Volume 3
Number 3

Fall 1998

The Journal of Construction Education

K. C. Williamson III, Ph.D., ***Editor/Publisher***

Thomas H. Mills, ***Associate Editor***

A Tri-Annual Publication of
The
Associated Schools
of
Construction

ISSN 1522 8150

The *Journal of Construction Education* (ISSN 1522 8150) was founded in 1996 by the Associated Schools of Construction, an association of 92 international colleges and universities with construction education programs. The purpose of the *Journal* is to provide an important process necessary for the preservation and dissemination of manuscripts that report, synthesize, review, or analyze scholarly inquiry. The *Journal* is an important way of our focusing international attention on and contributing to the understanding of the issues, problems, and research associated with construction education and training. The recognition of scholarly work within the realms of curriculum information, contemporary educational practices, educational research and instructional application development within construction departments, schools and colleges, and industry are the reasons for the *Journal's* existence. The *Journal's* mission is to provide construction educators and practitioners with access to information, ideas, and materials for improving and updating their understanding of construction education and training. It is also intended to help its constituency become more effective in developing the talents of learners within construction programs. This *Journal* is not only a living textbook of construction education, but also a perpetual and dependable learning source for construction professionals whether they are within academia or within industry. The *Journal* will be published tri-annually (Spring, Summer, and Fall issues). The divisions of the *Journal* include invited and editorially reviewed Book Reviews and Teaching Profiles, and blind peer reviewed Educational Practice and Research Manuscripts.

Editor/Publisher
Kenneth C. Williamson III, Ph.D.
Langford Building A, Room 427
College Station, TX, 77843-3137
Tel: 979.845.7052
E-mail: jce@taz.tamu.edu

Author Instructions for Submitting

Submission to the *Journal* implies the manuscript is original and is not being considered nor has been published in whole or part within another journal. It is encouraged that author(s) present their works at annual conferences and other conferences. In that papers submitted, reviewed, presented or published within conference proceedings are considered a "work-in-progress," it is expected that manuscripts submitted to the *Journal* will reflect changes resulting from that presentation process. Manuscripts not modified in part by this process will not be considered to represent an original work and the *Journal* will not consider the manuscript publishable. Manuscripts accepted for publication will require authors to sign the Assignment of Copyright Agreement. This agreement must be signed and submitted with the manuscript's review documentation.

Authors should prepare manuscripts according to the Publication Style Guide, which conforms to the Publication Manual of the American Psychological Association (4th ed). All manuscripts must include an abstract, which is limited to one paragraph, containing a maximum of 200 words. Immediately following the abstract, a maximum of five key words must be included. Typing instructions and instructions on preparing headings, paragraphs, text body citations, tables, figures, references, appendices, and abstracts appear in the Publication Style Guide. All manuscripts are subject to editing for personal, university, program and sexist language. Manuscript length per se is not an issue, although length should be relate to the manuscript's "information value."

The *Journal* considers it unethical for authors to withhold the data on which their conclusions are based from other competent professionals who seek to verify the substantive claims through reanalysis and who intend to use such data only for that purpose, provided that the confidentiality of the participants can be protected and unless the legal rights concerning proprietary data preclude their release. JCE expects authors submitting to the *Journal* are expected to have available their data throughout the editorial review process and for at least five years after the date of publication.

Manuscripts being submitted for review by the JCE Board of Reviewers must be submitted electronically from the JCE Website. The work submitted by authors will be circulated to review board members electronically and all correspondence with the authors, editors, and review board members will also be handled in this manner. The Editor and Associate Editor are responsible for managing the electronic review process.

Educational Practice and Research Manuscripts that appear in the *Journal* are subjected to a blind review by a minimum of three members of the JCE Board of Reviewers. All contributions, whether invited or unsolicited, are critically reviewed. Manuscripts must demonstrate clear communication and authority of knowledge of the topic to ensure acceptance. Authors are encouraged to make liberal use of multimedia to visually present data and ideas. Reviewers are selected from those having content knowledge concerning the manuscript's topic. This review process generally takes from four to six weeks. Authors are notified upon receipt and completion of the review process.

The Journal of Construction Education

Fall 1998

Volume 3
Number 3
pp. 144 – 227

Editorial

Educational Practice Manuscripts

Educational Research Manuscripts

Other

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 149-149

1522-8150/98/$3.00/General Manuscript

Editorial
Annual *Journal* Entries

In the following I will provide the reader with an analysis of manuscripts submitted for review and publication. It has been an interesting year in which I have learned a bit more about being a editor of the journal and a significant amount about publishing a journal. During this term a formal contract was entered into between the ASC and Texas A&M University for support of the *Journal*. The ASC will pay a stipend of $5,000.00 for their contribution to the *Journal's* publication and TAMU's College of Architecture will provide 1.5-month summer stipend for the Editor. In conjunction with the stipend the College will provide support services to include an Administrative Assistant. The terms of the contract are that the ASC contribution is at the total control of the Editor. I will use the monies to further the *Journal's* technology and not a any salary to the Editor. The ASC cannot afford to provide additional grants to provide the computers, software, and Internet fees associated with the maintenance of a web-based journal. As Editor, I would like to thank all those who have contributed to the *Journal*.

Vital Statistics

Number of manuscripts accepted vs. rejection. There were twenty-five manuscripts considered for publication during the past year. Four of the publications represent those that were grandfatherd in by the ASC Board of Directors and will not be included in the statistics. Of the twenty-one manuscripts submitted for publication, nine were rejected as not being acceptable for publication. This provides the Journal with a forty-two percent rejection rate. Knowing that most of these have already been through a review prior to submission it seems to be a high rejection rate. However upon reading the reviews it is quite obvious that the ASC Board of reviewers is drawing a clear distinction between the Annual Conference Proceedings and the *Journal*.

Average number of pages per published manuscript. There was no significant change in the number of pages per manuscript. The average was 10.17, which was a change of –0.38 from the previous year.

Average number of images, tables, and appendices. This is where the stats get strange. As predicted the number of images increased 1.22 images per manuscript over the prior years to an average of 2.89 this year. Tables decreased 1.8 per manuscript to an average of only 0.67. Attachments increased from .5 per manuscript to 0.83. Not only did the number of attachments increase the so did their number of pages. This could be an effect of the Journal requiring that if an image or table exceeded one page then it must be included as an attachment. Some of the attachments were quite lengthy. Upon review, this is seems to be a correct decision. John Murphy's manuscript includes four pages of two column listings of Learning Outcomes that will go along way toward establishing a national construction education standard. It was a good piece of work.

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 150-163

1522-8150/98/$3.00/Educational Practice Manuscript

Toward a Taxonomy of Learning Outcomes for Construction Management Education

Allan J. Hauck
Colorado State University
Fort Collins, Colorado

In recent years, there have been many efforts made to improve the outcomes assessment processes used to evaluate the effectiveness of undergraduate programs in construction management. Most outcomes assessment programs have emphasized opinion surveys of graduating seniors and alumni rather than the measurement of specified learning outcomes. The first task required for this measurement process is the establishment of a comprehensive list of appropriate learning outcomes. This paper describes the initial steps of a curriculum reform effort at Colorado State University by identifying the steps completed to date and outlining the remaining process to accomplish this goal. The major result at this point is the start of a complete taxonomy of learning outcomes for an accredited program designed to prepare construction management professionals and the development of evaluation techniques which will be used to analyze the success of the current curriculum in achieving these outcomes. The methods used to create this taxonomy are described as well as the results of the process to date.

Key Words: Learning Outcomes, Outcomes Assessment, Curriculum Reform, Curriculum Evaluation, Construction Education

Introduction

To meet the requirements of numerous accreditation bodies -- and to determine ways to improve the delivery of undergraduate education in construction management -- there have been significant discussions of outcomes assessment in recent years. Segner & Toy (1991) presented the general case for outcomes assessment in construction education and the requirements for this process which were being introduced at that time by the American Council for Construction Education (ACCE). Slobojan (1992) discussed the implementation of essential components of an outcomes assessment plan in preparation for program accreditation or re-accreditation reviews. These authors sought to demonstrate the value of the *process* of outcomes assessment to improving construction management curricula but did not try to specify the desired *results*.

Similarly, Shahbodaghlou & Rebholz (1994) and Yoakum (1994) presented two models for the outcomes assessment process used at Bradley University and California State University - Chico, respectively. These models were similar in that they focused on collecting data from opinion surveys completed by graduating seniors, alumni, employers of alumni, and industry advisory committees. While these surveys, also used at many other Universities, provide valuable feedback on the general success of an academic program, they cannot directly assess the success of the graduates in attaining specific learning outcomes. In other words, these surveys of external constituencies generally target the measurement of administrative goals; such as, the success of career placement or the attitudes of former students toward particular courses. These surveys are not designed to measure student success at demonstrating specified learning outcomes. To measure this success, outcomes assessment programs must be far more detailed than alumni surveys: they must measure classroom and graduate performance relative to the desired learning outcomes. The assessment of these learning outcomes is a major means of making significant improvements in university curricula. Evaluating proposed curriculum changes from a learning outcomes perspective can help "guide the process of evaluation and change so we do not have change for change sake but true continuous quality curriculum improvement" (Auchey, et. al., 1997, 88).

Successful curriculum reform has been listed as the primary reason university programs in construction management implement active outcomes assessment programs. In a survey of all known construction related programs, Huber (1994) collected data designed to measure the perceptions of unit administrators toward outcomes assessment. He found that the top three reasons cited by these administrators for using this process were:

1. Curriculum changes
2. Improving teaching/learning
3. Program or curriculum evaluation (Huber, 1994, 108).

Given the importance of outcomes assessment -- and the specification of desired learning outcomes -- to successful curriculum reform, it was surprising to find limited reference in the literature to a classification of the intended learning outcomes at the major construction programs. It may be assumed that these references exist only in administrative documents in each department or that departments rely on accreditation requirements to describe the academic output of their courses. More communication among construction programs, however, may be necessary. Auchey, et.al. (1997) provide a listing of intended program outcomes at Virginia Polytechnic Institute as part of their description of the Learning Outcome Template (LOT); a tool used in the continuous improvement of academic curricula (see discussion below). Perreault (1993) and Hauck & Rockwell (1996) report on survey results designed to measure the occupational requirements and desirable characteristics of managers of the construction process. These listings of requirements for the practitioner in construction certainly provide a starting point for the determination of an overall classification system for the desired learning outcomes of a construction education program.

It is in this environment that the construction management faculty at Colorado State University (CSU) has started a comprehensive curriculum reform effort. The goals for this effort include the following:

1. to make any desired changes by considering the curriculum as a whole; not by piecemeal changes to one course at a time.
2. to start the curriculum reform effort from a comprehensive list of desired learning outcomes; not from a list of course titles.
3. to create this list of learning outcomes from external sources; not just from the course objectives listed in current departmental syllabi.

4. to establish an outcomes assessment process which measures the success at attaining the stated learning outcomes; not just the graduates' perceptions of the program.

If successful, this "taxonomy" of learning outcomes will remain a dynamic document which helps identify the overlaps in curricular content as well as the weaknesses in the current curriculum. Hopefully, it will change the discussion from "Where do we need a new course?" to "Where do we need to modify the learning outcomes and what is the best place in the curriculum to accomplish each outcome?" The discussion below describes the results of this process to date.

Method

The concept of learning outcomes is not foreign to any faculty member. All faculty have grown accustomed to designing and implementing a course around a specified set of course objectives. These objectives, if stated in terms of specific, measurable behaviors, can be used as appropriate learning outcomes. An academic unit could develop a comprehensive set of learning outcomes simply by combining the stated objectives from all required courses, debating the veracity of the resulting list, and making modifications to the list as needed. While this may be a successful approach to describing the current curricular content of an academic program, there are at least two problems associated with this tactic. First of all, this approach is insular in that the results will describe what is currently being done rather than what could be done. If important content is missing from the current curriculum, those same shortcomings will exist in the resulting list of learning outcomes. The second problem relates to the course objectives themselves. Typically, these objectives are not detailed enough and they do not specify the competency level expected at the completion of the course. A course objective might be stated as the "ability to perform quantity takeoffs." One would have to be in the course, however, to know whether this implies takeoffs in all 16 CSI divisions and whether this means an introduction to this process or a demonstrated mastery level of competence. Because of these problems, another source for learning outcomes was sought. While course objectives eventually will be used for comparison with the program's specified learning outcomes, it was decided that starting with these objectives would lead to errors.

To avoid the circular logic implied by using existing course objectives, an external source of appropriate learning outcomes was sought. Two sources of valid outcomes were reviewed and combined in order to prepare a first draft of a total set of learning outcomes which would form a basis for the revised curriculum.

The first and primary source was the content descriptions for the Certified Professional Constructor (CPC) examinations. These exams were developed and are administered by the American Institute of Constructors' (AIC) Constructor Certification Commission (CCC). "In 1994, the AIC Constructor Certification Commission was organized under the auspices of AIC to expand the Constructor qualifying process to include a written examination and to offer an internationally recognized certification process to AIC members and nonmembers alike" (AIC Constructor Certification Commission, 1997, 1). The Commission has established a two tiered approach to full recognition of the professional Constructor. This process parallels the two step professional recognition process used in the field of engineering. To attain the first level designation of Associate Constructor (AC), a candidate must qualify on the basis of education and/or experience and successfully complete the Constructor Qualification Examination (CQE) Level I. To attain the next designation of Certified Professional Constructor (CPC), an individual must have completed all AC requirements, acquired another seven years of acceptable professional experience, and passed the CQE Level II. After completing all requirements, certified individuals use the acronym “CPC” after their names to designate their professional status. The examinations described above were the result of an extensive process which included the input of numerous practitioners and educators in the field of construction -- referred to as Subject Matter Experts (SMEs) -- to determine a valid set of specifications for the content of the exams. Since the CQE Level I is intended to be given to graduating seniors in nationally accredited construction management programs, the description of the specifications for this exam was used as the major source for the learning outcomes discussed in later sections.

The second source for valid learning outcomes of construction management programs was the curriculum requirements of ACCE. This organization is the recognized accrediting body for university programs related to construction management. Current curriculum requirements for ACCE accreditation include a minimum number of credit hours in each of five categories:

1. General Education
2. Mathematics and Sciences
3. Business and Management
4. Construction Science
5. Construction

While current ACCE requirements establish the content in each of these categories by using course titles and general subject matter descriptions, there is currently a proposal before the ACCE Board of Trustees to replace these general descriptions in the last two categories with more specific “core topics” and “Essential Elements of Instruction (EEI)” (ACCE, 1997). For example, one of the core topics proposed within the Construction Science category is “Construction Graphics” which is further delineated with a listing of EEI including basic sketching and drawing techniques, orthogonal representation, notes and specifications, computer applications, etc. While still a subject of dispute among the members of the Board of Trustees, these more detailed descriptions of desired curricular content -- especially the EEI -- provided another excellent source for externally validated learning outcomes.

Since the construction management faculty at CSU are committed to retaining their ACCE accreditation and to promoting the completion of the CQE Level I among graduates of the program, it was decided that the two sources described above would be used as a starting point in the developing their list of desired learning outcomes. It was proposed that the curriculum reform effort would continue through the following steps:

1. The initial list of learning outcomes would be further refined through faculty discussion.
2. An appropriate competency level at graduation for each learning outcome would be specified.

3. The Learning Outcome Template (LOT) developed by Auchey, et. al. (1997) could then be used as a tool to analyze where in the current curriculum each learning outcome could be covered and at what competency level.
4. This analysis using the LOT will highlight changes which should be made in current courses. The analysis should also identify areas where courses safely can be deleted and where additional courses should be added to the new curriculum.

This process should accomplish the goals set for this comprehensive curriculum reform effort as outlined in the previous section.

Results

First, it should be noted that the process described above is currently ongoing and that this section reports on results in progress. These results include 1) a classification of eleven "knowledge areas" which incorporate all of the learning outcomes desired from the new curriculum, 2) the current draft of the complete listing of desirable learning outcomes, and 3) a format to be used for the learning outcomes template which will accommodate the proposed curriculum analysis. These results are described in the following paragraphs. Much work remains to finalize the list of learning outcomes, establish appropriate competency levels for each outcome, modify courses and curricular content to align with the learning outcomes, and redesign the outcomes assessment process to include measures of student achievement of the specified learning outcomes. The success rate of graduating seniors on the CQE Level I will be one of the elements in this outcomes assessment process. It is anticipated that another one to two years will be required to complete the entire curriculum reform effort.

The first result was the determination of the major classifications -- or "knowledge areas" -- into which all learning outcomes would be sorted. This was adapted directly from the classification system used by the CCC for the content of CQE Level I (see Table 1). The CQE Level I ("Construction Fundamentals") uses the first ten of the eleven knowledge areas listed in Table 1 (AIC Constructor Certification Commission, 1997, 6). Knowledge Area #11 -- Personnel Development and Management -- was added by the CSU faculty to reflect a major program emphasis in this area. Additionally, when the first group of SMEs met in September 1995, they had included significant content in this area which was not well incorporated into the ten knowledge areas finally selected for the content of the Level I examination. Interestingly, much of this content appears to have been included in the Level II examination in categories such as "Developing Staffing Requirements" and "Creating and Enhancing Working Relationships". The percentages indicated in Table 1 after the descriptor for each knowledge area is the weighting assigned to that area in CQE Level I. For example, approximately 6% of the questions on this exam are intended to measure "Communication Skills."

Table 1

"Knowledge Areas" used for Major Classifications of Learning Outcomes

Knowledge Area #1 -	Communication Skills (6.0%)
Knowledge Area #2 -	Design/Engineering Concepts & Associated Mathematics and Sciences (9.0%)
Knowledge Area #3 -	Management Concepts and Philosophies (4.5%)
Knowledge Area #4 -	Construction Materials and Methods (10.5%)
Knowledge Area #5 -	Estimating, Plan Reading, Bid Process, Codes, Insurance, and Ability to Establish Work Methods (15.0%)
Knowledge Area #6 -	Budgeting/Cost Accounting, Cost Control, and Cost Closeout (11.0%)
Knowledge Area #7 -	Scheduling and Schedule Control (17.0%)
Knowledge Area #8 -	Safety (8.0%)
Knowledge Area #9 -	Construction Surveying and Project Layout (4.0%)
Knowledge Area #10 -	Project Administration (15.0%)
Knowledge Area #11 -	Personnel Development and Management (not on CQE Level I)

Adapted from *Certified Professional Constructor Candidate Handbook* (AIC Constructor Certification Commission, 1997)

The next result was the current draft of the complete listing of learning outcomes as presented in Appendix A. This listing reflects the two major sources used to generate these learning outcomes: the description of the specifications for the CQE Level I examination and the "core topics" and EEI used to describe the curricular requirements of ACCE. Those learning outcomes derived from the latter source are indicated in Appendix A by the initials "ACCE" appearing in parentheses. For example, "Construction Graphics" apparently was not included in the specifications for CQE Level I but was added to Knowledge Area #1 (Communication Skills) because it is listed as a core topic in the "Construction Science" category by ACCE. Most of the subheadings for this topic are derived from the EEI listed in the ACCE proposal. Some of the listings by CCC and ACCE are duplicative within a given knowledge area. In Knowledge Area #3, for instance, "Generic Management Concepts" listed by CCC presumably overlaps greatly with "Principles of Management" as listed by ACCE. At this point in the development of this taxonomy, those duplications have not yet been eliminated to ensure that no areas are neglected. In future drafts, similar categories will be combined and redefined without reference to source.

Much of the detail in this list of learning outcomes results from an early draft of the specifications for CQE Level I which was prepared by the first meeting of SMEs in September 1995. This group consisted mainly of construction practitioners from all geographic areas and many specialties within the field. They prepared an excellent listing of the skills required to manage each of the phases of a typical project concentrating on the management of contracts, costs, schedules, personnel, and safety. The details of this listing of skills provided an excellent source for the description of appropriate learning outcomes for an academic program in construction management. This list was rearranged to align with the eleven knowledge areas included in Appendix A.

When finalized, this taxonomy of learning outcomes will have many uses in the restructuring of the curriculum at CSU. It should be noted that this classification does not necessarily relate directly to the content of specific courses - nor is it intended to. For example, writing and oral presentation skills listed in Knowledge Area #1 probably will be developed in many, if not all, courses. On the other hand, Knowledge Area #9 - Construction Surveying and Project Layout - may fit more easily into a single course. A listing by learning outcome categories rather than by courses should encourage the integration of learning across the artificial boundaries of courses. Applying this concept, Virginia Polytechnic Institute has introduced generic “Integrated Lab” and “Construction Practice” courses which reinforce numerous learning outcomes from seemingly diverse knowledge areas (Auchey, et. al., 1997). Regardless of the final result in terms of courses, it is important that all faculty agree that the specified learning outcomes should be attained. Using the language of a work breakdown structure (WBS), all faculty should participate in the discussion through the third or fourth level of the WBS. It should be a departmental decision that the “ability to conduct a safety audit” is a part of the intended outcome of the curriculum. How that outcome is achieved may be up to a single instructor in just one course.

