative to other freshman courses in the university. Comments from students in the trial course included:

> Likes - *" very flexible", "the teachers made it fun"," gave me the opportunity to work at my own speed and at the times I was most productive, not just a set time to complete the drawings", "no tests", " I liked drawing and learning new things, I feel more qualified since I took this course" , "learning how to use CAD","the field work and looking up references".*
> Dislikes - *"extremely fast-paced", "too many drawings", " I never knew my exact grade, I think it would have helped me work harder", "the time needed", " I had to work a lot of late nights and long hours", "the speed of assignments".*

The results of the faculty administered student survey (Table 1) suggest that the students in the traditional/control course were generally better prepared in drafting, blueprint reading and CAD prior to taking the course. The students in the trial course felt that their level of improvement was considerable. The overall motivation level and perceived quality of the course suggest that students in both courses were fairly motivated and perceived the courses to have high value. This conflicts with the results of the SPTE II survey. Comments provided from both groups of students support the development of a non-traditional construction education environment. Most students support the concept, flexibility and "real world" approach, but they all expressed concerns about scheduling around other classes and work, and the overall method of evaluation.

Results of survey of Construction Graphics courses (Fall 1996)

	Traditional Control Course	Modified Target Class	Scale
Previous level of drafting	2.57	1.83	1=none, 5 = extensive
Previous experience using drawings	3.00	2.33	1=none, 5 = extensive
Previous level of CAD	1.93	1.78	1=none, 5 = extensive
Level of drafting improvement	3.50	4.28	1=none, 5 = considerable
Blueprint reading improvement	4.21	4.22	1=none, 5 = considerable
CAD improvement	1.43	3.39	1=none, 5 = considerable
Level of motivation	3.93	4.11	1=low, 5 = high
Level of structured environment	2.36	2.22	1=flexible, 5=structured
How prepared do you feel	3.29	3.22	1=not, 5=very prepared
Overall course value	3.86	4.22	1=low, 5=high
Preference of lecture vs activity based delivery	Both courses strongly prefered activity based delivery.		
Preference of textbook projects vs real projects	Both courses strongly preferred real projects.		
Preference of structured-vs-flexible classroom	Both courses preferred a flexible classroom structure.		

TABLE 1

The informal survey of associated administrators and faculty suggested general support for the overall concept. The concerns expressed paralleled those expressed by the students relative to scheduling and evaluation. Additional concerns were expressed on the overall administration and execution of such an approach on a larger scale. It was suggested that another phase be tried on a

larger group of students in several courses together. (i.e. all first and second year students in any construction course).

CONCLUSIONS

After discussion with associated faculty, students and a review of associated literature, the group of faculty involved with this project have made these conclusions from the initial phase of this project.

1. Construction courses and delivery systems must include practical, "real-world" activities/projects. The faculty must become mentors and leaders for the students and not isolate themselves from their educational activities. Everyone involved must be attuned to the "best methods" to enhance students academic experience.

2. Students are interested in a new approach to construction education. They recognize that there may be some pitfalls along the way, but they feel that these would be offset by the benefits. They support any approach that will make them more marketable and prepared to enter the construction industry.

3. Faculty with professional industrial experience are supportive of this approach to construction education. They recognize that, at least initially, a heavy responsibility will fall on the faculty to make modifications, resolve problems and make the overall system work properly. It is the feeling of the faculty that once this approach has completed a full four year cycle the students will actually be running the program, making the decisions, mentoring each other and creating the projects.

4. The administration at Pittsburg State University is supportive of this process and is interested in implementing the approach on a larger scale.

This process is under consideration by other programs in the Department of Engineering Technology at Pittsburg State University.

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