The final result of the process so far is the creation of a Learning Outcome Template (LOT) for each knowledge area identified. This idea expanded on the work of Auchey, et. al. (1997) in which they applied this matrix to a summary listing of program outcomes. An example of one LOT (for Knowledge Area #6) is presented in Appendix B. The matrix includes a list of all learning outcomes for that knowledge area along the left edge and a list of all courses currently required in the curriculum along the top edge. The goal is to indicate in which courses each of the learning outcomes is presented. In addition, since many learning outcomes will appear in several courses (e.g., “introduced” in one course and “mastered” in a later course), the faculty will also indicate the expected level of student learning (on a scale of 1 to 4) in each course. The first step is to complete the right hand column which indicates the expected level of mastery at graduation. This discussion and debate among the faculty as to which learning outcomes are expected -- and at what competency level -- greatly improves the ability of the faculty to define the values and mission of the academic program. When completed, these templates should 1) identify the expected content of all required courses, 2) highlight the existing overlaps in the curriculum, 3) identify the content areas where more emphasis is needed, and 4) help guide faculty decisions related to deleting existing courses and adding new ones.

Discussion

What has been presented above is a “work in progress.” As of this writing, four major steps have been accomplished:

1. two external, valid sources for the initial selection of learning outcomes have been identified.
2. a “broad scope” classification of eleven knowledge areas has been selected.
3. a complete draft of a comprehensive list of appropriate learning outcomes has been prepared.
4. Learning Outcome Templates for each knowledge area encompassing the entire list of learning outcomes have been presented to faculty for review.

In addition, five major steps which must be addressed to complete the curriculum reform effort have been identified as follows:

1. further debate about and refinement of the list of expected learning outcomes must be completed.

2. expected competency levels for every learning outcome at the time of graduation must be established by the faculty.
3. all Learning Outcome Templates must be completed in order to analyze the strengths and weaknesses of the current curriculum.
4. those areas in which courses should be modified, deleted, or added to accomplish the specified learning outcomes must be identified and revisions need to be completed.
5. the existing outcomes assessment process must be redesigned in order to measure the program's success at achieving the specified learning outcomes.

The final result of this effort should be not only a redesigned curriculum which is more responsive to desirable outcomes identified by the faculty. Just as importantly, the result should be a dynamic *process* though which future curriculum changes can be evaluated from a perspective of the entire curriculum rather than a single course. By creating a means of observing the "big picture" at any point in time, creative solutions to future curriculum challenges can be accomplished without fear of a negative impact on the outcomes of instruction.

References

American Council for Construction Education (1997). Unpublished proposal to the Board of Trustees to change curriculum requirements. Dated March 18, 1997.

AIC Constructor Certification Commission (1997). *Certified professional constructor candidate handbook.* St. Petersburg, Florida: AIC Constructor Certification Commission.

Auchey, F. L., Mills, T. H., Beliveau, Y. J., & Auchey, G. J. (1997). Using the learning outcome template as an effective tool for evaluation of the undergraduate building construction program. *Proceedings of the 33rd Annual Conference of the Associated Schools of Construction.* University of Washington: Seattle, Washington.

Hauck, A. J. & Rockwell, Q. T. (1996). Desirable characteristics of the professional constructor, the initial results of the constructor certification skills and knowledge survey. *Proceedings of the 32nd Annual Conference of the Associated Schools of Construction.* Texas A&M University: College Station, Texas.

Huber, J. (1994). The assessment of future constructors. *Proceedings of the 30th Annual Conference of the Associated Schools of Construction.* Bradley University: Peoria, Illinois.

Perreault, R. (1993). Identification of the occupational requirements of the construction manager. *Proceedings of the 29th Annual Conference of the Associated Schools of Construction.* Colorado State University: Fort Collins, Colorado.

Segner, R. & Toy, G. A. (1991). Outcomes assessment in construction higher education. *Proceedings of the 27th Annual Conference of the Associated Schools of Construction.* Brigham Young University: Provo, Utah.

Shahbodaghlou, F. & Rebholz, F. E. (1994). Outcome assessment model for a construction program. *Proceedings of the 30th Annual Conference of the Associated Schools of Construction.* Bradley University: Peoria, Illinois.

Slobojan, J. (1992). Implementing outcome assessment for program accreditation. *Proceedings of the 28th Annual Conference of the Associated Schools of Construction.* Auburn University: Auburn, Alabama.

Yoakum, B. (1994). Program assessment, good management practice. *Proceedings of the 30th Annual Conference of the Associated Schools of Construction.* Bradley University: Peoria, Illinois.

Appendix A

I. COMMUNICATION SKILLS
  A. Communication Skills
    1. Comprehension
    2. Vocabulary
    3. Writing
    4. Oral Presentation
    5. Listening Skills
      a. Construction Graphics (ACCE)
      b. Basic Sketching Techniques
      c. Basic Drawing Techniques
      d. Orthogonal Representation
      e. Graphic Vocabulary
      f. Detail Hierarchies
      g. Scale
      h. Drawing Organization/Content
      i. Drawing Notes
      j. Specifications
      k. References
      l. Conventions
      m. Computer Applications
      n. Visualization

II. DESIGN/ENGINEERING CONCEPTS & ASSOCIATED MATH AND SCIENCE
  A. Materials Science (ACCE)
    1. Soil
      a. Composition and Properties
      b. Terminology
      c. Units of Measure
      d. Standard Designations
      e. Sizes and Gradations
      f. Conformance References
      g. Testing Techniques
    2. Wood
      a. Composition and Properties
      b. Terminology
      c. Units of Measure
      d. Standard Designations
      e. Sizes and Gradations
      f. Conformance References
      g. Testing Techniques
    3. Steel
      a. Composition and Properties
      b. Terminology
      c. Units of Measure
      d. Standard Designations
      e. Sizes and Gradations
      f. Conformance References
      g. Testing Techniques
    4. Concrete
      a. Composition and Properties
      b. Terminology
      c. Units of Measure
      d. Standard Designations
      e. Sizes and Gradations
      f. Conformance References
      g. Testing Techniques
  B. Design Theory and Application
    1. Structural Mechanics
    2. Soil Mechanics
    3. Electricity
    4. Thermodynamics
    5. Basic Fluid Design/Hydraulics
    6. Electrical Systems
    7. Mechanical Systems
    8. Mechanics of Materials
    9. Structural Design
    10. Concrete Formwork Design
  C. Statistics (ACCE)

III. MANAGEMENT CONCEPTS AND PHILOSOPHIES
  A. Generic Management Concepts
    1. Contract Forms
      a. Stipulated Sum, etc.
    2. Business Organization
      a. Corporation
      b. Partnership, etc.
    3. Basic Accounting Principles
  B. Management Philosophies
    1. Management Systems
      a. Total Quality Management (TQM)
      b. ISO 9000
      c. Partnering
    2. Leadership
      a. Ethics
      b. "Constructor Code of Conduct"
  C. Human Resource Management
  D. Economics (ACCE)
  E. Principles of Management (ACCE)
  F. Organizational Behavior (ACCE)
  G. Business Law (ACCE)

IV. CONSTRUCTION MATERIALS AND METHODS
  A. Materials and Methods by CSI Division
    1. Knowledge of Heavy Equipment
    2. Knowledge of Sitework/Excavation
    3. Knowledge of Concrete/Rebar
    4. Knowledge of Masonry
    5. Knowledge of Metals
    6. Knowledge of Rough/Finish Carpentry
    7. Knowledge of Insul./Roofing/Siding
    8. Knowledge of Doors and Windows
    9. Knowledge of Finishes
    10. Knowledge of Specialties
    11. Knowledge of Equipment
    12. Knowledge of Furnishings
    13. Knowledge of Special Construction
    14. Knowledge of Conveying Systems
    15. Knowledge of Mechanical Systems
    16. Knowledge of Electrical Systems
    17. Knowledge of Technology (Computer Networks, Fiberoptics, Video, etc.)
  B. Construction Methods (ACCE)
    1. Products
    2. Systems
    3. Interface Issues
    4. Site Organization
    5. Site Development
    6. Assembly Techniques/Equipment

V. ESTIMATING, PLAN READING, BID PROCESS, CODES, INSURANCE, AND ABILITY TO ESTABLISH WORK METHODS
  A. Identify, Obtain, and Process Relevant Information
    1. Knowledge of Bid Process
    2. Ability to Read and Draw Plans
    3. Ability to Write, Read, and Interpret
    4. Specifications
    5. Knowledge of Laws, Regulations, and Codes
    6. Knowledge of Site Conditions and Requirements
    7. Knowledge of Insurance and Bond Requirements
    8. Knowledge of Value Engineering
    9. Knowledge of Life Cycle Costing
    10. Ability to Establish Suitable Work Method
    11. Ability to Establish Site Layouts in Consultation with Subcontractors
  B. Costing
    1. Ability to Perform Estimating and Bidding

2. Ability to Generate Conceptual Estimates
3. Ability to Generate Preliminary Estimates
4. Ability to Define Work Breakdown Structure
5. Ability to Perform Quantity Take-off
6. Ability to Generate Detailed Estimate
7. Ability to Solicit Bids and Quotes
8. Ability to Analyze Subcontractor Bids
9. Ability to Analyze Materials Quotes
10. Ability to Analyze Equipment Costs
11. Ability to Analyze Labor Costs
12. Ability to Assess Appropriate Overhead
13. Ability to Assess Appropriate Profit

C. Estimating (ACCE)
1. Types of Estimates and Their Uses
2. Quantity Takeoffs
3. Labor Productivity Factors
4. Equipment Productivity Factors
5. Pricing
6. Pricing Data Bases
7. Job Overhead Costs
8. General Overhead Costs
9. Bid Preparation and Submission
10. Computer Applications

VI. BUDGETING/COST ACCOUNTING, COST CONTROL, AND COST CLOSEOUT

A. Budgeting and Cost Accounting
1. Ability to Establish a Budget
a. Ability to Obtain Budget Information
b. Ability to Assign Cost Breakdown

B. Cost Control
1. Ability to Prepare Cost Report and Compare Expenditures to Budget
a. Ability to Obtain Current Budget Information
b. Ability to Evaluate Cost Breakdown
c. Ability to Determine Progress of the Project vs. the Budget
d. Ability to Determine Actual Equip. Costs vs. Projected Costs
e. Ability to Determine Actual Labor Costs vs. Projected Costs
f. Ability to Determine Actual Overhead Costs vs. Projected Costs
2. Ability to Document Work Performed to Enable Pay Release
a. Ability to Assess/Verify Earned Value
b. Ability to Analyze Progress
c. Ability to Review Schedule of Values
3. Ability to Monitor and Make Adjustments due to Claims
a. Knowledge of Entitlements
b. Knowledge of Damages
4. Ability to Document Change Orders
5. Ability to Prepare Progress Payment Requests to the Owner

C. Cost Closeout
1. Ability to Finalize Costs Including Claims
a. Knowledge of Retainage
b. Knowledge of Backcharges
c. Knowledge of Final Payments
2. Ability to Determine Final Payment Requisition

D. Cost Accounting and Finance (ACCE)
1. Cost Accounting Formats
2. Fixed Overheads
3. Variable Overheads
4. Insurance and Bonding
5. Bidding and Procurement Practices
6. Record/Report Practices
a. Capital Equipment
7. Depreciation and Expensing
8. Forecasting Costs
9. Cash Flow Requirements
10. Payment Processes
11. Time Value of Money

VII. SCHEDULING AND SCHEDULE CONTROL

A. Scheduling
1. Ability to Establish a Logical Sequence and Relationship among Activities
2. Ability to Estimate Duration of Each Activity
3. Ability to Prepare Preliminary Schedule
4. Ability to Create CPM Schedule
5. Ability to Analyze CPM Schedule

B. Schedule Control
1. Ability to Monitor Progress of a Project
a. Ability to Update a Schedule
b. Ability to Review/Compare Target to Actual Schedule
c. Ability to Evaluate Need for a Revised Plan of Action
d. Ability to Create/Implement a Revised Plan of Action
e. Ability to Evaluate Delay Claims
2. Ability to Expedite Materials/Equipment to Avoid Delays

C. Schedule Closeout
1. Ability to Demobilize a Project Site
2. Ability to Administer Substantial Completion Process
a. Certificate of Substantial Completion
b. Record of Final Completion Dates

D. Planning and Scheduling (ACCE)
1. Parameters Affecting Project Planning
2. Schedule Information Presentation
3. Network Diagramming with CPM
4. Calculations for CPM
5. Resource Allocation and Management
a. Impact of Changes
b. Computer Applications

VIII. SAFETY

A. Safety Planning
1. Knowledge of Applicable OSHA Requirements
2. Ability to Establish Safety and Health Procedures on Site
3. Ability to Perform Hazard Analyses

B. Safety Administration
1. Ability to Implement Safety Procedures and Policies
2. Ability to Monitor Safety Procedures and Policies
a. Ability to Conduct a Safety Audit
b. Ability to Document Safety Audit Results
3. Ability to Enforce Safety Procedures and Policies
4. Ability to Comply w/ OSHA Requirements including Documentation

C. Safety (ACCE)
1. Mandatory Training
2. Mandatory Procedures
3. Mandatory Records
4. Mandatory Maintenance
5. OSHA Compliance
6. OSHA Inspections
7. OSHA Penalties

IX. CONSTRUCTION SURVEYING AND PROJECT LAYOUT

A. Basic Construction Surveying
1. Ability to Establish Distances from Existing Points
2. Ability to Establish Elevations from Existing Points
3. Ability to Set Up Surveying Instruments

B. Project Layout
1. Knowledge of Surveying Procedures
2. Ability to Layout the Project
3. Ability to Interpret Site Information

C. Surveying (ACCE)

1. Basic Surveying Procedures
2. Construction Layout
3. Alignment Control

X. PROJECT ADMINISTRATION

A. Procurement of Resources
1. Subcontractors
a. Ability to Determine Subcontractors' Qualifications
b. Knowledge of Contracts and Subcontracts
c. Ability to Write and Obtain Agreements with Relevant Parties
d. Ability to Communicate Policy, Procedures, and Safety Requirements
2. Materials
a. Ability to Identify and Qualify Vendors
b. Ability to Identify Lead Times
c. Ability to Complete and Execute a Purchase Order
3. Equipment
a. Ability to Identify and Qualify Vendors
b. Ability to Identify Lead Times
c. Ability to Complete and Execute a Purchase Order/Lease Agreement

B. Job Site Mobilization
1. Ability to Set Up Project Site
a. Field Office(s)
b. Storage Areas(s)
c. Site Layout
2. Ability to Provide for Subcontractors' Startup Requirements
a. Ability to Provide Work/Storage Areas
b. Ability to Coordinate Subcontractors
3. Ability to Implement Administrative System on Site

C. Contract Administration and Control
1. Documentation
a. Ability to Issue Purchase Orders/Contracts
b. Ability to Oversee Submittal Process
c. Ability to Request and Evaluate Change Orders
i. Responsibilities of Owner
ii. Duties of Architect/Engineer
iii. Responsibilities of Contractor
2. Dispute Avoidance and Resolution
a. Knowledge of Relationship between Planning and Dispute Avoidance
b. Knowledge of Relationship between Documentation and Dispute Avoidance
c. Knowledge of Relationship between Personnel Management and Dispute Avoidance
d. Knowledge of Negotiation Options
e. Knowledge of Arbitration
f. Knowledge of Litigation
g. Knowledge of Mediation

D. Job Site Administration
1. Materials and Equipment Handling
a. Ability to Coordinate Deliveries
b. Ability to Verify Receipt
c. Ability to Track and Control Usage
d. Ability to Handle/Dispose Debris
2. Quality Control
a. Ability to Review Submittals for Completeness and Compliance to Specs
b. Ability to Control Construction Process to Comply with Contract Documents
c. Ability to Control Project Compliance with:
i. Codes
ii. Zoning
iii. Ordinances
iv. Government Regulations
v. Trade Organization Regulations
d. Ability to Implement Corrective Measures
3. Project Documentation
a. Ability to Maintain Ongoing Project Records
i. Daily Field Reports
ii. Accident Reports/Records
iii. Policy Manuals
iv. Organizational Charts
v. Requests for Information (RFI)
vi. Correspondence
vii. Progress Reports
viii. Telephone Conversations

E. Punchlists
1. Ability to Create Punchlists
2. Ability to Complete Punchlists
3. Ability to Verify Punchlist Completion

F. Turnover of Deliverables
1. Project Documentation (files & records)
2. Letters of Warranty
3. Final Inspection Certificates
4. Certificates of Occupancy
5. Lien Releases
6. Letters of Compliance with Government Regulations
7. Specified Extra/Excess Stock
8. Key Schedules
9. Owner Training and Orientation
10. Operation and Maintenance Manuals
11. As-Built Drawings

G. Project Management (ACCE)
1. Concepts, Roles, and Responsibilities
2. Administrative Systems and Procedures
3. Cost Control Data and Procedures
4. Documentation at Job Site and Office
5. Quality Control Philosophies/Techniques
6. Computer Applications

H. Construction Law (ACCE)
1. Construction Contracts
2. Roles and Responsibilities of Parties
3. Regulatory Environment
4. Licensing Requirements
5. Lien Laws and Contractor's Rights
6. Local and National Labor Law
7. Administrative Procedures to Avoid Disputes

XI. PERSONNEL DEVELOPMENT AND MANAGEMENT

A. Selection and Assignment of Staff
1. Ability to Determine Personnel Requirements
a. Ability to Determine Areas of Responsibility
b. Ability to Divide List of Responsibilities
c. Ability to Design an Organizational Chart
2. Knowledge of Hiring Requirements including Governmental Regulations
a. Ability to Determine Job Descriptions
3. Ability to Understand and Enforce Policies and Procedures
4. Ability to Set Up Record Keeping for Staff

B. Develop Teams and Individuals to Enhance Performance
1. Ability to Designate Team Leaders
2. Ability to assess Strengths and Weaknesses of Teams
3. Ability to Determine Placement of Correct Teams for Jobs
4. Knowledge of Team Process
5. Ability to Plan Development of Teams
6. Ability to Integrate Teams into Schedule
7. Ability to Evaluate Team Members
8. Ability to Train and Educate Team

C. Human Resource Management
1. Personnel
a. Ability to Identify, Record, Assess, and Communicate Staffing Needs
b. Ability to Take Action to Meet Future Requirements
c. Ability to Evaluate Performance of Site Personnel

d. Ability to Record and Act Upon Requests for Information from Site Personnel
e. Ability to Understand Hiring Requirements including Government Regulations
f. Identify and Select Staff
g. Ability to Conduct Personnel Testing
h. Determine Quality of Staff's Work
i. Ability to Inform Staff of Legal Requirements
j. Ability to Recommend Improvements

2. Team Building
   a. Ability to Create. Maintain, and Enhance Effective Working Relationships
   b. Ability to Conduct Team Meetings
   c. Ability to Establish and Maintain Relationship with Co-Workers
   d. Ability to Identify, Minimize, and Resolve Interpersonal Conflicts
   e. Ability to Follow Through with Commitments to Team Members
3. Community/Public Relations
   a. Ability to Implement Community/Public Relations Procedures
   b. Ability to Establish and Maintain Relationships w/ Clients and Representatives
   c. Ability to Establish and Maintain Relationships with the General Public
4. Project Meetings
   a. Ability to Conduct Job Meetings
   b. Ability to Use Rules of Order
   c. Ability to Establish an Agenda
   d. Ability to Keep/Issue Minutes
   e. Ability to Select Appropriate Personnel for Meeting
   f. Ability to Evaluate Ideas
   g. Ability to Evaluate Views
   h. Ability to Disseminate Organizational Policy

Appendix B

LEARNING OUTCOMES TEMPLATE
CONSTRUCTION MANAGEMENT

KNOWLEDGE AREA #6 - BUDGETING/COST ACCOUNTING, COST CONTROL, AND COST CLOSEOUT (11.0%)

			Levels of Student Learning:	MTCM CORE						CONSTRUCTION MANAGEMENT												ENGINEERING SCIENCE						BUSINESS		
		1. 2. 3. 4.	Preparatory Foundation Knowledge Development Proficiency/Practical Application Mastery/Analysis and Evaluation	MC 110 - Teams & Leadership	MC 151 - Intro to Mfg & Const	MC 251 - Mat'ls Test/Processing	MC 131 - Graphic Communic./CAD	MC 141 - Energy & Transportation	MC 241 - Energy Control Systems	MC 232 - Arch. & Constr. Planning	MC 261 - Const. Surveying	MC 317 - Safety Management	MC 361 - Mech. Sys. in Bldgs.	MC 362 - Const. Contracts	MC363 - Quantity Surveying	MC 364 - Adv. Const. Systems	MC 365 - Const. Estimating	MC 366 - Const. Equip. & Methods	MC 461 - Project Scheduling	MC 464 - Project Administration	MC 487a - Internship	CE 256 - Statics	CE 358 - Mechan. of Materials	CE 350 - Soils Engineering	CE 364 - Prop. of Materials	CE 370 - Elem. Structural Design	F 432 - Design of Wood Structures	BA210 - Financial Accounting	BG 260 - Legal Envir. of Business	BN 300 - Mgmt. Fundamentals
			Skills and Competencies																											
A.			Budgeting and Cost Accounting																											
	1.		Ability to Establish a Budget																											
		a.	Ability to Obtain Budget Information																											
		b.	Ability to Assign Cost Breakdown																											
B.			Cost Control																											
	1.		Ability to Prepare Cost Report and Compare Expenditures to Budget																											
		a.	Ability to Obtain Current Budget Information																											
		b.	Ability to Evaluate Cost Breakdown																											
		c.	Ability to Determine Progress of the Project vs. the Budget																											
		d.	Ability to Determine Actual Equipment Costs vs. Projected Costs																											
		e.	Ability to Determine Actual Labor Costs vs. Projected Costs																											
		f.	Ability to Determine Actual Overhead Costs vs. Projected Costs																											
	2.		Ability to Document Work Performed to Enable Pay Release																											
		a.	Ability to Assess/Verify Earned Value																											
		b.	Ability to Analyze Progress																											
		c.	Ability to Review Schedule of Values																											
	3.		Ability to Monitor and Make Adjust-ments due to Claims																											
		a.	Knowledge of Entitlements																											
		b.	Knowledge of Damages (Cost/Time)																											
	4.		Ability to Document Change Orders																											
	5.		Ability to Prepare Progress Payment Requests to the Owner																											
C.			Cost Closeout																											
	1.		Ability to Finalize Costs Including Claims																											
		a.	Knowledge of Retainage																											
		b.	Knowledge of Backcharges																											
		c.	Knowledge of Final Payments																											
	2.		Ability to Determine Final Payment Requisition																											
D.			Cost Accounting and Finance (ACCE)																											
	1.		Cost Accounting Formats																											
	2.		Fixed Overheads																											
	3.		Variable Overheads																											
	4.		Insurance and Bonding																											
	5.		Bidding and Procurement Practices																											
	6.		Record/Report Practices																											
	7.		Capital Equipment																											
		a.	Depreciation and Expensing																											
	8.		Forecasting Costs																											
	9.		Cash Flow Requirements																											
	10.		Payment Processes																											
	11.		Time Value of Money																											

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 164-172

1522-8150/98/$3.00/Educational Practice Manuscript

Performance Outcomes: An Integral Component of Program Assessment

Norma Jean Andersen
North Dakota State College of Science
Wahpeton, North Dakota

Kenneth W. Andersen
North Dakota State University
Fargo, North Dakota

The Council on Post-Secondary Accreditation in the US Department of Education has mandated that accrediting agencies use outcome assessments in evaluating their programs. As a result, the American Council for Construction Education (ACCE) and the Accrediting Board for Engineering and Technology (ABET) are including outcome assessment as part of their requirements for accreditation. Several articles have been published dealing with outcome assessment models for construction programs. Each of these articles outlines procedures for developing outcome assessment based on the mission and strategic plan of the institution and program. Although these previous articles establish reasonable and well thought out processes for assessment, the question still remains: how do the course content and student performance outcomes tie to program goals, objectives, and program assessment? This paper will explain how student performance outcomes can be related to the program goals and objectives and at the same time become the foundation for the assessment outcomes.

Key Words: Outcome Assessment, Program Assessment, Accreditation, Performance Outcomes, Curriculum Development

Introduction

Outcome assessment is a requirement at most academic institutions. The Council on Post-Secondary Accreditation in the US Department of Education has mandated that accrediting agencies use outcome assessments in evaluating their programs. In addition, the six regional associations for schools and colleges require outcome assessments as part of the requirements for granting or renewing accreditation. As a result, the American Council for Construction Education (ACCE) and the Accrediting Board for Engineering and Technology (ABET) also include outcome assessment as part of their requirements for accreditation. In addition, taxpayers, parents, and employers want to be assured that students have the skills necessary to secure jobs and keep them. To say that all of our gradates obtain employment is not good enough. Educators must be able to document that students have the knowledge, skills, attitudes and behaviors necessary to perform on the job. All construction programs must examine their goals and objectives, then develop outcome assessments to meet the assessment requirements.

Several articles dealing with outcome assessment models or program assessment for construction programs have been published (Slobojan, 1992, Yoakum, 1994, and Shahbodaghlou, 1994). Each of these articles outlines the procedures for developing outcome assessment based on the mission and strategic plan of the institution and program. The program mission is written and then goals and objectives are developed to drive the achievement of the mission. Shahbodaghlou

(1994) outlines measurable objectives for each program goal and identifies how the objectives will be measured and data collected. Youkum (1994) concentrates on developing the criteria for a reasonable yet simple assessment plan. Slobojan (1992) looked at the purpose of outcome assessment and how to write goals and measurable objectives. He stated that assessment was the result of external forces and internal forces. Examples of external forces are accreditation and institutional requirements, and examples of internal forces are improved marketing and quality improvement programs. Programs must determine which forces are going to dominate their assessment efforts because it will impact how they write their objectives. Slobojan addresses establishing outcome assessment at the program level including three categories of objectives: demographic, attitudinal and performance objectives. These authors established reasonable processes, but they do not go far enough to meet the demands of accountability facing today's construction educator. Their processes do not address how we as educators can prove that students can do what we say they can do at the completion of the program.

Auchey, Mills, Beliveau, and Auchey (1997) moved in the direction of student performance outcomes when they developed The Learning Outcomes Template (LOT). LOT is used to incorporate learning outcomes into each course and provides a mechanism to discuss the competencies and skills to be included in each course syllabus and their progression through the core curriculum. The LOT is an excellent model to use once the learning or performance outcomes have been identified. Although the authors suggest that the mission and goals of the curriculum be reviewed, they make no connection to the learning outcomes identified. In addition, they do not indicate how they will support the goals and objectives of the program, college and institution.

Currently, construction faculty across the nation are developing outcome assessments for their programs that are part of the over-all assessment process for their institution. At the same time, many are developing performance outcomes for their programs to meet accreditation requirements. In many cases, these two endeavors are viewed as separate, unrelated activities and there is no connection between the student performance objectives and the objectives for the program, college, and institution. ACCE has been working on the new criteria for accreditation. The new criteria has identified core topics and Essentials Elements of Instruction (EEI). The core topics and EEI are to be defined according to the program emphasis and within the institutional constraints. Once the EEI have been identified, student performance objectives and assessment outcomes must be developed that support the goals and objectives of the program. This paper will explain how student performance outcomes based on EEI can be tied to the program and college goals and objectives while at the same time supporting the institutional goals, objectives, and assessment plan.

Program Planning and Assessment Process

A typical program planning and assessment process includes the institutional, college, and program levels as shown in Figure 1. An institutional mission statement is written and a strategic plan developed. Next, the college and program levels develop their mission, goals, and outcomes. Most faculty have a limited and superficial involvement in the process at the college and institutional level. As a result, faculty commitment is minimal. Flaws in the system develop when the educators fail to ask how the program and college levels impact and drive the mission, goals, and objectives of the institution.

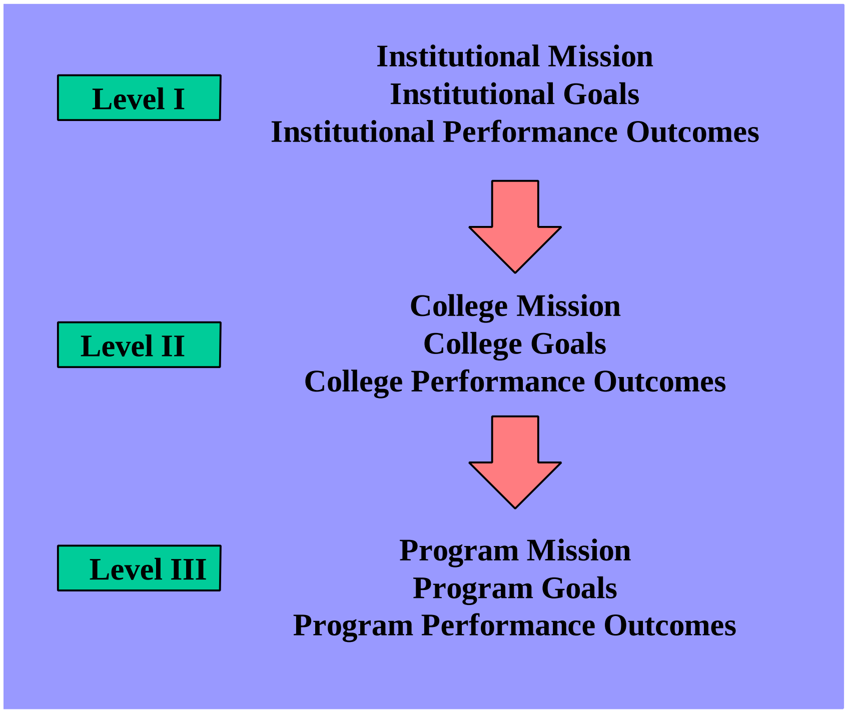


Figure 1: Typical program planning and Assessment process.

When the planning and assessment process is expanded to the course level as shown in Figure 2, everyone teaching a course would have the responsibility of connecting what is taught to the mission, goals, and outcomes of the program, college and institution. The process shown in Figure 2 also includes two other components. Information input from advisory committees, students, graduates and industry is asked for at the program and course levels. Likewise, such input from industry, graduates, and students helps educators keep the content current and pertinent, thus producing a graduate who meets the mission, goals, and outcomes of the program, college and institution. Also, the general education component of the institution that encompasses the whole educational process is integrated into the mission, goals and performance outcomes at each level. The general education component, common to all institutions, is that aspect of education that develops a well-rounded educated graduate and is an integral part of the mission, goals and outcomes at all levels. In conjunction with the course content, the general education component produces an individual who will meet the needs and challenges of an ever changing world.

Each educator has the responsibility to identify and include comprehensive course content. To ensure that all levels work together to support and drive the institutional mission we must ask:

1. What competencies should students have when they complete a degree?
2. How can students demonstrate that they have achieved the competencies at the desired level of performance?

Figure 2: Comprehensive program planning and Assessment process.

If these two questions are asked at each level and asked with increasing vigor at the program and course levels, course performance outcomes will become an integral part of the entire assessment outcome process. Before concentrating on the course level, it is important to revisit the mission, goals and outcomes at the program, college and institutional levels and make sure these questions are answered.

For the purpose of this paper, the following program mission statement, program goals, and course content goals have been developed. These are intended to serve as a generic example to provide the explanation for the Comprehensive Program Planning and Assessment Process Model (Figure 2), and the Flow Chart for Developing Course Performance Outcomes (Figure 3).

An example of a program mission statement is:

> The Construction Management program's mission is to prepare graduates to assume responsible management positions in the construction industry.

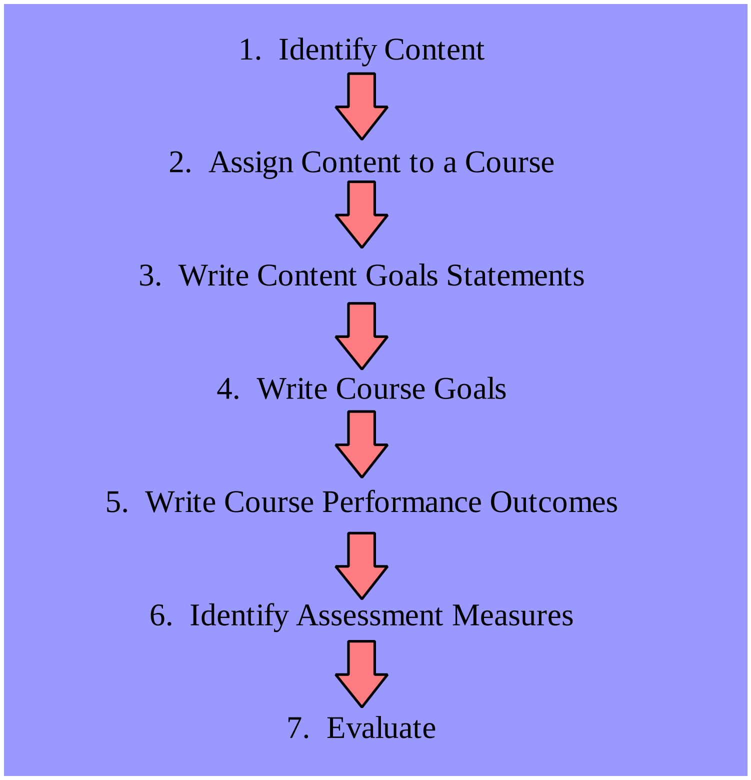


Figure 3: Flow chart for developing course performance outcomes.

Examples of program goals are:

1. Provide a comprehensive construction management curriculum blending the fundamentals of construction management, business management, and engineering.
2. Provide graduates with opportunities for growth and development in their personal, professional and public life.
3. Provide graduates with opportunities to develop and enhance communication and interactive skills.
4. Provide a curriculum that includes comprehensive general education to develop a well-rounded individual with insight into social and human issues.

Prior to developing course goals and student performance outcomes, programs must identify program content (Figure 3 -- Step 1). Accredited programs or programs seeking accreditation will need to compare their content to the core topics and EEI identified in the accreditation criteria. Active involvement of advisory committees, business and industry, graduates and students at this level will ensure program content is current and pertinent to the needs of the industry.

Once the program content is identified, it can be assigned to the appropriate courses (Figure 3 -- Step 2). This process enables faculty to look across the curriculum to identify overlaps, to spot voids in the content, to sequence the courses, and to sequence the content within each course. After the content has been assigned to a course, the content goal statements can be written

(Figure 3 -- Step 3). Daniel E. Vogler (1991) states in his book Performance Instruction: Planning, Delivering and Evaluating that “Content goals are a simple and effective means to communicate curricular intent and specific curricular content”(p.3). The content goal should be focused toward the learner and allow the learner to have a clear picture of the knowledge, skills and attitudes required to exit the learning experience. Vogler’s Curriculum-Pedagogy-Assessment model, explained in his book, facilitates instructional decisions while maintaining great flexibility. The roots of this model can be traced to Bloom’s well-known *Taxonomy of Educational Objectives* that categorize learning activities into learning domains and performance levels (Figure 4).

LEVEL	**DOMAIN**		
	Cognitive	**Psychomotor**	**Affective**
Simple	**Fact**	**Imitator**	**Awareness**
	Understanding	**Practice**	**Distinguish**
Complex	**Application**	**Habit**	**Integrate**

Figure 4: Domains and levels.

According to Vogler, the key factors to consider when writing content goals are:

1. Write content goals as action statements in the present tense.
2. Choose a verb for the action statement which donates an action which can be measured.
3. Limit one verb per content goal statement.
4. Focus on the performance you will require from students in order to demonstrate a specified level of competency for a given content area.
5. Orient the action verb to the domain and level where you want the learner to exit the learning experience. It is assumed that to exit at a higher level in a domain the learner must also be able to perform at the lower levels in that domain.
6. Develop a goal to communicate what the student will be able to do not an instruction method.
7. Group content goals into units so that broad performance objectives may be developed for the course rather than a performance outcome for each content goal. Detailed or sub-performance outcomes are developed in the lesson plan.

Examples of content goal statements for a typical construction course, *CME 315 Specifications and Contracts* are:

1. Explain construction contracting methods
2. Analyze agency relationships
3. Differentiate organization types
4. Examine contract disputes and torts
5. Explain construction bonding process
6. Interpret construction contract documents
7. Analyze construction specification components and organization
8. Analyze technical section components and organization
9. Analyze contract conditions
10. Prepare construction specifications
11. Explain construction insurance
12. Interpret subcontracts
13. Analyze contract relationships
14. Explain dispute resolution processes
15. Recognize ethical construction issues

The program mission, program goals and the content goals identified for *CME 315 Specification and Contracts* provide the foundation for the development of the course goals (Figure 3 -- Step 4). The question is what should students be able to do upon completion of the course? In this example, the student should be able to have a fundamental knowledge of construction contracts and enough knowledge and skills to write a construction specification. Each course goal should address these issues.

Examples of course goals are:

1. Provide students with a fundamental knowledge of construction contracts and their associated liabilities and incentives.
2. Provide students with knowledge and skills to interpret and write construction specifications.

After the course goals are written, student performance outcomes can be developed to reflect what students must do to demonstrate their competencies for the specified content goals. Since content goals are written as simple action statements, they are easily converted to student performance outcomes (Figure 3 -- Step 5). Course content goals will cluster into units of instruction. Performance outcomes are developed by units or clusters of content goals. The simple, yet crucial question to be asked is: what should students be able to do at the completion of this course to demonstrate their skills and knowledge? Examples of student performance outcomes are as follows:

1. The student will identify the components of the contract, interpret the requirements, and explain the project manager's role in the administration of the contract.
2. The student will identify the stakeholders and analyze the contractual relationships.
3. The student will explain the organization of the specification and compare and contrast performance and descriptive specifications.
4. The student will prepare a performance and descriptive specification.

5. The student will be able to identify ethical construction issues and discuss attitudes and values related to the ethical issues.

Once the students performance outcomes have been identified, assessment measures can be developed (Figure 3 -- Step 6). Assessment measures must evaluate the action specified in the content goals and performance outcomes to effectively assess student achievement.

Examples of assessment measures at the course level are listed below:

1. The students will be provided a set of contract documents. They will
   - answer questions about the documents
   - list the contract requirements, and
   - write a paper to discuss the project manager's role in the administration of the contract.
2. The student will write and prepare both a performance and descriptive specification based on a set of criteria.
3. The student will identify a construction ethics issue and write a paper to discuss the attitudes and issues involved.
4. The student will complete short answer and essay questions to identify the contractual issues involved, relationships of the contracting parties, and discuss possible solutions to resolve the dispute presented in a case study.

These four assessment measures tie directly to the five course performance outcomes and the two course goals previously identified. The assessment measures and course goals resulted from the content goals developed for the *Construction Specifications and Contracts* course. Construction specifications and contracts are an integral part of construction management fundamentals identified in Program Goal 1. Performance outcomes that require students to think, organize and write in response to a given assignment support the general education components in Program Goals 3 and 4. Performance outcomes, dealing with construction ethics, attitudes and values, support the growth and development of the individual identified in Program Goal 2. These in turn support the program mission statement that stresses that graduates must be prepared to assume responsible positions in the construction industry. At each stage of the process, student expectations have been addressed and specified. This process keeps the focus on the mission, goals and performance outcomes of the program, college, and institution.

The final step in the process for developing course performance outcomes is evaluation (Figure 3 -- Step 7). The evaluation process insures that course content and student competencies are appropriate and at the same time continue to support the mission and goals of the institution, college, and program while meeting the needs of the industry.

Summary

Expanding the program planning and assessment process to include course goals and student performance outcomes evolved while addressing the requirements in the ACCE accreditation self study. This report requires that the syllabus state the course objectives in relation to the program goals and objectives. The requirement, on the surface, appears to be simple but becomes more complex as one tries to tie the course content specifically to specific goals of the program, college, and institution.

The Planning and Assessment Model (Figure 2) develops a complete planning and assessment process that transcends assessment beyond the program level to the specific course and student performance outcomes. The model provides a mechanism for faculty to evaluate individual course content as well as content across the curriculum in relation to the needs of the construction industry. In addition, this process becomes a tool for improving teaching and learning. Faculty must answer whether or not the content identified does, in fact, help the student achieve competencies identified by the program and the industry. Focusing teaching and learning in this way eliminates non-essential material and helps facilitate the learning experience. Students benefit from this process because the intent of the content and requirements for satisfactory performance are clearly specified. Student performance outcomes with assessment measures identified for each course serve as the foundation to develop and implement a comprehensive assessment plan for the program, college, and institution.

References

Auchey, F. L., Mills, T. H., & Beliveau Y. J. (1997). Using the learning outcomes template as an effective tool for evaluation of the undergraduate building construction program. *Proceedings of the 33rd Annual Conference Associated Schools of Construction,* 81-94.

Marzano, R.J., Pickering, D., & McTighe, J. (1993). *Assessing student outcomes, performance assessment using the dimensions of learning model*. Association for Supervision and Curriculum Development. Alexandria, VA.

Shahbodaghlou, F & Rebholz, F.E. (1994). Outcome assessment model for a construction program. *Proceedings of the 30th Annual Conference Associated Schools of Construction,* 87-97.

Slobojan, J. (1992). Implementing outcome assessment for program accreditation. *Proceedings of the 28th Annual Conference Associated Schools of Construction,* 29-33.

Vogler, D.E. (1991). *Performance instruction: planning, delivering, evaluating*. Instructional Performance Systems, Inc. Eden Prairie, MN.

Yoakum, B. (1994). Program assessment good management practice. *Proceedings of the 30th Annual Conference Associated Schools of Construction,* 191-200.

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 173-181

1522-8150/98/$3.00/Educational Practice Manuscript

The Use of Nonlinear Computerized Presentation to Simulate a Practical Experience

Richard Ryan
University of Oklahoma
Norman, Oklahoma

The understanding of construction material or component creation and procurement is an integral part of the construction process. Because of this importance most construction education programs teach these processes in materials, methods or practices classes. The practical experience of an on-site visit or field trip is often the best learning medium for explanation of a particular material manufacturing or component fabricating process. However the practical experience is not always possible because of unavailability or lack of time. The computer and authoring software can be used to create a method of supplementing this missed practical experience. Text, images, video and audio can be combined into a nonlinear interactive format to simulate a field trip to a manufacturing or fabrication facility. The application format, content and distribution method can be used repeatedly in an educational setting with minimal maintenance. The need for content editing is minimized because the manufacturing and fabricating processes are similarly performed regardless of geographic location, season of the year or varying product use. It is not the intent of this discussion to represent that this digital simulation of a practical experience can replace the actual experience of visiting the facilities or witnessing the process as it takes place. The purpose of this paper is to discuss the creation and benefits of using nonlinear computerized presentation to simulate the practical experience of an on-site visit to a concrete batch plant in Norman, Oklahoma. It is hoped that other construction educators can use this model and discussion to create other similar applications.

Key Words: Concrete, Computerized Simulation, Construction, Digital, Field Trip, Multimedia

Introduction

The understanding of construction material or component creation and procurement is an integral part of the construction process. Because of this importance most construction education programs teach these processes in materials, methods or practices classes. The practical experience of an on-site visit or field trip is often the best learning medium for explanation of a particular material manufacturing or component fabricating process. However this practical experience is not always possible because of unavailability or lack of time.

A computer and authoring software can be used to create a method of supplementing this missed practical experience. Text, images, video and audio can be combined into a nonlinear interactive format to simulate a field trip to a manufacturing or fabrication facility. In this context simulate does not mean to create a digital “virtual” environment, but describes capturing and organizing information and images experienced during a tour of an actual facility and presenting them to a viewer using a computer. The nonlinear presentation allows the viewer to choose the path he or she wants to use to review the application content. Based upon the author’s experience this method is much more conducive for efficient information review than a linear format, such as PowerPoint.

The digital platform provides a convenient and flexible means of editing, updating and distributing the application. Applications can be used repeatedly in an educational setting with minimal maintenance. The need for content editing or updating is minimized because the simulated manufacturing and fabricating processes are similarly performed regardless of geographic location, season of the year or varying product use.

The use of nonlinear computerized presentation to simulate a practical experience is perceived by the author as a means to supplement course content for construction materials and methods classes. Typically the learning objective of a field trip is to provide users the opportunity to gain knowledge of a construction material manufacturing and fabricating process. The teaching method employed on a field trip is primarily visual association supplemented by oral explanation. This is the same teaching method of the computerized application, to associate video and images with text explanation. However it is not the intent of this discussion to represent that this digital simulation of a practical experience can replace the actual experience of visiting the facilities or witnessing the process as it takes place.

The purpose of this paper is to discuss the creation and benefits of using nonlinear computerized presentation to simulate the practical experience of an on-site visit to a concrete batch plant in Norman, Oklahoma. It is hoped that other construction educators can use this model and discussion to create other similar applications.

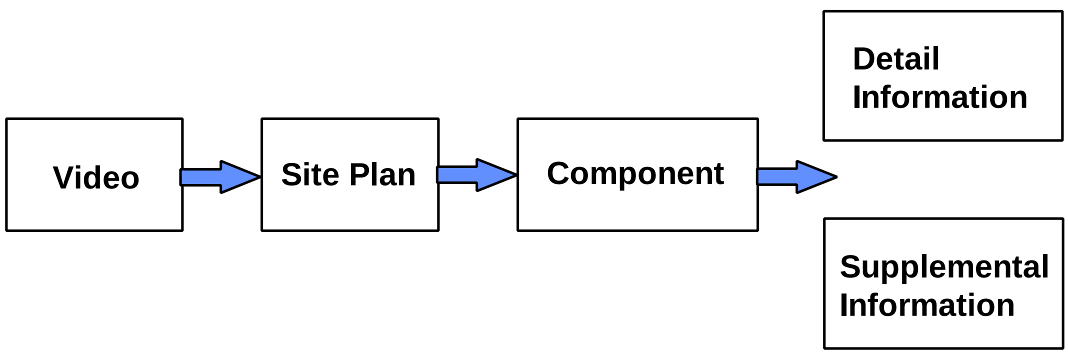
The Application Communication Format

The teaching objective of the Norman Concrete batch plant application is to relate to the viewer images and associated information about concrete manufacturing, the facility, the process being performed, and the subsequent end product. This is basically the same teaching objective as an on-site field trip. The application communication format simulates the knowledge gathering experience of the viewer walking around the site observing the components and listening to a narrative about the process. The viewer can be further prompted to learn information about the facility, process, or product by viewing the application at his or her leisure and answering appropriate questions in the form of an electronic or hardcopy exercise required by the instructor.

The first level of information transfer begins with the user viewing a video clip of the actual facility at ground level. The video is recorded as a sequential tour, as if the viewer were passing through the facility viewing its components from the start of the process to its completion (*See Figure 2, Screen 2*). The same components shown in the video are also depicted in a site plan of the facility. This site plan is the second level of information transfer (*See Figure 2, Screen 3*). The video and site plan provide general information about the facility layout, components of the facility, and the process sequence as would be seen on a walking tour.

A text label is placed on each component shown in the site plan. When the viewer activates a specific label by clicking on it with the mouse, a link is established to images, video, text or audio information about the specific component. The included resources address the purpose, parts and materials used in this part of the overall process. This is the third level of information transfer (*See Figure 2*, *Screen 15*). Detail and supplemental information are linked to the component information. This fourth level provides detail information concerning the actual facility component or supplemental information about the component, materials being used or the product at that particular stage of development. This supplemental information might include further text or audio explanation, charts or graphs, other information copied from a textbook, or World Wide Web sites containing additional information resources (*See Figure 2, Screen 31*). This level can be used to guide viewers to specific information that might not normally be explored on a traditional field trip.

Because of the nonlinear format, the viewer can choose which part of the process to review by clicking on the component, reviewing the linked information, and returning to the site plan when the review is satisfied. By using the four levels in the information transfer format the viewer can sequentially or randomly view the total manufacturing or fabricating facility and process. (See *Figure 1*.)



Level 1

Ground level video starting at the plant entrance showing all components

Level 2

Plan view of the whole facility:

* additives
* aggregates
* batch hopper
* control room
* conveyor
* feed hopper
* sand
* shop
* storage

Level 3

Aggregates:

* images of aggregate storage bins
* text explaining aggregate use in the process

Level 4

Course Aggregate (Detail):

* images of course aggregate storage
* images of aggregate being unloaded in the bins
* image of aggregate held in a hand

Course Aggregate (Supplemental):

* text explaining the specifications and use of course aggregate

Figure 1: Example of the four levels of the communication format for the Norman Concrete batch plant application; focus on aggregates

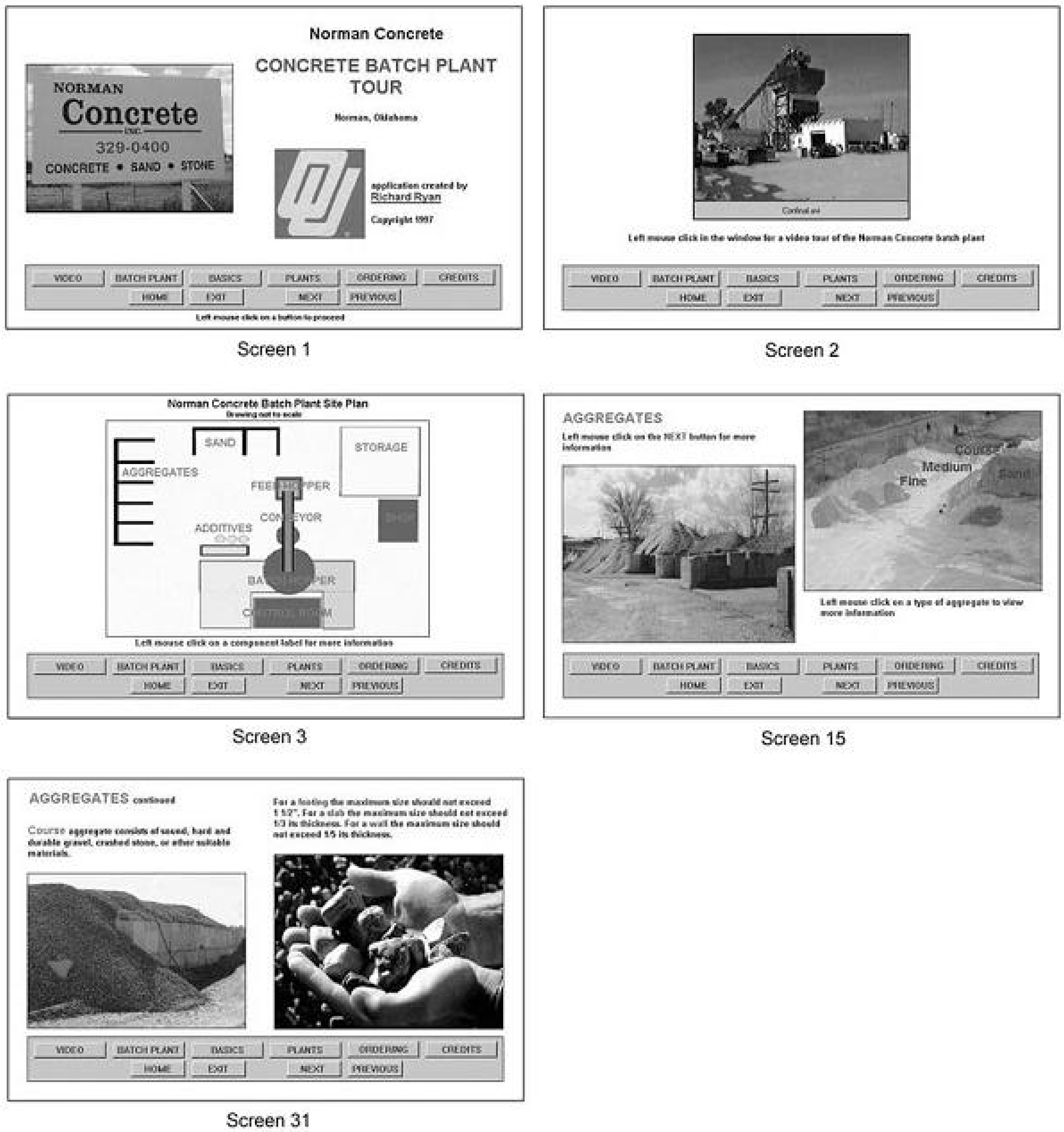


Figure 2: Screens depicting the communication format for the Norman Concrete batch plant application; focus on aggregates

Application Creation

Howles and Pettengill (1993) suggest that "*Creating an instructional multimedia presentation is somewhat like producing a Broadway play. It requires careful attention to scripting, theme development, sequencing, and visual design*." By following listed guidelines from the Asymetrix ToolBook II Publisher Users Manual (1996) this complexity was minimized for the authoring of the Norman Concrete batch plant application:

- *Keep things simple* - Use only a few multimedia elements and apply them sparingly until you have a good feel for how they will work and perform on the types of computers your audience uses.

- *Be selective about the types of multimedia you use* - Keep your application focused on its message, not on the special effects. Too many multimedia elements can dilute the power of your message and its individual elements.

- *Study traditional techniques for using multimedia* - Techniques used for motion pictures, graphics, and sound can be applied to multimedia applications as well. Your audience is probably familiar with TV and movie conventions, so design your multimedia application to confirm these conventions.

A helpful beginning development tool is a preliminary or proposed storyboard created in spreadsheet format (See *Figure 3*). This storyboard should depict the proposed resources to be included in the application, the basic presentation structure and the logic or links desired within the application. The links form the nonlinear paths by which the user can explore the topic and search for specific information. The developer should develop the application communication format based upon the preliminary storyboard.

The following strategy was used for creating and implementing the Norman Concrete batch plant application:

1. <u>Define the learning objective, desired content and level of information to be conveyed</u>: These items were determined based upon desired course content and by the audience for which the application was to be used. The learning objective was based upon what the users needed to learn and how this knowledge about concrete manufacturing was to be applied. The content and level of information to be conveyed was based upon what was necessary to fulfill the learning objective successfully. At this stage of application development, content and level of information to be conveyed need to be flexible and adaptable. These considerations will be influenced by steps 3., 4., 5. To aid in this development a proposed storyboard was created.

2. <u>Secure permission for resource collection</u>: Application use, content needs and necessary resource collection activities were discussed with on-site personnel at the Norman Concrete batch plant. Once permission was obtained from the facility's management to collect the required resources then a strategy and schedule for resource collection was developed and communicated back to the facility's management. After permission was verified the storyboard was better defined so that on-site resources could be collected efficiently, minimizing disruption to the normal workflow at the facility.

3. <u>Create a formal storyboard depicting the desired content and the logic</u>: This storyboard was the primary guideline for resource collection and authoring of the application. It established the structure of the application, including content and logic. The content was packaged to address the four levels of the application communication format. Text

information, audio and visual resources within the levels were linked so that the user could navigate through the application. This nonlinear format was much more difficult to author than a linear format. The information transfer logic was more complex and had to be fashioned to meet the learning objective. The operating interface or menu system had to be evaluated for understanding and efficiency. It was important to document the information as shown in the example storyboard for logic debugging and future application revision (See *Figure 3*). The column headings used in the example storyboard are defined below:

ID: assigns a script identification number to each page for linking
PAGE NAME: assigns the name to each page for reference
DESCRIPTION: briefly describes each page's content by purpose or content breakdown
RESOURCE(S) - Type: classifies the text, audio, video, or still image resources included in the page content
RESOURCE(S) - Name: lists the file name of the resource included in the page content
SCRIPTING NOTES: describes how the link is established from the page or resource
LINKS TO: identifies the link destination from that page or resource
BGRND: identifies the page background

ID	PAGE #	DESCRIPTION	RESOURCE(S)		SCRIPTING NOTES	LINKS TO	B GRND
			Type	Name			
1	1	home	title				
			image	ncsign.jpg			
			image	oulogo.jpg	www link	www.ou.edu	
			text	rryan	www link	www.ou.edu	
			menu		buttons	pages 1,2,3,30,31,32,40	1
					buttons	exit, next, prev	
2	2	video page	menu		buttons	pages 1,2,3,30,31,32,40	1
					buttons	exit, next, prev	
			video	confinal.avi	video player box		
3	3	site plan	image	plan.jpg			
					hypertext	pages 5,10,15,25,26,27,28	
			menu		buttons	pages 1,2,3,30,31,32,40	1
					buttons	exit, next, prev	

Figure 3: Storyboard example from the Norman Concrete batch plant application

A simple application storyboard can be structured the same as chapters in a book. However the user has the option of choosing a major category or chapter in a nonlinear fashion. Once linked to that category, the information presentation can be more linear and guided, such as depicting the sequential steps in a process. The Asymetrix ToolBook II Publisher Users Manual (1996) states that ToolBook II uses the metaphor of a book as the basis for applications.

4. Collect, digitize and edit the required resources based upon storyboard requirements: Visual resources were collected using a 35mm camera and a high-8 video camera. Hard copy pictures were converted to digital format using a scanner. Adobe Photoshop and Paintshop Pro image editing software were used to edit and convert images to .jpg digital format. The .jpg format was used so the images would be recognizable by web browser software. Most of the images collected on the batch plant site were gathered, edited and digitized by a Construction Science undergraduate student for a Directed Reading class. Video was captured using a high-8 video camera. The video was taken from the back of a pickup truck driving through the batch plant site in the same pattern that a walking tour would be taken. The video was digitized and edited using an Intel video capture board and Adobe Premiere. Audio was recorded on-site using a pocket recorder and converted to digital format.

Collecting the resources greatly influenced the content of the storyboard. Viewing and photographing the site and process as it was occurring yielded potential resources and information that were not included in the storyboard. Updating the storyboard as changes or additions occurred minimized the final linking problems.

5. Author the application: The concrete batch plant application was authored using Asymetrix ToolBook II Publisher. This authoring software platform offers tools to help with menu structure, page colors, backgrounds, graphics, formats, and linking. Auto scripting tools are included to easily and efficiently establish the page and resource links within the application. During the authoring process minor revisions to the storyboard were needed and additional resources had to be collected based upon changed content or deficient quality of required resources. At this stage of development the organization and completeness of the storyboard greatly influenced the efficiency of the authoring. As partial fulfillment of his directed reading class requirements the Construction Science undergraduate student that collected most of the resources authored a prototype application.

6. Evaluate the application: Typical users evaluated the prototype application. Objective and subjective comments and reactions concerning content and the communication format were noted and appropriate changes incorporated into a revised storyboard.

7. Revise the application: Based upon comments received in step 6., advancements in hardware and software technology and greater authoring understanding and proficiency, the application was revised. The author has realized that the revision effort will be continuous as authoring, World Wide Web and hardware and input device capabilities grow. The scope of the content of the Norman Concrete batch plant application can be

easily broadened and better adapted to the teaching environment because of these growing capabilities.

8. Implement the application: The Norman Concrete batch plant application is being used in the Construction Science Materials and Methods class. It is used as a teaching supplement for concrete procurement process discussion. The user can download the application to a networked workstation from the College server or from a www site. Class participants are required to view the application in order to answer questions concerning concrete and the Norman Concrete batch plant. The application is also used as a visual aid in conjunction with class lecture about the concrete procurement process.

Educational Application Use

In the classroom applications of this type can be used as an information supplement about the manufacture and use of a specific construction product. As observed by the author during field trips or practical experiences, students typically only casually observe. In many instances explanation of what is being seen is not heard because outside noise or not being close enough to the speaker inhibits this. Though it is not the same as actually visiting the facility, the Norman Concrete batch plant application has great potential for overcoming these shortcomings and more effectively transferring necessary information to the viewer.

The application can be accessed from the College server or from a www site. It can be projected for viewing in the classroom during lecture about the subject. The instructor can guide the viewers through the application and focus oral discussion about the detail and supplemental information. Focused and repeated review can be promoted by assigning exercises requiring specific answers concerning the facility, the manufacturing process, or supplemental points of interest. At their own leisure users can access the application for further review if desired or needed for exercise completion.

Observations And Further Development

Application creation is time consuming and requires appropriate hardware, software, input devices and qualified personnel. Collecting quality images, video and audio that effectively depict the desired information focus must be planned and staged if necessary. The storyboard outline is essential and necessary for efficient resource collection and application authoring. Storyboard creation and resource collection comprised approximately sixty percent of the total time spent on the creation of the Norman Concrete batch plant application.

Information seeking question and answer exercises can easily be created and used to focus attention to specific application content. The author has observed the benefit of using questions to motivate the user to read the text and view the images and video included in the Norman Concrete batch plant application. How the user navigates through the information seeking answers promotes understanding of the manufacturing process and the included components. The four levels of the communication format of the Norman Concrete batch plant application promote learning by association and allow the user flexibility in how information is reviewed. The application communication format can be customized to emphasize detail or supplemental information possibly not heard, discussed or viewed during a site visit. The format can be easily modified as changes are needed and more resources are added.

Other manufacturing or fabricating processes such as asphalt batching, precast concrete manufacturing, or steel fabricating are also integral parts of the construction process. The need to explore this practical knowledge provides a strong incentive for creation and use of applications that simulate the practical experience of an on-site visit. Computer networks and the World Wide Web offer construction programs without convenient access to manufacturing or fabricating facilities an accessible alternative to relate this practical experience to users. There is great future potential for construction educators to use these computerized applications like textbooks to supplement course content.

Based upon the author's perception this type of application has potential for two uses in the construction industry. Applications can be prepared containing easy to follow information focusing on manufacturing practices or positive company attributes that might distinguish the manufacturer from other competitors. Price and service information can be included based upon customer needs and prior relationship. The application can be distributed on a CD and given to potential customers to be viewed at their leisure on their own computer. At the manufacturing facility the application can be used to provide a new employee with an overview of the work environment and the subsequent manufactured product or for specific "on time" task training when qualified personnel are not available for the work task required.

This discussion has focussed on beginning development of an interactive narrated virtual walk-through that simulates the experience of touring a manufacturing or fabricating facility. Application development will be strongly influenced by the effectiveness of these first steps. Further developments for the Norman Concrete batch plant application include:

- Use of more video and audio for appropriate process component explanation
- Link more World Wide Web resources to enlarge the application information content
- Incorporate a computer based model of the plant and simulate a walk-through tour of the model
- Create several appropriate question and answer exercises
- Explore the possibilities and benefits of including customized marketing information in the applications in exchange for sponsorship for application creation and maintenance

References

Asymetrix (1996) *A Guide to Creating Interactive Applications, Asymetrix ToolBook II Publisher Users Manual*

Howles, Les and Pettengill, Connie (1983, June). Designing Instructional Multimedia Presentations: A Seven Step Process *T.H.E. Journal*

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 182-188

1522-8150/98/$3.00/Educational Practice Manuscript

Using Peer Evaluations to Assign Grades on Group Projects

Nancy Holland and Leslie Feigenbaum
Texas A&M University
College Station, Texas

Through the use of individual and group projects the learning experiences of students can be enhanced. However, in group projects there is a concern about equity when assigning grades. If the same grade is assigned to all member of the group there is the underlying assumption that all members of the group contributed equally. Given the variety of talents, abilities and motivators of students in construction education that assumption lacks validity. However, through the use of peer evaluations, the members of the group are allowed to voice their perceptions of their contributions and those of the other members in the group. By quantifying these perceptions and weighing them individual grades can be derived that do not inflate to overall grade on the project. If properly administered, these evaluations can become a motivator for enhancing involvement. In addition, the students can develop skills necessary for accomplishing objectives through group decision making as well as team building strategies.

Key Words: Peer Evaluation, Group Projects, Performance Scoring

Introduction

Through the use of group projects the quantity and complexity of materials covered in a particular course is substantially increased. The typical fifteen-week semester sets a physical boundary around methodology and the quantity of information that can be presented. Furthermore, if only individual assignments are used there is the physical limit of the amount of work that a single individual can perform. Through the use of projects, making the learner a participant in the process enhances the learning experience. According to Smith (1995) learning by doing, when used properly, is a much more powerful learning technique. The student is actively involved in the learning process. Learning by doing in a group can be even more effective. Students need to learn to work in a group. Industry, indeed most of society, organizes its activities by groups and bases its rewards partially, if not completely, on group effort. The need to work in groups is echoed by many others (Barley, 1990), changes in technological environments has resulted in an increasing emphasis on work groups (McMaster, 1995). The design of complex products such as aircraft and automobiles has long been accomplished using working groups rather than individuals. (Cooley, Hawkins, Hamilton and Crick, 1994) Among the benefits are improved designs, real world experience and the development of team skills. Drawbacks are cumbersome decision-making, inefficient task accomplishments and the possibility of destructive inter-group conflict. The use of group projects enhances learning not only of the subject matter but facilitates the development of the skills necessary for consensus and team buildings. Katzenbach & Smith (1993) provide the following differentiation between teams and groups: "Teams require both individual and mutual accountability and produce discrete work products through joint contributions of their members -- a team is more than the sum of their parts." All of these secondary benefits clearly point out the advantages of using group projects to enhance learning. However, they also uncover the difficulty in evaluating the performance and contribution of the individual members of the group.

Individual Evaluation

There can clearly be arguments for not evaluating individual members on the team. First, the concept that a team is a unit and that they should share equally in the rewards as well as the punishments. However, in the academic arena there is a need for equity and fairness. According to Michaelson and Black (1994) The grading system must be responsive to students concerns for fairness and equity. This concern for equity on group projects can be alleviated by using peer assessments and evaluations. Michaelson and Black (1984) go on to point out that these evaluations can serve other purposes. "The peer evaluation solves two important motivational problems. One is providing an incentive for participating in group discussion. The other is that it tends to remove students' fear that they will have to choose between getting a low grade on the group assignment and having to "carry" group work." Taking courses pass fail, which is in some ways equivalent to the student that does not contribute to the group. Research shows that students often use the pass / fail option to reduce the effort and study time in that area so that they can concentrate on other courses where they are being graded. Consequently, students do not perform as well or learn as much in these pass / fail courses as in a regular course (Jacobs & Chase, 1992). Therefore, when assigning group projects, it is important that the individual student understand from the beginning that he / she will receive an individual grade based on their individual participation in the group. Furthermore, Grades provide two important benefits for students: motivation and feedback. Grades do not motivate students to study. Although some students would study and learn without grades, most would not. Eison and Pollio (1989) found in a research study of 5,000 undergraduates that over 50% of the students felt they would not learn or remember very much without being grades.

In the studies by Saaverda and Kwun (1993) they found that "on the whole, both field and laboratory studies indicate that peer assessment is a valid and reliable evaluation procedure." Mitchell and Lindin (1982) point out a short coming in these evaluations is that group members typically are unwilling to differentiate performance, as evidenced by their tendency to underrate peers who are more capable than the average member and to overrate those that are less capable. Whatever shortcomings exist in the peer evaluation process the concern for equity and the motivation that they provide compensate for whatever lack of reliability that exists. Using multiple evaluation procedures can compensate for this lack of reliability. In this scenario a portion of the students final grade in the course is made up of individual projects, group projects, papers, presentation and exams.

Another essential element in peer evaluations is confidentiality. If there is the fear that the other persons within the group can find out how they were rated by there other group members, peer pressure could result in the group members giving everyone the same rating. This would clearly adversely impact reliability and validity of the peer evaluations.

Developing the Evaluation Procedure

Peer rating scales are easy to design, administer and score (Kane & Lawler, 1978). In order to take advantage of the positive motivators for peer evaluations on group projects planning is required on behalf of the instructor. One of the first issues concerns how many people will be in the groups and how will they be assigned to the groups. From a peer evaluation perspective groups of three or more makes it very difficult for the members of the group to determine how they were rated by their peers. However, from a work load perspective, the groups need to be just large enough so that all members must contribute in order for the project to be successfully completed. The issue is percentage of the grade will be impacted by the results of the peer evaluations. Typically 25 to 40% works best. The peer evaluation process takes points from those who did less and gives them to the persons who did more of the work on the project. The greater the percentage the greater the number of points can be transferred. Another issue that needs to be addressed before any group assignments are made is how to deal with those group members who refuse to participate in the peer evaluation process. In order for the peer evaluation process to work fairly, all of the perceptions of all of the group members need to be compared and evaluated. If someone does not participate that objective cannot be accomplished. Therefore, a motivational policy needs to be developed prior to making any assignments. One possibility is to assume that the non-participant contributed nothing toward the project and factor that into the evaluation process. Another possible method is to use the other group members evaluations to assign the individual grades and then assign some penalty for not completing the evaluation process.

When the group assignment is made the evaluation form, return procedure, deadlines and how they will be factored into their individual grade must be presented. From the experience of the authors a simplistic evaluation works best. Appendix A is an example of a simplified peer evaluation form. This form asks the user to rate their contribution on the project and that of their peers. Furthermore this form defines how it will be used in assigning the final grade, when it is due and how it shall be returned. From a practical perspective it is advantageous to have these evaluations returned to some location outside the classroom. This adds confidentiality and removes some of the peer pressure.

Applying the Results

The first step in applying the results of the peer evaluations is to assign a grade for the project. This is the grade that all of the members of the group would make if they had all contributed equally to the project. The second step is to develop an evaluation matrix similar to the one found in Appendix 2. This matrix has the team members names on both the horizontal and vertical axis. The results of the individual peer evaluations are entered horizontally. When all of the information has been entered, the columns are totaled to develop a total number of evaluation points. Then these individual evaluation points are converted into a percentage score based on the total number of evaluation points for all persons in the group.

The evaluation points percentage becomes the basis for distributing the results of the peer evaluation. This percentage is then multiplied by the percentage of the project that is subject to the peer evaluation which is in turn multiplied that amount by the number of persons within the group. The result of that calculation is then added to the amount of the grade that was not subject to peer evaluation. Appendix C shows how the evaluation procedure would be applied.

Conclusion

The peer evaluation procedure is designed to help provide equity to grade distribution and to provide motivation to those students who may not be as talented to become actively involved in the process and not depend on some one else to drag them through the project. In addition, this procedure allows for the students to develop the skills necessary in completing group and team projects. When group projects are used in a course multiple types of evaluations need to be performed. Some of the evaluations can be in the form of group evaluations and in the form of evaluations being performed by the instructor.

References

Barley, S. (1990). The Alignment of Technology and Structure Through Roles and Networks. *Administrative Science Quarterly, 35*, 61-103.

Cooley, W. L., Hawkins, T. A., Hamilton, P.H. and Crick, M. J. (1994). Issues and Experiences in Teaching Students to Design In Teams. *1994 ASEE Annual Conference Proceedings p. 2575*.

Eison, J. and Pollio, H. R. (1989). *LOGO II: Bibliographic and Statistics Update*. Cape Girardeau: Center for Teaching and Learning, Southwest Missouri State University.

Jacobs, L. C. and Chase, C. I. (1992). *Developing and Using Test Effectively*. Jossey-Bass, San Francisco, Ca., pp 212-213.

Kane, J.S. and Lawler, E. E. (1978). Methods of Peer Assessment. *Psychological Bulletin, 85*, 555-586.

McMaster, D. K. (1995). Assigning Individual Grades In a Group Project Design Course: One Method That Seems to Work. *1995 ASEE Annual Conference Proceedings*. p. 1985.

Michaelson, L. K. & Black, R.H. (1994). *The Key to Harnessing The Power of Small Groups I Higher Education - Building Learning Teams*. Growth Partners p.14.

Smith, D. L (1995). Effective Teaching Without Lecturing. *1995 ASEE Annual Conference Proceedings*. p.341.

Saavedra, R & Kwun, S. K. (1993) Peer Evaluation in Self Managing Work Groups. *Journal of Applied Psychology, 78* (3) 450 - 462.

Appendix A

Peer Evaluation Document

PARTNER EVALUATION

Group projects are sometimes looked upon as being "unfair." Through the use of the partner evaluation your perception of the quantity of work that you performed and that of your partner is analyzed against the perceptions of your partner. Through this process, hopefully equity is achieved. These evaluations are a serious statement and are used to re-distribute 40 % of the grade on the project. In order for this process to work effectively there is the need for you to be honest and objective. Your ratings and comments are confidential and are destroyed once your grade has been calculated.

These evaluations must be submitted to my mailbox no later that 5:00 PM on Monday. Complete this evaluation and place it in a white sealed envelope. Evaluations that are not in a sealed envelope will be ignored. If you do not submit an evaluation it will be assumed that you did not perform your fair share of the work and your grade on the project will be reduced by two letters.

NAME: ________________________________

I PERFORMED:

1 2 3 4 5 6 7 8 9
None of the work Fair share of the work All of the work

PARTNER 1's NAME: ___________________________

THIS PARTNER PERFORMED:

1 2 3 4 5 6 7 8 9
None of the work Fair share of the work All of the work

PARTNER 2's NAME: ___________________________

THIS PARTNER PERFORMED:

1 2 3 4 5 6 7 8 9
None of the work Fair share of the work All of the work

IF YOU HAVE ANY COMMENTS *CONCERNING* THIS PROJECT OR SUGGESTIONS ON HOW TO IMPROVE THE CLASS PLEASE WRITE THEM HERE.

Appendix B
Evaluation Matrix And Grade Calculation Formula

	Member 1	Member 2	Member 3
Ratings on member 1's Evaluation			
Ratings on member 2's Evaluation			
Ratings on member 3's Evaluation			
Total Rating			
% Member Score			

Total Rating = Σ (m1..m3)

% Score = MX / Σ (m1..mx)

DETERMINING THE INDIVIDUAL GRADES

Z = Percentage weight of member evaluation

G = Grade on the group project

Distribution Amount = G * Z

Base Grade = 100 - distribution amount

M1's Final Grade = (Z * G * M1's % Score * Number of Group Members) + (G * (1 - Z)

Appendix C
Sample Grade Calculation

	Member 1	Member 2	Member 3
Member 1	5	7	5
Member 2	5	5	5
Member 3	5	7	4
Total Rating	15	19	14
% Member Score	.3125	.3958	.2917

Overall Project Grade 85

Partner Evaluations = 40 %

Member 1's Grade = (.40 * 85 * .3125 * 3) + (85 * (1 - .4)) = 82.875 or 83
Member 2's Grade = (.40 * 85 * .3958* 3) + (85 * (1 - .4)) = 91.37 or 91
Member 3's Grade = (.40 * 85 * .2917* 3) + (85 * (1 - .4)) = 80.75 or 81
Average of all three Grades = (83 + 91 + 81) / 3
Average = 85

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 189-198

1522-8150/98/$3.00/Educational Practice Manuscript

Developing a Laboratory for Heating, Ventilating, and Air-Conditioning Courses

Tim Wentz
University of Nebraska
Lincoln, Nebraska

Kirk Alter
Purdue University
West Lafayette, Indiana

Heating, ventilating and air-conditioning (HVAC) systems are an integral part of any building, often comprising 20% to 40% of the total building cost. Clearly, it is difficult to be in responsible charge of the construction of an entire building without also having an understanding of how and why mechanical systems work the way they do. The main difficulty in teaching the fundamentals of HVAC systems to construction management students revolves around the fact that most students have very little background or experience with these systems. Added to this problem is the fact that most texts on the subject matter are very technical in nature, principally written for design engineers and not construction managers. It is believed by many researchers that most students find learning easier, and more comprehensible, if the material is presented visually. This paper discusses two different approaches to providing visual “hands on” teaching methods through the use of a HVAC laboratory.

Key Words: Heating, Ventilating and Air-Conditioning (HVAC), laboratory, visual learning.

Introduction

HVAC systems are actually very simple, straightforward systems. There are no great mysteries on how they operate. At the same time, for those not familiar with mechanical systems, it can appear the systems work by "magic". Inasmuch as a large percentage of all construction management students traditionally come from a general contracting background, it is not surprising then that mechanical systems courses have historically been perceived by the students as some of the most difficult courses in a construction management curriculum.

It should also be kept in mind that construction management education strives to produce a technical manager capable of identifying problems, quantifying problems and then resolving problems in the context of the construction industry. Accordingly, it is necessary that construction managers be able to think "holistically"; that is, be able to see entire systems as a part of a whole building or construction. This is only possible if the students understand the systems themselves. To that end, there is a very fine, but well defined, line between teaching design engineering and teaching the fundamentals of how and why those systems work. Clearly, some design fundamentals have to be taught in order for the student to reach an understanding of why it works. However, we as educators must always be alert to the fact that we are not teaching design engineering. In some respects, we are teaching something far more difficult; technical management.

The need to teach mechanical systems holistically lends itself well to teaching visually in a "hands-on" setting. Most students learn faster, and more comprehensively, when technical material is supported and reinforced with a visual model. Furthermore, this type of learning reinforces the critical thinking perspective we are trying to instill in our construction management students. Linking the analytical "left brain" thinking with the holistic "right brain" thinking, will, ultimately, result in a student more capable of "whole brain" thinking. Combining lecture and lab instructional experiences, or "teaching around the cycle", where the relevance of each new topic is explained, followed by a presentation of the basic information and methods associated with the topic, followed by opportunities for the students to practice the methods and to explore applications (Felder, 1996) seems to be the most effective and efficient means to stimulate a systems approach in the construction management undergraduate.

Laboratories in Construction Management Education

The American Council for Construction Education (ACCE), the accreditation body for university level construction programs, specifically states that "the nature of construction programs imposes a need for special types of space and equipment to introduce the student to realistic construction methods and procedures" (Egger, Varzavand, and Shofoluwe, 1992), formally recognizing the need for construction programs to incorporate laboratory experiences into their curricula. Among those schools accredited by the ACCE, however, the spectrum of available lab experiences is quite broad, ranging from traditional drafting and materials testing (especially soils and concrete), to computer labs where project management software is used to teach scheduling, estimating, and spreadsheet management, to labs where full size building structures are constructed (Egger et al, 1992).

Johnston (1990) describes "Living Labs" as controlled learning centers for the student to experience and appreciate the materials used, labor required, and the equipment of construction along with their relationship to the project site as a key element of a construction student's education. He goes on to say that the traditional soils labs and concrete labs are effective only in teaching the student testing procedures to check the quality of the materials used on site, and fail to demonstrate in any meaningful fashion topics such as the workability of soils as equipment moves it or compacts it, different finishing techniques, or the need for workable concrete. The problem addressed by Johnston is how to best train students in the visualization process that they must have to succeed in the construction industry, and how to create value in the construction education process by enabling students to gain experience without requiring unacceptably high levels of actual on-the-job field experiences.

Although not specifically cited by Johnston, the seminal article in integrating lecture and lab courses in construction materials and methods to more closely simulate the actual construction process appeared in Koehler's and Easley's 1988 article on "Using a Building Systems Approach to Construction Materials and Methods Courses." In that article the authors specifically address the problem of students who "do not have a conceptual understanding of the working relationships between the nature of the materials, the equipment required for application, the method of construction, and the jobsite conditions" (Koehler and Easley, 1988). The approach, described as a building systems approach, attempts to integrate the study of building materials with the study of construction methods to encourage the student to approach the construction process from an integrated systems perspective. The effect of this approach should be a heightened awareness of the graduate as construction manager of the interplay of building systems and processes.

Although first introduced in the late 1980s, and expanded upon in the early 1990s, the integrated, or building systems approach to construction education has been adopted by ACCE schools in only a limited fashion (Egger et al, 1992), and has only primarily focused on general building construction. Limited adoption has been more a function of lack of resources than an academic dispute over the worthiness of such an approach. The focus on general building construction - wood, steel and concrete material and structures, on the other hand, is the result of a long-time focus of construction education on the static construction elements - foundations, structures,......., rather than the dynamic building processes such as the mechanical, electrical, and plumbing (MEP) building systems. The emergence of industry demand for a greatly increased offering in MEP construction management education (Lew and Achor, 1994) and (Alter and Koontz, 1996) forces construction educators to intensify the effort to incorporate a building systems approach as the most effective means of educating students on the dynamic processes of buildings.

Implementation Problems-HVAC Laboratories

In spite of the great need to incorporate lab experiences in the MEP construction management curricula, the relatively new focus on the teaching of mechanical and electrical systems in the context of construction management presents some problems. Historically, mechanical and electrical systems were taught by the respective engineering departments, leading to the attitude in construction management that mechanical and electrical systems were areas for which someone else was responsible. During our careers in construction, most of us have encountered the construction manager of a large commercial project who literally refused to open the plans to the "M", "P" or "E" sheets because they were too confusing or poorly understood.

This attitude has proven itself to be defective. Industry demands for construction managers specifically trained to operate in the mechanical and electrical segment of the construction industry have risen dramatically. Additionally, industry now expects all construction managers to have the ability to coordinate and supervise the mechanical and electrical trades in the construction process. This is not possible, of course, without possessing a strong fundamental knowledge of mechanical and electrical systems.

Due to the only recent focus on mechanical and electrical systems in the construction management environment, there are relatively few mechanical and electrical laboratories developed specifically for construction managers. Many existing laboratories described as mechanical or electrical were often developed within construction technology programs. It should be no surprise then that these laboratories have a tendency to focus more on the *components* of the mechanical systems, rather than the installation, operation, and performance of such systems. Historically, courses in the MEP area were "often classified as technical emphasizing design and operational topics while ignoring the subcontractors project coordination issues and installation methods. The courses should include a focus on materials, methods, sequence, and technical interface phase" (Mouton & Johnston, 1989). Further, the experiments and demonstrations used within these laboratories tends to revolve around those skills required in a technology environment, not a management environment.

This particular problem is accelerated by the texts and other materials generally available to construction management students. The vast majority of all texts were specifically written by design engineers for design engineers. This is not to say these are poor texts. Quite the contrary; they are often excellent texts..... for design engineers. It is no wonder then that many construction management students become confused about the focus of a mechanical systems course and immediately get bogged down in the technical design aspects of the material.

A final problem that plagues most institutions is, of course, resources. Most universities have severe space shortages to speak nothing of the financial shortages that drive many of the problems, and solutions, facing higher education. Simply put, allocating precious resource space for a mechanical systems laboratory, which requires more space than more traditional academic uses, is not a priority at most institutions.

Model Laboratory Implementation

Both Purdue University and the University of Nebraska have spent a considerable amount of time and effort in addressing the problems encountered in teaching mechanical systems within existing construction management programs. We have found, through research, trial and error, experience, and good fortune that students invariably achieve a more comprehensive knowledge of mechanical systems if the text and lecture material is supplemented with visual examples and demonstrations.

In discussing this problem with practitioners of related fields, most notably those in facility management and technical repair and service, we have found that they are struggling with the exact same problem; i.e., how best to impart a fundamental knowledge of mechanical systems to students with no previous background in the industry. From this recognition of a common problem we realized that if we could effectively teach the fundamental knowledge of mechanical systems to students, it could be used as a platform for specialized education in a number of different, but inter-related fields**.**

Furthermore, we realized that by forming a partnership between several different branches of the construction industry, we could overcome a number of our common problems. Out of this realization came our proposed model for an HVAC laboratory.

Partnering with Campus Facility Management

Seeking out an alliance or partnership with campus facility management may be the optimal choice in creating value for the university when incorporating MEP labs into the curricula. If the construction management department is to offer practical MEP lab experiences it must overcome the obstacles of lack of physical space and limited access to operational MEP systems. Facility managers, on the other hand - campus or otherwise, are constantly seeking to find ways to provide continuing education opportunities on constantly evolving and technically sophisticated MEP systems and controls, and training experiences on non-critical systems for new employees. Finding a way to combine resources to meet these needs provides an obvious marriage between the two parties.

Model Laboratory at the University of Nebraska

The first step in developing a model laboratory is acquiring the space for the laboratory. At the University of Nebraska. through a partnership with Facility Management, the department was able to obtain a working HVAC equipment room to use as a working laboratory.

Modifying an existing mechanical equipment room to serve as a laboratory solved a number of difficult problems. First and foremost, this overcame the problem of acquiring a new space or renovating an existing space, a difficult economic problem, if not a difficult political problem. We found that laying claim to a working mechanical room rarely produces any competition between departments, as would often be the case with the acquisition of more traditional classroom space.

This concept of using an existing mechanical equipment room, or, for that matter, a whole building, as a working laboratory is not new to higher education. For example, the University of Nebraska Board of Regents is currently considering a design for the new Information Science, Technology and Science Building on the Omaha campus that "will be similar to walking through a textbook". This design envisions exposing various structural, mechanical and electrical components of the building and using monitors and stations placed throughout the building to literally turn the building itself into a working laboratory.

The model laboratory should also be of newer design, if at all possible. Typically, a newer design will incorporate equipment and systems of higher efficiency and proven reliability and, clearly, will better represent mechanical equipment rooms the students will actually encounter in the industry. Additionally, a newer equipment room frequently contains space for future expansion that oftentimes is never used. Hence, the laboratory is apt to have more floor space.

The model laboratory should also contain as many different elements of the heating, ventilating and air-conditioning systems as are available on campus. This is usually not a problem, as most universities employ a central system to provide steam and chilled water to remote air handling units. Therefore, most equipment rooms will contain an air handling unit, a simple steam to hot water converter, a pump or two, an air separation system with expansion tank, a condensate pump and other miscellaneous equipment. With the general acceptance of ASHRAE Standard 62-1989 on ventilation, most newer air handling units have ample provisions for outdoor air intake, along with relief air or exhaust air provisions as well.

One distinct advantage of using an existing equipment room as a HVAC laboratory is the flexibility it affords. For example, one concept most construction management students have trouble understanding is how steam "moves" in a system and what role steam plays in the big picture. Having a working steam fired heat exchanger available, along with a cutaway of the same type of heat exchanger or other similar diagram, the student can begin to visualize, in their mind, what must be happening inside the heat exchanger. Now, by adding a high temperature glass steam trap and high temperature glass piping to the condensate drain side of the heat exchanger, the students can actually see the condensation formation and how the condensate leaves the heat exchanger for its' return to the boiler. Finally, by adding temperature and flow sensors to the hydronic side of the heat exchanger, the student can measure the amount of heat transfer to the fluid. The student begins to build the system as a whole in their mind. A change of phase from gas to liquid......., a transfer of energy........, delivering that energy and conditioning an occupied space.........., - mentally, a system is born.

Both facility management and industry can build off of this same systems foundation. Again, as an example, facility management has a great deal of difficulty training their new technicians how to troubleshoot and repair various steam devices, such as steam traps. With the addition of a by-pass line around the high temperature glass steam trap, the addition of a float and thermostatic trap or perhaps a bucket trap, and facility management has their own test stand suitable for teaching their service technicians how to troubleshoot and repair steam traps. The difference in using a model laboratory for this purpose is that the knowledge of how to troubleshoot and repair steam traps is built upon the fundamental knowledge of how and why steam works, thus preparing the facility management service technician to apply the same knowledge to a wide variety of steam devices. In this manner, the HVAC laboratory serves a dual purpose.

Model Laboratory at Purdue University

Purdue's existing curriculum supports the full scale construction of a wood frame, steel frame, and concrete structure each semester. Currently the mechanical and electrical specializations incorporate lab experiences into those structures each semester. This provides opportunities for all students involved to recognize an integrated building systems approach combining the traditional structures approach to the construction management lab experience with the dynamic interface of the installation of electrical and mechanical systems. At this time due to curriculum, space and time constraints, the effective value of incorporating electrical and mechanical lab experiences is limited to an integrated materials and methods approach. While important, and effective in providing specialty subcontracting management experiences for the student, fully operational systems experiences are severely limited.

For several years now, the department has looked at various equipment room spaces in the building housing the department, and has been offered space within the building to create a mechanical/electrical lab. Significant MEP contractors and major equipment suppliers have been involved in the brainstorming process to create the optimal laboratory setting. Some of the criteria considered important include the opportunity to install and operate mechanical and electrical building systems in full scale models, the ability to provide education in specialized MEP systems, and the ability to examine the benefits and detriments of the various choices of systems from installation, operational, and maintenance perspectives. After continuing examination the ad hoc committee tasked with creating the lab decided that the existing spaces offered were too limiting for the objectives desired.

With three major construction associations representing over 7000 companies supporting the development of construction management specializations in electrical and mechanical construction, however, and a goal to continue to be successful in providing quality education to undergraduate and graduate students, and practicing professionals, the department has identified a need for a new laboratory and continuing education facility. The facility will be used for teaching mechanical and electrical construction management and continuing education for Purdue students, Purdue Physical Facilities personnel, Construction Associations continuing education programs, and individual construction firm's customized training programs.

Some of the criteria and characteristics of the new facility are:

- The facility will be a joint effort between Purdue Physical Facilities and the School of Technology.
- The proposed size of the facility will be between 30,000 and 40,000 square feet with large, open, and flexible spaces with high bays, classrooms, continuing education training rooms, and computer instruction capabilities.
- All students in the major will have classes in the facilities.
- The facility will incorporate the use of state of the art communications and voice/data transmission to the "home office".
- Professional assistants will be hired to assist with both lab and continuing education functions.
- Design and construction costs will be minimized, with the primary funding coming from the construction industry.
- The facility will be used for undergraduate and graduate education, outsourced training for major mechanical and electrical equipment manufacturers, and construction industry continuing education training.

Both the Nebraska and Purdue models offer benefits and restrictions, but both also serve to illustrate effective approaches to actively incorporating mechanical and electrical laboratories into the construction management education curricula. Other ACCE departments should not consider Nebraska and Purdue simply fortunate enough to have the resources available to have construction laboratories "in which the student can actually build a project and observe construction management concepts" (Andersen & Andersen, 1993), and commiserate about those construction programs with limited resources. They should actively seek out partnerships with campus physical services, creatively offering to add value to both entities. All campuses have underutilized equipment rooms simply waiting for creative exploitation.

Partnering with Industry

Partnering with industry is critical to the success of any model laboratory. As written (Payne, 1997) the tangible benefits of industry/academe partnerships in the field of engineering education, equipment manufacturers, contractor associations, and individual contracting firms will have a vested interest in the endeavor to create successful mechanical and electrical construction labs. All will want to influence what and how construction management students are taught, all will want to keep abreast of trends in construction management education and research, and all will want to determine the best schools from which to recruit future employees.

Industry will want to be involved in the design and development of the laboratory, inasmuch as industry will also be using the laboratory for their own teaching purposes, such as the example previously given concerning the repair and troubleshooting of steam traps. Major HVAC manufacturers have approached Purdue in a quest to outsource some of the technical dealer training required in order to keep their dealers current on the latest HVAC technologies. Consider the symbiotic benefit to the undergraduate students should this occur. Additionally, industry is also an invaluable resource for many of the components of the laboratory that would not otherwise be available. For example, manufacturers are often very generous with displays, equipment cutaways, literature, submittals, and other materials that can be used to good effect in a laboratory setting.

With the lab, manufacturers and physical plant employees will be able to examine the attributes of various alternate products and materials. As in the steam trap example discussed above, with a few minor alterations in the steam trap test stand industry representatives can demonstrate the differences in the various types of steam traps and their relative advantages and disadvantages depending on the application.

Curricula

With the addition of laboratory experiences in the mechanical and electrical construction education experience a tremendous amount of flexibility in the curricula is introduced. This flexibility manifests itself in many different ways. With just a minimum of mechanical equipment, technical demonstrations and experiments can easily be developed for many fundamental HVAC processes, including psychometrics, heat transfer, pumping and fan laws, air delivery and conditioning, temperature control, and HVAC systems selection.

In addition to basic technical instruction the lab setting allows you to physically demonstrate and experience value engineering options and constructibility studies that are technically based and economically derived, encouraging the students to "develop a relevant decision process that will serve their professional needs as a negotiating conduit between Owner's Architect/Engineer, the General Contractor, and the Specialty Subcontractor" (Mouton & Johnston, 1989).

Well prepared and executed lab experiences will go beyond the purely technical elements of mechanical and electrical construction. Lab exercises should be designed to include all elements of the construction management process including:

- Cost & resource estimates.
- Scheduling requirements including manpower loading.
- Pre-fabrication opportunities & advantages.
- Scope identification.
- Safety awareness.
- Preparation of comprehensive materials, tools, and equipment lists.
- Recognition of the technical information and project documents required in the installation of similar projects.

- Preparation of an outline of the sequence of the entire process and the specific steps of the construction activity.
- Design of a checklist to monitor the quality of the construction process and product.

Benefits and Outcomes

There are numerous benefits in utilizing an HVAC laboratory in a construction management curriculum. Clearly, the first benefit accrues to the students in that they are gaining a much broader and applicable education, in a format that will be easier for them to understand and comprehend. Students interviewed after concluding a mechanical systems class which utilizes a visual approach to learning, rarely fail to mention the importance of actually seeing the devices and systems they are studying.

A second important benefit is obtained by industry. Not only do they have access to construction management students with a solid background in the fundamentals of mechanical systems, they also have access to a laboratory that can help further their own industries development.

A third, and perhaps tangential benefit that has been observed revolves around the development of a student's understanding of what is involved in laying out, constructing and installing the various aspects of a mechanical system. Hand in hand with this new understanding, the student inevitably gains a new respect for the craftspeople responsible for the installation of the work. From this basis of respect, the student will find it much easier to understand, communicate and, therefore, manage those workers.

Recommendations

As funding resources become more limited throughout our society, it is imperative that we as educators find better, more cost effective ways of teaching. Using the environments that surround us is one way in which we can increase our effectiveness without increasing our costs in delivery.

Additionally, we have to become more adept at using all of the resources available to us. Particularly those resources, such as the mechanical and electrical construction industry, that are currently under-served by higher education.

Finally, greater effort needs to be made in solving similar problem in related industries by promoting partnering agreements. By combining the resources available in industry, education and management, far more is possible than if each attacked their own problems separately.

References

Alter, K.D. & Koontz, J.R. (1996). Curriculum development and continuing education in project management for the specialty subcontracting industry. *Proceedings of the 32nd Annual Conference of the Associated Schools of Construction, 37-48.*

Andersen, K.W. & Andersen, N.J. (1993).Using physical pipe models to teach construction management concepts. *Proceedings of the 29th Annual Conference of the Associated Schools of Construction, 1-5.*

Egger, H.S., Varzavand, S., & Shofoluwe, M. (1992). Survey of the physical facilities for an accredited ACCE construction education program. *Proceedings of the 27th Annual Conference of the Associated Schools of Construction, 59-64.*

Felder, Richard (1996, December). Matters of Style, *American Society for Engineering Education Prism*, 18-27.

Johnston, Hal. (1990). The industry and the universities: Partners for better construction education. *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, 59-65.*

Kirk, W. Max & Mulligan, Don (1996). Teaching right brain thinking in a construction curriculum, *Proceedings of the 32nd Annual Conference of the Associated Schools of Construction, 1-9.*

Koehler, D.J. & Easley, S.C. (1988). Using a building systems approach to construction materials and methods courses. *Proceedings of the 24th Annual Conference of the Associated Schools of Construction, 51-53.*

Lew, J.J. & Achor, D.P. (1994). Developing a curriculum foe electrical building construction and contracting. *Proceedings of the 30th Annual Conference of the Associated Schools of Construction, 61-74.*

Mouton, J. & Johnston, H. (1989). Construction subcontracting as an educational topic. *Proceedings of the 25th Annual Conference of the Associated Schools of Construction*, 87-94.

Payne, R. (1997, January). Communication Conduit. *American Society for Engineering Education Prism*, 16-17.

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 199-212

1522-8150/98/$3.00/Educational Research Manuscript

The Perceptions of Construction Students Regarding the Ethics of the Construction Industry

Barbara J. Jackson and John D. Murphy, Jr.
Colorado State University
Fort Collins, Colorado

This study replicates work done by Dr. Barbara Cole at the University of Memphis regarding the "ethics of business students and of business practitioners regarding business ethics," (1993). The purpose of this study was to assess the perceptions of construction students regarding the ethics of the construction industry. A questionnaire was administered to 285 college construction students from six universities, one from each of the six ASC regions. The study focused on the responses of college senior construction students to a series of basic ethical situations. Students were first asked to answer, as they believe the typical construction person would respond and, second, to answer as they believe the ethical response would be. The results indicate that the students perceived a significant difference between the "ethical" response made to the basic situations, and the "typical construction person's response" to the basic situations. The effects of demographic variables including gender, age, grade-point average, family in construction, ethics courses required, and number of ethics courses taken were also analyzed. All demographic variables analyzed had an impact on students' responses with the exception of grade-point average.

Key Words: Ethics, Ethical Standards, Student Perceptions, Ethical Behavior, Construction Ethics

Introduction

Two hundred years ago, Benjamin Franklin insisted that business is the pursuit of virtue. The founding fathers of this country were not saints, they were businessmen. Franklin insisted that business is a way of life that is, at its very foundation, ethical. After all, what is more central to business than the honoring of contracts, or paying ones debts on time, or coming to mutual agreements about what is fair exchange? "Ethics are not superimposed on business. Business is itself an ethics, defined by ethics, made possible by ethics," (Solomon, 1994).

Do the business and ethics perceptions of Benjamin Franklin and Solomon hold even a tread of resemblance to perceptions held today? Or do the concerns of Kidder (1997), who suggests that we are raising an entire generation of people without their own built-in sense of ethics, hold more validity in today's fast paced, high pressure, high technology society.

We may only need to look to current headlines to gain insight into this matter. According to USA Today (1997), a major study, based in Bryn Maer, Pennsylvania, found that ethical and legal lapses are common at all levels of the American workforce. Nearly half, 48 percent, of U.S. workers admit to taking unethical or illegal actions in the past year. The Ethics Officer Association and the American Society of Chartered Life Underwriters & Chartered Financial

Consultants sponsored the survey of 1324 randomly selected workers, managers, and executives in multiple industries, including construction.

The study revealed that 56 percent of workers feel some pressure to act unethically or illegally on the job. And the problem seems to be getting worse. The same study found that more than 60 percent of workers feel more pressure than 5 years ago and 40 percent feel greater pressure than a year ago. Despite more than two decades of intense media scrutiny, public pressure, academic research and corporate ethics programs designed to teach values and integrity, the business world seems unable to curb unethical behavior or improve its own image (Greengard, 1997). Combine this pressure with a workforce full of ethical confusion, mixed messages, razor-thin profit margins, and cutthroat competition and it is not difficult to see why the problem seems so prevalent.

The construction industry is by no means immune from this national trend in ethical erosion. Given the current environment, should we as construction professionals and educators, expect any different behavior from our students once they enter the workforce? Where do our students stand regarding ethics? And how do these students perceive the ethical behavior of the construction industry itself? And finally, what factors impact these perceptions? This study attempts to answer these questions.

Methodology

Participants

A questionnaire was administered to construction students at six universities across the continental United States. One school from each of the six Regions of the Associated Schools of Construction was selected. The schools were selected from the 1995-1996 Associated Schools of Construction membership directory. To limit curriculum content variances, only schools with ACCE accredited baccalaureate construction programs were considered. The six schools surveyed included:

Region 1: Northeast - Virginia Polytechnic Institute
Region 2: Southeast - Auburn University
Region 3: Great Lakes - Purdue University
Region 4: North Central - Colorado State University
Region 5: Southwest - Texas A&M University
Region 6: Far West - California Polytechnic State University

The sample of students consisted of university senior construction majors. A total of 340 questionnaires were sent to faculty at the six universities. The faculty at each of the schools was asked to administer the questionnaires to their senior construction students.

Instrumentation

The instrument utilized in this study was first developed by Froelich and Kottke, (1991) to assess an individual's perceptions of appropriate and inappropriate ethical behavior and to identify personal ethical beliefs that could conflict with company interests. The original survey consisted of 21 items representing basic ethical situations, which may encountered in a business/organizational setting. Through extensive validation analysis, 11 of the original 21 items were eliminated. Chronbach's alpha (internal-consistency estimate) for the revised 10-item scale was 0.89. This study, like the Cole study (1993), utilized the 10 validated items of the Froelich and Kottke measurement scale (see Appendix A).

The participants were asked to respond to each of the 10 items using a Likert scale with six response options. Values of 1 to 6 were assigned to the responses from strongly agree to strongly disagree. The higher the response to the item, the stronger the <u>disagreement</u> with the statement, therefore, the higher the ethical response. The options of "not sure" or "undecided" were not used.

The students were asked to respond to each item twice. They were first asked to respond as they thought the "typical construction person" would respond. Then they were asked to respond, as they believed the "ethical" response would be. For the purposes of this study, students were instructed to assume the "typical construction person" to be an individual with at least 5 years of construction experience in either a management or field position. The term "ethical response" refers to behavior that is not only legal but also honest, honorable, fair, responsible, socially acceptable, etc.

As in the Cole study, students were not asked how they themselves would respond to the ethical situations. It was believed that more honest responses would be obtained by asking what the *standard* should be and then how well *others* met the standard. A person's answers in the "ethical" response category should give a good indication of that person's ethical standards regarding the situations presented in the survey (Cole & Smith, 1996).

Each questionnaire included a demographic information section in addition to the Froelich and Kottke (1991) measurement scale. The demographic information collected on each student included gender, self-reported GPA, age, construction experience, immediate family being involved in construction, whether ethics was a required course, and the number of ethics courses taken.

Data Analysis

Data collected was analyzed using the Statistical Package for Social Sciences (SPSS). The data were first analyzed for homogeneity of variance and found to be significantly lacking in homogeneity between "typical" and "ethical" responses. Therefore, non-parametric tests were chosen for data analysis.

To test for differences at the .05 level of significance between "typical" and "ethical" responses of students, the Wilcoxin Matched-Pairs Signed Ranks test was used. This test was selected because the study employs two related samples ("typical" responses and "ethical" responses made by the same person).

To test for relationships at the .05 level of significance between students' perceptions of ethics and the demographic variables, the Kruskal-Wallis one-way analysis of variance was used. The Kruskal-Wallis test was selected because the data are from independent samples (categories) that can be ranked in a continuous distribution. On variables with more than two categories for which significant relationships were found, Mann-Whitney tests were run as the follow-up tests.

Results

Response Rates

Each of the six schools surveyed returned questionnaires. Of the 340 questionnaires sent out, a total of 285 useable questionnaires were returned, or just under 84 percent.

Student Profile

Demographic characteristics of the student sample are presented in Table 1. Of the 285 student respondents the ratio of male students to female students was almost 10 to 1, and the majority of the students were between the ages of 18 and 25. Self-reported grade-point averages indicated that slightly less than half the students reporting had a GPA of 3.00 or above.

Of the 285 students surveyed, approximately 4 out of 10 students indicated that they did have immediate family (mother, father, sister, brother) involved in the construction business, and over 65 percent had over 1.5 years of construction experience themselves. Only 10 percent of the students indicated having no experience in the construction industry.

Almost seventy-five percent of the students who responded reported that ethics was not a required course in their construction programs, and yet seventy-five percent had taken at least one course where ethics was a major topic covered. Almost twenty percent of the students responding had taken 3 or more courses where ethics was a major topic covered.

It should also be noted that of the 285 students surveyed, 97 percent consider ethics to be an important issue in construction, and 83 percent said that they would probably find it easy to fit into the ethical environment of the industry. Furthermore, over 93 percent believe that they have become more aware of the ethical aspects of construction business decision-making as a result of their college education, and 83 percent think that ethics is adequately taught in their construction programs.

The "Ethical Standards" of Construction Students

As previously stated, students were not asked how they themselves would respond to any of the 10 scenarios given. However, the students were asked what the *ethical standard* should be. Therefore, how a student answers in the "ethical" response category to each of the 10 questions should give a good indication of that student's ethical standards, whether they would actually act in accordance with that standard or not. The results of this study clearly indicate that construction students know what *should* be done in the presented situations. A mean of 6.0 indicated the strongest possible disagreement with the statements and thus the highest ethical standard. The construction students surveyed had an average mean score of 5.2 on the "ethical" response to the 10 questions (see Table 2).

Students' Perceptions of the Difference between "Typical" and "Ethical" Behavior

This study also provides strong evidence that students believe that ethical behavior is not what it should be in the construction industry. In other words, the students perceive a significant difference between the "typical" response of construction people to the given situations, and the "ethical" response to the same situations. On each of the 10 questions, significantly more students scored higher on the "ethical" response than scored higher on the "typical" response (see Table 3). For example, nearly 90 percent of the students ranked the "ethical" response higher than the "typical" response to Statement 2 (necessary for company to engage in shady practices because the competition is doing so).

Table 1

Demographic Characteristics of Students

Category	**n**	**Percentage**
Gender		
Male	250	87.7
Female	35	12.3
Age		
18–25	248	87.0
Over 25	37	13.0
GPA (Self-Reported)		
3.00 and over	127	44.6
Under 3.00	157	55.1
Unreported	1	.4
Immediate Family in Construction		
Yes	110	38.6
No	171	60.0
Unreported	4	1.4
Years of Experience		
1 year or under	96	33.7
1.50-5.00 Years	136	47.7
Over 5 years	46	16.1
Unreported	7	2.5
Ethics Is a Required Course		
Yes	73	25.6
No	211	74.0
Unreported	1	.4
Ethics Courses Taken		
No courses	72	24.0
1 Course	84	28.0
2 Courses	83	27.7
3 Courses or more	59	19.7
Unreported	2	.7

Table 2

Comparison of the "ethical" response and "typical" response of students

Question	Mean Ratings	
	Ethical Response	Typical Response
supervisor asking employee to support someone else's incorrect viewpoint	5.15	3.78
necessary for company to engage in shady practices because the competition is doing so	5.30	3.27
overlook someone else's wrongdoing if in best interest of company	4.95	3.16
supervisor should not care how results are achieved as long as desired outcome occurs	4.89	3.13
supervisor asking employee to falsify document	5.71	4.56
profits should be given priority over product safety	5.58	4.18
lie to customer/client to protect company	5.11	3.35
lie to co-worker to protect company	5.15	3.55
lie to supervisor/manager to protect company	5.28	3.85
lie to another company's representative to protect company	5.01	3.32
Average	5.21	3.60

Note: A mean of 6.0 would represent the strongest possible disagreement with the statement, and the highest ethical response.

Table 3

Relationships between "Ethical" and "Typical" Responses according to Number of Student Respondents

Question	**Ethical > Typical**		**Ethical < Typical**		**Ethical = Typical**		**Z**	**2-Tailed P**
	f	**%**	**f**	**%**	**f**	**%**		
supervisor asking employee to support someone else's incorrect viewpoint	213	75.3	8	2.8	62	21.9	-12.129	.000*
necessary for company to engage in shady practices because the competition is doing so	255	89.5	2	0.7	28	9.8	-13.795	.000*
overlook someone else's wrongdoing if in best interest of company	235	82.7	4	1.4	45	15.8	-13.320	.000*
supervisor should not care how results are achieved as long as desired outcome occurs	235	83.3	2	0.7	45	15.9	-13.347	.000*
supervisor asking employee to falsify document	203	71.5	3	1.0	78	24.5	-12.372	.000*
profits should be given priority over product safety	203	72.0	2	0.7	77	27.3	-12.400	.000*
lie to customer/client to protect company	233	82.9	1	0.4	47	16.7	-13.395	.000*
lie to co-worker to protect company	231	81.0	1	0.4	53	18.6	-13.258	.000*
lie to supervisor/ manager to protect company	208	73.2	5	1.8	71	25.0	-12.487	.000*
lie to another company's representative to protect company	222	77.9	1	0.4	62	21.7	-13.048	.000*

*Significance at the .05 level

Although some might consider students to be somewhat naive when it comes to answering the "typical" construction person's response to each of the situations, it should be kept in mind that a large majority of the students surveyed (over 65 percent) already had over 1.5 years of experience working in construction. Therefore, the fact that significantly more students scored higher on the "ethical" response than scored higher on the "typical" response to all 10 questions is somewhat disturbing. This is particularly true when you consider the context, in which some of the questions could play out in the construction industry (i.e. falsifying a document, profits over safety, shady practices, etc.)

Demographic Factors

Among student demographics, all factors measured, with the exception of grade-point average, had a significant impact on student responses to several of the questions.

Gender

As Table 4 indicates, the mean ranks of female students were significantly higher than those of male students on the "ethical" response to 4 of the 10 questions (1- asking employee to support incorrect viewpoint, 3- overlook wrongdoing if in best interest of company, 4- not care how results are achieved, and 9- lie to supervisor to protect company). Female students also scored higher on the "typical" response to question 1. It should be noted in this case as well as in all the ones that follow, that the higher the score, the stronger the level of disagreement with the statement and, thus, the more "ethical" the response to the statement. This finding supports the research of Budner (1987) and McBride and Cline (1990) that found male students significantly more accepting of questionable practices than female students. However, one could question the reliability of such a finding when the sample size of women to men is somewhat small (35 female students to 250 male students). However, because this ratio of women to men among construction students is relatively close to the ratios that exist in the construction workforce, appropriate consideration of the results might be prudent.

Age of Students

The results of this study reveal that younger students hold a more idealistic view of the "ethical" behavior associated with 3 of the 10 questions. Students 18-25 scored significantly higher (stronger disagreement to the statements) than did students over the age of 25, to the "ethical" responses to question 5 (supervisor asking employee to falsify a document), question 7 (lie to customer/client to protect company), and question 10 (lie to another company's representative to protect company).

This result may simply indicate a naiveté on the part of the younger students. It may also indicate that as awareness and familiarity with the construction industry increases, "ethical" response decreases. This may be a reflection of the "everybody's doing it" syndrome prevalent in the industry.

Years of Experience

Those students with one year or less of experience in construction scored higher to the "ethical" response to 4 of the 10 questions, (4- not care how results are achieved, 5-asking employee to falsify document, 6- profits over safety, and 10- lie to another company's representative). This finding may be related to age of students where younger students (presumed less experienced) score higher than older (more experienced) students, suggesting a more unrealistic view of the construction industry. In this situation, multiple regression analysis might be an appropriate approach in future studies.

Table 4

Comparison of the "Ethical" Responses of Male and Female Students

Question	**Mean Ratings**		**Corrected for Ties**	
	Males	**Females**	**Chi-Square**	**Significance**
supervisor asking employee to support someone else's incorrect viewpoint	5.10	5.57	6.644	.010*
necessary for company to engage in shady practices because the competition is doing so	5.26	5.60	2.884	.089
overlook someone else' wrongdoing if in best interest of company	4.91	5.26	3.777	.052*
supervisor should not care how results are achieved as long as desired outcome occurs	4.83	5.26	5.878	.015*
supervisor asking employee to falsify document	5.68	5.89	3.124	.077
profits should be given priority over product safety	5.55	5.77	2.183	.140
lie to customer/ client to protect company	5.08	5.31	1.116	.291
lie to co-worker to protect company	5.11	5.40	3.291	.070
lie to supervisor/ manager to protect company	5.24	5.57	5.037	.025*
lie to another company's representative to protect company	4.98	5.20	1.585	.208
Average Mean Rating	5.17	5.48		

*Significant at the .05 level
Note: A mean of 6.0 would represent the strongest possible disagreement with the statement, and the highest ethical response.

Immediate Family in Construction

The one question where the involvement of a student's family significantly influenced the "ethical" response was question 2 (necessary for company to engage in shady practices because the competition is doing so.) Those students whose families were involved in construction scored significantly higher (p =.006, stronger disagreement) than those students whose family was not involved in construction. This particular situation suggests questionable behavior with potentially legal consequences. It appears that a student's family being involved in construction strongly influences their "ethical" response to this question. Among family members involved in construction there may be discussion related to where one draws the line in regard to acceptable behavior.

Ethics Courses Required and Ethics Courses Taken

Whether ethics courses was required in the student's program or not seemed to have little bearing on the responses. Only the "typical" response to question 7 (lie to customer/ client to protect company) was affected. Students with ethics courses required scored significantly higher (p =.030) than did students with no ethics courses required. No differences were found among the "ethical" responses.

However, in regard to the number of ethics courses taken, the result was somewhat unexpected. One would think that the "ethical" score would go up as the number of ethics courses went up. However, when it came to question 5 (supervisor asking employee to falsify document), those students taking no ethics courses or only one course where ethics was a major topic, scored significantly higher than those students having 2, or 3 or more courses where ethics was the major topic. There are those who would argue that somehow the "water gets muddy" the more ethics is discussed. However, the situation in question 5 is not really a gray area.

It is unclear as to why the "ethical" response to this question would go down as the number of courses discussing ethics goes up. This finding may relate to the concerns of such people as Frank, Gilovich, & Regan (1993), Kumar (1991), Peters (1989), and Wolfe (1993) who fear that the typical business curriculum may lead students away from rather than toward strong ethical values. The conclusions of these authors suggest that the problem may not lie with the ethics courses but with the rest of the business curriculum that stresses profit and performance with an "end justifies the means" focus (Cole, 1993). It may be wise to consider the bigger messages regarding ethics being delivered in construction classrooms as well.

Implications and Recommendations

Ethics has never been a clear-cut issue in the business environment or in the classroom. There have been many attempts in the last two decades to curb ethical transgressions. The number of firms with ethics training programs has increased from 7 percent to 40 percent in 1994. Companies with ethics codes have swelled from 13 percent to 73 percent during the same period (Greenwald, 1997). Ethics can not be mandated by training programs, codes, corporations, or by institutions. Ethics is a personal issue.

Because individuals make decisions and are the ones to take actions, it is individuals who will make a difference in the ethical environments of our corporations. Individuals are the ones who must be grounded in ethics. As teachers and professors we have an opportunity to influence individuals.

In an attempt to close the gap between typical and ethical behavior clearly reflected by this study, construction programs need to take a proactive approach to ethics education. By addressing the “real” concerns of the industry and discussing the implications of certain ethical behaviors to all parties involved and to the industry as a whole, educators may influence the next generation of construction managers and executives. Ethics and principles should be integrated into every aspect of the construction management process as a natural thought process. In other words, ethics should be involved in the decision making process automatically and shown to be an issue of personal and professional accountability. The emphasis in instruction should be on developing individual ethical thinking processes rather than on presenting answers to ethical issues or listing rules for behavior.

An example of this approach might be a new course currently being taught by the author. The new course, required of all freshmen students within the author's Construction Management department, involves team building and principle centered leadership, with a heavy dose of ethics. The course focuses on *individual accountability* and after only one semester appears to be having an impact on students' understanding of individual principles and ethics as they relate to success in business and the concept of team. As one student stated, "The most important thing I learned from taking this class is to sit down and look at my own personal code of ethics. I think I always knew what they were, but this class really made me think about them and put them into perspective." Another student shared "that ethics and principles still have a place in the business world and if utilized can lead to personal and corporate success." There appears to be a real hunger and appreciation for such instruction among those students who have participated in the new course.

Construction programs and individual faculty should concern themselves with the messages being delivered in the classroom regarding ethics and how they relate to the construction industry. A conscientiousness regarding the messages being delivered in the classroom is important if education is to have an impact on the ethical environment of the construction industry. Undoubtedly, professors do communicate their own ethical views, whether intentionally or inadvertently, and they influence the perceptions of students.

If construction companies are interested in closing the gap that this study indicates exists between ethical and typical behavior then they need to make known their concerns about the issue. Construction companies and their trade associations need to increase their efforts to make aware and promote ethical conduct and decision-making at all levels. Top executives need to set standards and model ethical behavior for their companies, and encourage open communication and discussion regarding ethical concerns. A real effort must be made by the construction leadership to clarify the ethical parameters within which all parties associated with the construction project are to operate.

Conclusion

This study is but a first look into a very important topic previously not addressed in construction. Although the 10 questions used in this study create a baseline for ethical measurement, further research should be done using questions specifically related to construction (bidding and estimating procedures, quality of work, adherence to specifications, etc.). An industry that so heavily depends on teamwork, the cooperation of numerous entities (municipalities, manufacturers, suppliers, trades people, professionals, craftsmen), and the management of billions of dollars, can not and should not take the issue of ethics lightly.

The temptation to become apathetic or disillusioned by the results of this study regarding the state of the “ethical environment” associated with construction should be countered by the possibility for groundbreaking research and application in education and industry. There is much work to be done, but work that can only result in good things for all involved.

A follow up study including the assessment of construction practitioners is being conducted and the results should be available in spring 1999.

References

Budner, H.R. (1987). Ethical orientation of marketing students. *The Delta Pi Epsilon Journal, 29*(3), 91-99.

Cole, B.C. (1993). *Perceptions of college business students and of experienced business practitioners regarding the ethics of business people*. Unpublished doctoral dissertation, Memphis State University, Tennessee.

Cole, B.C. & Smith, D.L. (1996). Perceptions of business ethics: Students vs. business people. *Journal of Business Ethics, 15*, 889-896.

Frank, R.H., Gilovich, T., & Regan, D.T. (1993) Does studying economics prohibit cooperation? *Journal of Economic Perspectives, 7*(2), 159 – 171.

Froelich, K.S., & Kottke, J.L. (1991), Measuring individual beliefs about organizational ethics. *Educational and Psychological Measurement, 51*(2), 377-383.

Greengard, S., (1997, October), Cheating and stealing. *Workforce*, pp. 46-53.

Jones, D. (1997, April 4-6), Doing the wrong thing: 48% of workers admit to unethical or illegal acts. *USA Today*, pp. 1A-2A.

Kidder, R.M., & Lloyd, B. (1997), Ethics for the new millennium. *Leadership and Organizational Development Journal. 18* (3), 145-148.

Kumar, K., Borycki, C., Nonis, S.A., & Yauger, C. (1991). The strategic decision framework: Effect on students’ business ethics. *Journal of Education for Business. 67*(2), pp. 74-79.

McBride, M.H., & Cline, C.G. (1990). *To be or not to be ethical. That’s the question for advertising students and practitioners.* (Report No. CS 507 243). Minneapolis, MN: Association for Education in Journalism and Mass Communication. (ERIC Document Reproduction Service No. ED 322 555)

Peters, T. (1989, September 19). 15 observations to consider on the issue of ethics. *Seattle Post-Intelligence*, p. B5.

Solomon, R.C. (1994*). The New World of Business: Ethics and Free Enterprise in the Global 1990's.* Littlefield Adams.

Wolfe, A. (1993). We've had enough business ethics. *Business Horizons, 36*(3), 1-3.

Appendix A

Opinion Survey on Ethics in Construction

Please respond to the following statements in two ways. In the first column, indicate how you believe the typical construction person would respond to the statement; in the second column, indicate what you believe the ethical response to the statement would be.

For the purposes of this survey, the typical construction person should be assumed to be an individual with at least 5 years of construction experience in either a management or a field position. The term ethical response refers to behavior that is not only legal but also honest, honorable, fair, responsible, socially acceptable, etc.

SA = Strongly Agree, A = Agree, MA = Mildly Agree, MD = Mildly Disagree, D = Disagree,
SD = Strongly Disagree. Please circle your selection.

	The Typical Construction Person's Response	The Ethical Response
It is okay for a supervisor to ask an employee to support someone else's incorrect viewpoint.	SA A MA MD D SD	SA A MA MD D SD
It is sometimes necessary for the company to engage in shady practices because the competition is doing so.	SA A MA MD D SD	SA A MA MD D SD
An employee should overlook someone else's wrongdoing if it is in the best interest of company.	SA A MA MD D SD	SA A MA MD D SD
A supervisor should not care how results are achieved as long as the desired outcome occurs.	SA A MA MD D SD	SA A MA MD D SD
There is nothing wrong with a supervisor asking an employee to falsify a document.	SA A MA MD D SD	SA A MA MD D SD
Profits should be given a higher priority than the safety of a product.	SA A MA MD D SD	SA A MA MD D SD
An employee may need to lie to customer/client to protect the company.	SA A MA MD D SD	SA A MA MD D SD
An employee may need to lie to co-worker to protect the company.	SA A MA MD D SD	SA A MA MD D SD
An employee may need to lie to a supervisor/manager to protect the company.	SA A MA MD D SD	SA A MA MD D SD
An employee may need to lie to another company's representative to protect the company.	SA A MA MD D SD	SA A MA MD D SD

Survey instrument adapted from "Measuring Individual Beliefs About Organizational Ethics" by K.S. Froelich and J.L. Kottke, 1991, Educational and Psychological Measurement, 51(2).

Appendix B

Student Survey

The following statements should be answered as they apply to you personally.

I believe I have become more aware of the ethical aspects of construction business decision-making as a result of my college education.	SA A MA MD D SD
I will probably find it easy to fit into the ethical environment of the construction industry.	SA A MA MD D SD
Ethics is an important issue in construction.	SA A MA MD D SD
Ethics is adequately taught in my construction curriculum.	SA A MA MD D SD

STUDENT INFORMATION

Gender:	______ Male		______ Female	
Age:	____ Under 18	____ 18-25	____ 26-35	____ Over 35
Classification:	______ Jr	______ Sr	______ Grad	______ Other
Cumulative GPA:	____ 3.00 or above	____ 2.00-2.99	____ Under 2.00	

I have immediate family (mother, father, sister, brother) who have previously, or are currently working or involved in the construction industry.			Yes	No
I have experience working in the construction industry. Number of years: ____			Yes	No
Number of courses taken at the college level in which ethics was the major topic covered:	____0	____1	____2	____3 or more
Ethics is a required course in my construction program:			Yes	No

Survey instrument adapted from "Measuring Individual Beliefs About Organizational Ethics" by K.S. Froelich and J.L. Kottke, 1991, Educational and Psychological Measurement, 51(2).

Journal of Construction Education
Fall 1998, Vol. 3, No. 3, pp. 213-222

1522-8150/98/$3.00/Educational Research Manuscript

Culture Shock: Preparing Students for Globalization of the Construction Industry

Linda M. Kiisk
Colorado State University
Fort Collins, Colorado

Out of 92 students surveyed in a third year Construction Management course at Colorado State University none of the respondents answered that they had extensive exposure to international cultures in a classroom setting. In keeping with the University mission to achieve excellence in international education in all its instructional, research, and outreach programs, a construction management course was infused to implement a multidisciplinary and multicultural experience. Construction management, interior design, engineering and landscape students were combined into teams with international students and other members of the international community. These teams were challenged to propose design and construction solutions for a new residence. This paper shares the course procedure, infusion techniques and the results of a three year accumulation of course exit surveys from this course. Students and faculty involved with the course support the need for future integration of international opportunities in the classroom setting.

Key Words: Global, International, Multi-cultural, Communication Techniques, Course Infusion

Culture Shock: Preparing Students for Globalization of the Construction Industry

The current process of construction management has changed dramatically to include the development of specialists, advanced technology, and complex cultural relationships (Gould, 1997). It is becoming more imperative that faculty seek ways to prepare students for the globalization of the industry. There are three major reasons that faculty should strive to incorporate cultural awareness in course content: 1) to facilitate successful project management; 2) to prepare for the adoption of an international building code by the year 2000; and 3) to provide expertise in technical communications with an international market.

Successful construction project management depends on the ability to collaborate. Gould (1997) found that two out of four reasons for the lack of success in construction project management are misunderstanding of cultural differences and ignorance of collaborative techniques. He goes on further to state that "construction is also more of a service industry than a manufacturing or product based industry" (Gould, 1997, p. 8).

Along with the need to facilitate successful project management, an International Building Code (IBC) will be released in two years. The International Code Council (ICC) was founded in 1994 to "develop a single set of comprehensive and coordinated national codes..." (Allen, 1997, p.8). The major catalyst was international trade. To compete with regulatory standardization, the United States must present a unified front (Allen, 1997).

A third, and compelling reason for cultural infusion in the classroom setting is to provide a viable background for technology linkages between foreign countries. The National Research Foundation states that young professionals will be required to comprehend the connection between technology and culture, as well as understand foreign languages and regional differences (Mead, 1997). Construction firms are no longer limited geographically by communication systems. Project overhead has been reduced by technology transfers between distant locations (Moavezadeh, 1991).

Although the construction industry recognizes the need to adapt to a global economy, students at Colorado State University (CSU), and undoubtedly many other universities, receive limited exposure to foreign cultures in the classroom setting. Three years of careful observation of a course in architectural and construction planning, showed there to be only five international students out of a total of approximately 180 enrolled in this course--which is required by two major programs. In addition, exit survey results revealed that extensive travel to foreign countries, and exposure to visitors from foreign countries in home and work settings was virtually non existent for the majority of students.

The following paper outlines the course procedure, infusion techniques and exit survey results. Faculty involved with the project faced many unforeseen challenges. Most of the difficulties arose from communication barriers and disrespectful attitudes towards foreign practices. These experiences send a strong signal to construction educators to adapt their courses to promote cultural awareness.

Course Procedure

Students in Construction Management and Interior Design are required to take a four-credit lecture/lab course entitled "Architectural and Construction Planning". Content for the course includes: Building design concepts, project planning and working drawings applied to wood frame residential structures, and investigation of alternative building systems. In preparation for the course, students are required to have one to two semesters of construction graphics and materials and methods of construction.

Traditionally, faculty who offered the course introduces students to all phases of residential design from concept, schematics and design development to construction documentation of a house. Each student was assigned a local site and challenged to design a 1,800 square foot residence. The building program varied from instructor to instructor. The common factors between all offerings of the course were that each student was required to design a house and to come up with their own graphic solution.

In 1995, after participating in a yearlong multicultural infusion training program, the process for the course was changed. The course content and products remained the same—houses were still designed and documents were produced. Students, however, were now placed in design teams that represented a cross section of disciplines. Construction management students were required to work with interior design students, and with business, engineering and landscape students enrolled in the course as an elective.

Table 1

Comparison of Course Procedures between the Infused and Traditionally Taught Course

INFUSED	TRADITIONAL
Team-based architectural planning	Individually-based architectural planning
International clients	No Client
Design Review Presentation to Industry	Class Presentation
Structural Overlay with Environmental Systems	No Structural Overlay with Environmental Systems
Individually Prepared Set of Contract Documents with Peer Evaluation	Individually Prepared Set of Contract Documents without Peer Evaluation
Trip to Permit Office	No Trip to Permit Office

The design teams were then assigned one to two "mock" clients. The clients were provided by Colorado State University's Intensive English Program. The University offers eight weeklong programs to visitors from around the world who are preparing for university education at an American institution. For example, two Intensive English students from Japan might be assigned to a team of two to four CSU students.

Prior to the first day of class, the construction faculty member spent time with the intensive English teacher to determine the best matches for each team. For example, non-traditional aged CSU students might be paired with younger, foreign students. In certain cases, women from Saudi Arabia could not be placed on a design team with men. The day before the mock clients were introduced to the CSU teams, the Intensive English teacher provided them with background on the course and went over a list of potential questions that the design teams might ask. In addition, the international participants were encouraged to share family photographs and floor plans of traditional building construction from their country.

The CSU teams were visited by the Intensive English teacher prior to the initial client meeting. The instructor carefully went over six basic tips for interviewing foreign students/clients. These tips were developed by Elliot Skolnick, graduate instructor in the English program:

1. Warm-Up. Allow your client to get to know you before you begin to ask questions about the building. Many Americans are too quick to start business conversations before addressing the human qualities and needs of individuals. Most foreigners see this habit as extremely rude. CSU students may want to start off the conversation by asking: "How are you? How long have you been attending classes at CSU? What are you planning to study?"

2. Proximity, Touching, Staring. Each culture has its own unique comfort level with personal space. Some cultures (South American) promote close physical contact and touching, while others, (Middle Eastern), do not allow men to touch or stare at women. A gentleman from the Middle East is considered to be rude if he looks into the eyes of a woman. Many American women may find this to be uncomfortable, and disrespectful.

3. Questioning Techniques.

a. Complex questions—do not ask questions that have two parts or are extremely long.
b. And/or questions—"do you like a house out of brick or stone?" This question does not allow the interviewer to find out whether the foreign student likes only brick, only stone or both brick and stone. It is better to say "would you like your house to be built with brick?"
c. yes/no questions—some oriental cultures find it rude to say "no". And Americans may find their Japanese clients are extremely vague. Also, yes/no questions may not provide enough information.
d. open-ended questions—these are questions that have no prescribed answers. Sometimes the foreign student has a good command of English and can easily expand on an answer. Often, however, the student is unwilling to provide additional information.
e. restate don't repeat –an American typically makes the mistake of just asking the same question twice, versus trying to understand which words are not easily translated by the client. It is better to search for synonyms or watch for visual clues when a client seems to feel comfortable with the question.
f. louder is better—often when a client has difficulty understanding building terminology, the interviewer automatically asks the question more loudly. The client is usually not deaf, just unfamiliar with the wording.

4. Check for understanding. The American students may assume that their client understands scale of spaces. For example, one group was told by their Japanese client that they wanted a 20 foot long children's room. After further investigation, the client was measuring in "ping", not "feet". Fortunately, the misunderstanding was caught before documents were produced.

5. Cross-Cultural Difference. Spaces and building construction methods vary from culture to culture. Some cultures require complete visual separation for genders, others have spaces dedicated for worship in the home. Most residential construction outside the United States is masonry versus wood frame. Students interviewing clients need to carefully determine differences and advise their client.

6. Speed, Vocabulary, and Slang. A common mistake for Americans is to speak very quickly and to use slang. Describing the building "footer" can be confusing for the client. One team said that their client did not know what a fence was—so students were challenged to draw or describe the object.

The client meetings were set up to take place in the classroom for one to two hours per week for six weeks. Teams and their clients could meet at the selected site, visit model homes or go to construction sites. It was also a course requirement to share one social event with the client. Sometimes the client invited the students to a Japanese restaurant, or cooked dinner and gave a slide show about their country. In one case, a client from the United Arab Emirates was taken to a Fraternity house and served spaghetti.

Information collected by the design teams from their client was compiled with additional data from Web sites, library collections and interviews with additional international members of the community. Site conditions, zoning, codes, covenants, mechanical/ electrical/ plumbing requirements also were required to be incorporated into the design. The goal was to involve students in all aspects of a planning process as closely as possible. Project notebooks were kept by each team that recorded meeting minutes, phone conversations, project data and weekly team progress evaluations.

The sixth week of the course, design teams and their clients were required to present their solutions to a design review panel made up of practicing professionals from the Fort Collins community. Realtors, architects, engineers, and construction managers evaluated the students' proposals and offered feedback for changes. Students conducted peer evaluations of each team's presentation. Three-dimensional massing models were constructed—complete with contours and site features. A schematic design drawing set was required for submission and evaluated by the course instructor.

The remainder of the course focused on construction planning. Students spent one week making design changes and producing a structural report. Teams had to select a structural system, determine joist size and spacing, calculate structural loads and spans for bearing capacity, size girders and column spacing, indicate load bearing walls and header dimensions. Foundation and framing diagrams were produced for each level of the house. The framing diagrams were then overlaid with proposed mechanical, electrical and plumbing systems. The instructor evaluated each team's submission for accuracy and correctness.

Once the design was modified to incorporate the design review board's comments and building systems analysis, students individually drew or fabricated models of their house. Specifications and schedules were produced. Upon completion of the construction drawing set, students visited the building permit office for a tour of the facilities and were given a lecture on the permit review process. The course thereby, reflected each aspect of the architectural and construction planning process prior to start of construction. Cultural sensitivity and collaboration were integrated into the course procedure at every stage of the course.

Infusion Training and Techniques

As part of the University mission, the Provost's Office sponsors a multidisciplinary group of faculty, staff and administration in a yearlong training process. The primary objectives of the training (now in its tenth year) are to:

1. Acquire knowledge that leads to the development of sensitivity to human diversity;
2. Help address the diverse student audience;
3. Improve the depth of courses by infusing content with multicultural references;
4. Develop an annotated bibliography on diversity issues;
5. Disseminate to colleagues ways in which curriculum can be modified;
6. Evaluate the impacts derived by students and faculty from modification of the course.

Participants of the yearlong training commit to attending retreats, monthly seminars, and social events that incorporate cultural issues. Each faculty member is assigned a mentor and follow-up on course procedure is required. A course that is traditionally offered in the program curriculum is infused. The majority of faculty members introduce cultural aspects through literary sources and group activities.

The architectural and planning course highlighted in this paper however, is unique in that it involves students with real people from foreign countries. This difference holds students accountable for application of communication/collaboration techniques—since their house plans reflect a visual understanding of their client's needs. Design teams had to understand scale, placement and types of objects, as well as building materials and site conditions. A common complaint by the design teams was that their client wanted to place a high masonry wall around the property for security reasons, or that their client wanted a separate entrance for men and women. Many clients did not believe in attaching a garage. These requests highlighted tangible cultural differences.

The Results

Students enrolled in the Architectural and Planning Course were asked to complete an exit survey (instructor prepared items) following their final client meeting. The responses from 92 questionnaires submitted over the course of three years were documented. Data for three out of eight of the survey questions have been tabulated.

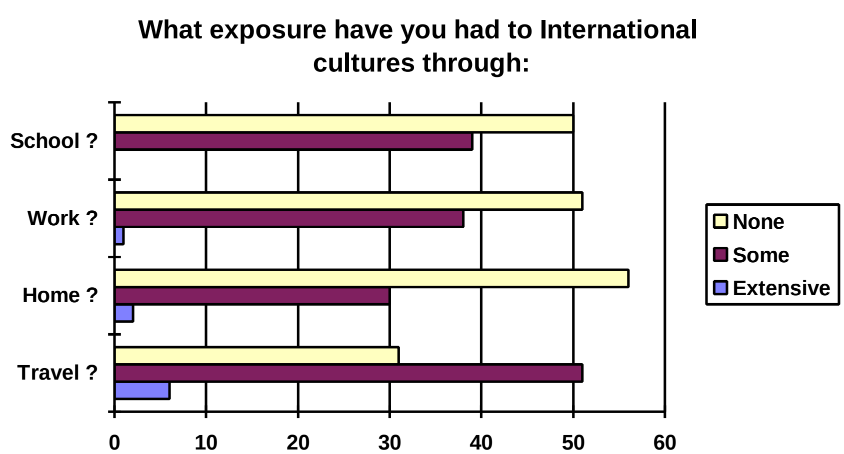


Figure 2. Number of Responses to Level of Exposure to International Cultures

1. School--Students who responded that they had *some* contact with international cultures through a school setting generally stated that "my school had a foreign exchange program", or "I took a foreign language class", or "I studied history". In no case did respondents say that they had previous experience working on class projects with international students or members of the community. Many students who marked *none* on the survey noted that the infused course was the first time that they had exposure to an international culture.

2. Work—Students who responded that they had *some* contact with international cultures through work stated "my job employed people from Mexico", or "I worked in a Mexican restaurant". Students who had *extensive* contact replied that they worked in a foreign country or that they worked for a family business run by immigrants.

3. Home—students who marked *some* on their response, stated that they hosted a foreign exchange student. Others noted that they "watched TV". Students who marked *extensive* had a parent or relative living with them from a foreign county.

4. Travel—students who marked *some* had interesting interpretations of the question. One student responded that he/she had been to "Maine". Another said that he/she went to "Florida". One wonders if the students should take a geography class or if the United States has such distinct cultures that the people in another state seem like "foreigners. Most students said "I went to Mexico (or the Caribbean) for Spring Break" or that they studied abroad over Spring Break. Students who had *extensive* travel experience generally indicated that they and their family made frequent trips abroad.

The second and third questions on the exit survey relate to the impact of the infused course on their education.

Question 2:

Do you think that there is a need for multicultural diversity training in your education?	Yes 79	No 11

Students who replied yes, stated a variety of reasons for requiring the training. One said, "yes, so we don't piss any cultures off". Another student answered "yes, because America is the melting pot and foreign cultures can be considered to make significant profit". The few students who saw no need for the training answered "I don't plan on working with foreigners", and, " No, I don't think it's relevant to dwell on other cultures, this is the United States." One student felt "it should be an option...if people don't want to learn about other cultures, you shouldn't force them."

The third question questions dealt with the success of the infusion. Students were asked:

Question 3:

Do you think that your class assignment to work with a foreign student increased your awareness of another culture?	Yes 69	No 22

One student who replied "yes", stated "It opened my eyes that there are several different styles to work with. I have been so focused on American design that I didn't realize how naive I was." Another said, "I did not know much about Saudi Arabia until I did this assignment". A third student replied, "We learned how different other cultures can be from our own, it opened my eyes." And, lastly, "I thought having foreign students really pushed us to learn communication".

Students who responded that the assignment did not increase their awareness indicated various reasons. Several did not get to know their clients. Or their client's English was poor. Or, "it was too difficult". Another student said, " My main goal is not to learn about cultures, but the building process". Or, "This is an architecture class, not a culture class".

Conclusions and Lessons Learned from the Infusion Process

Both the Construction Management faculty member and the Intensive English instructors who organized the infusion of the architectural and construction planning course were surprised by the lack of prior contacts between American and International students. The following is a list of some key findings:

1. American students need to be "required" (receive a grade) before they will initiate a contact with an international student. When the course was offered the first year of infusion, students were told to invite their international client(s) out for a social event. None of the students did this. The following years, students were required to write a one page summary about a social event with their client. The paper was collected for a grade.

2. American students need to research their client's respective culture prior to the first client meeting. Some students would come up to the faculty member after the client's country was assigned and ask where the country was located. Many students had no previous knowledge of the customs, language or religious practices of their client's country.

3. Basic rules of etiquette and communication need to be covered. When the course sections were large (over 46 students in a lab section with up to 12 international clients), team meetings with the clients were difficult to monitor by the instructors. Often the instructors found teams were discussing their plan solutions--while completely ignoring their client. Sometimes the client would show up for a meeting (with family photos and cultural information) and none of the design team students showed up for class. (Attendance was required and graded.) In a severe case, two Japanese women shunned a construction management student, because they felt he was rudely commenting about their need for a religious figure to be placed in a space. The women would come to the client meeting and turn their back on the American—as if he did not exist. Fortunately, the Intensive English teacher pointed out the situation and the design team met in private with the construction faculty member and the problem was solved.

4. Encourage American students to apply interview techniques. Some students found that their communication skills with a foreign student were not strong enough to overcome cultural boundaries. This inability to creatively collect information from their client greatly impacted the design team's solution. Other teams greatly enriched the communication process by bringing in photographs of similar projects, magazines of American or international designs. Many students sketched out definitions to difficult words and construction concepts.

5. Follow-up/closure of the event should be required. The international students find that this class assignment is the highlight of their contact with the University. Many have been touched by the efforts made on their behalf by the American students. Some of the international students cried during their presentation, because they had never felt so appreciated in the United States. Most of the design teams presented professionally bound copies of the house solution to their client on the last day of class.

Table 2

Comparison Between the Advantages and Disadvantages of an Infused Course

ADVANTAGES	**DISADVANTAGES**
American students have a "real life" experience with international students	Course preparation and coordination is too time consuming. Faculty members spend a great deal of time inviting guests, setting up final field trip, and coordinating student teams with the Intensive English Program instructors.
The Interview techniques presented at the beginning of the course provide students with tools for communication.	Method of evaluation. Team projects often do not reflect the quality of individual effort. (note: by the third year, grades were based on an *average* between individual grades for quizzes and exams and combined with team scores. Also, peer reviews were implemented.)
Students have a basis for comparison between their lifestyle and that of another culture.	Team assignments are important for a successful outcome. Some teams were poorly matched by personality, discipline, ability and compatibility with the client.
Creation of a product allows for immediate feedback as to the success of the communication.	Lack of education in team problem solving skills led to poor time management and communication. Lack of written communication skills or verbal skills also affected the quality of the project solution.
Students are introduced to construction materials and styles utilized in other countries. Including methods of measurement.	Students may have difficulty making decisions as to whether they should follow covenant guidelines or their client's directives.

The advantages outweigh the disadvantages if a construction program is committed to improving undergraduate education in cultural diversity of collaboration experiences. In addition, many disadvantages could be resolved by preparing students for the infusion in prerequisite courses. Overall, the infusion techniques for the architectural and construction planning were regarded as highly successful by the Intensive English Program. Faculty and international students have twice nominated the project for a university-wide award for diversity. Some American students and their clients maintain relationships outside the classroom. A few students have been invited to travel to their client's country.

Students involved with the course infusion have been prepared for globalization of the construction industry. As stated in the introduction, facilitation of successful project management "depends on the ability to collaborate". Students working in teams had the opportunity to apply and test their skills to a real life design/build project scenario. Participants that challenged themselves to study construction methods and materials utilized by their client's country prepared themselves for a competitive construction market guided by a set of international codes and system of measurement. Some students even drew their plans in metric scale. Students who participated in the infusion project also may be able to eliminate costly construction errors involving long distance communication and technology transfer. Design teams practiced communicating with their international clients via email and phone.

In conclusion, the infusion project supports the need for integration of international opportunities and collaboration in the classroom setting. Whatever the outcome however, students, clients and course facilitators are challenged to be sensitive to the needs of others, whether they are cultural differences or basic personality traits. And, as Gould (1997) reminds construction management educators "Even though large products often are constructed, a project's success is more dependent on the people involved than on a particular piece of equipment."

References

Allen, Thomas H. (October 1997). Goal 2000: One Building Code. *AIA Architect*, *4*, 8.

Dorsey, Robert W. (1992). *Evaluation of College Curricula Which Prepares Management Personnel for Construction*. Report to the Construction Industry Institute.

Gould, Frederick E. (1997). *Managing the Construction Process.* New Jersey: Prentice Hall.

Mead, Stephen P. (1997). *Skills for the 21st Century: What Constructors Need to Know.*

Unpublished Master's Thesis, Colorado State University, Fort Collins.

Moavenzadeh, Fred. (1991). Strategic Response to a Changing Engineering and Construction Market. *Construction Business Review.* 26-28.

National Research Council, (1988) *Building for Tomorrow, Global Enterprise and the U.S. Construction Industry*. Washington, DC: National Academy Press. 1-2, 66.

Author Index to Volume 3

Contributing Reviewers

Dr. Robert W Aderholdt, *Auburn University*
Mr. Kirk D. Alter, *Purdue University - BCM*
Dr. Alex Aswad, *Pennsylvania State - Harrisburg*
Dr. Flynn L. Auchey, *Virginia Polytechnic Institute & State University*
Dr. David L. Batie, *East Carolina University*
Mr. Dennis C. Bausman, *Clemson University*
Dr. Charles W. Berryman, *University of Nebraska - Lincoln*
Mr. Keith Bisharat, *California State University - Sacramento*
Dr. Richard A. Boser, *Illinois State University*
Dr. S. Paul Bunéa, *Fairleigh Dickinson University*
Dr. Rebecca C. Burleson, *Auburn University*
Mr. Jim K. Carr Jr., *The Ohio State University - Wooster*
Dr. Joseph J. Cecere, *Pennsylvania State - Harrisburg*
Mr. Travis L. Chapin, *Bowling Green State University*
Dr. Yohchia Chen, *Pennsylvania State - Harrisburg*
Dr. Jay P. Christofferson, *Brigham Young University*
Dr. Thomas E. Cooper, *Auburn University*
Mr. Gregg R. Corley, *Auburn University*
Mr. James F Goddard, *Kansas State University*
Mr. David W. Goodloe, *Clemson University*
Mr. Lin Harley, *Pennsylvania State - Harrisburg*
Mr. Paul E. Harmon, *University of Nebraska - Lincoln*
Dr. Allan J. Hauck, *Colorado State University*
Mr. Micheal F. Hein, *Auburn University*
Dr. Dana E. Hobson, *Oklahoma State University*
Dr. Joe Huber, *Indiana State University*
Dr. Toni Y. Hynds, *Texas A&M University*
Dr. Mostafa M. Khattab, *University of Nebraska - Lincoln*
Mr. Roger A. Killingsworth, *Auburn University*
Mr. Scott W. Kramer, *Auburn University*
Dr. David Lickteig, *University of Arkansas - Pine Bluff*
Mr. David A Marchman, *University of Southern Mississippi*
Mr. Richard J.L. Martin, *Georgia Institute of Technology*
Mr. Jon L. Mason, *Boise State University*
Dr. Richard E. Mayo, *Roger Williams University*
Mr. Bill W. McManus, *University of Oklahoma*
Mr. Hendrick D. Mol, *Auburn University*
Mr. John Mumford, *Clemson University*
Dr. John D. Murphy Jr., *Colorado State University*
Dr. Michael D. Nobe, *University of Nebraska - Kearney*
Mr. Albert Pedulla, *Texas A&M University*
Dr. Ray J. Perreault Jr., *Central Connecticut State University*
Ms. Chris Piper, *Clemson University*
Mr. Randy R Rapp, *Southern Illinois Univiversity - Edwardsville*
Mr. Kenneth F. Robson, *University of Oklahoma*
Dr. Leon R. Rogers, *Brigham Young University*
Mr. Richard C Ryan, *University of Oklahoma*
Mr. Scott Seltveit, *Moorhead State University*
Dr. Bolivar A. Senior, *Colorado State University*
Dr. James C. Smith, *Texas A&M University*

Acknowledgement

The Editor wishes to thank the Department of Construction Science and the College of Architecture of Texas A&M University for their support of the *Journal* creation and operations. Thanks are also due to the Editorial Advisory Board whose names appear on the second page; and to those serving on the Review Board listed above.

Membership Applications

Inquiries should be send to: Associated Schools of Construction, Hendrick D. Mol., Executive Director, Building Science Department, 119 Dudley Hall, Auburn University, Auburn, AL 36849-5315, Tel: 334.844.4518, E-mail: molhend@mail.auburn.edu

Organizations eligible for membership may fill out one of the application forms at: (http://ascweb.org). Please read the following membership grouping information, pick or enter the hyperlink into your web browser for the type of membership that fits your organization and submit the completed form.

- Institutional Members: shall be those institutions having at least one baccalaureate or higher degree construction program. Annual member dues are $400.00.
- Associate Members: shall be institutions of higher education, including junior and community colleges, not meeting institutional member requirements (two year programs). Annual member dues are $250.00.
- Industrial Members: shall be industrial organizations demonstrating a constructive interest in construction education. Annual member dues are $400.00 base membership or $650, which includes $250 for advertising industry, positions on the ASC web site. This service (http://ascweb.org/internet/positions/industry/main.asp) includes full-time, part-time, summer internship, and co-op program listings.