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The *Journal of Construction Education* (ISSN 1522 8150) was founded in 1996 by the Associated Schools of Construction, an association of 105 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.

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Editorial
Annual *Journal* Entries

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Provo, Utah

This is the eighth year of the *Journal's* publication. The following report provides information regarding the number of manuscripts received by the editors during the year 2003 and the number of manuscripts accepted for publication. In addition, data is provided indicating the number of manuscripts published as compared to the number of manuscripts received during the last six years of publication.

Vital Statistics

Number of manuscripts accepted vs. rejection. During the past year, twenty-six manuscripts were submitted to the *Journal* for consideration. Two of these were withdrawn by their respective authors before they were reviewed. Twelve of the manuscripts were accepted and published. The other twelve were rejected as not being acceptable for publication. This provides the Journal with a fifty percent rejection rate for the 2003 calendar year.

Figure 1 shows the number of papers submitted to the *Journal* for each year of the *Journal's* publication. Also shown for each year are the numbers of manuscripts that have been accepted for publication and the numbers of manuscripts that have been rejected.

Figure 2 shows the rejection rates for the years 1998 through 2003. The years 1996 and 1997 were not included in this analysis because there were so few manuscripts submitted. As noted, the average rejection rate for the *Journal* through the six-year period is 39.84 percent.

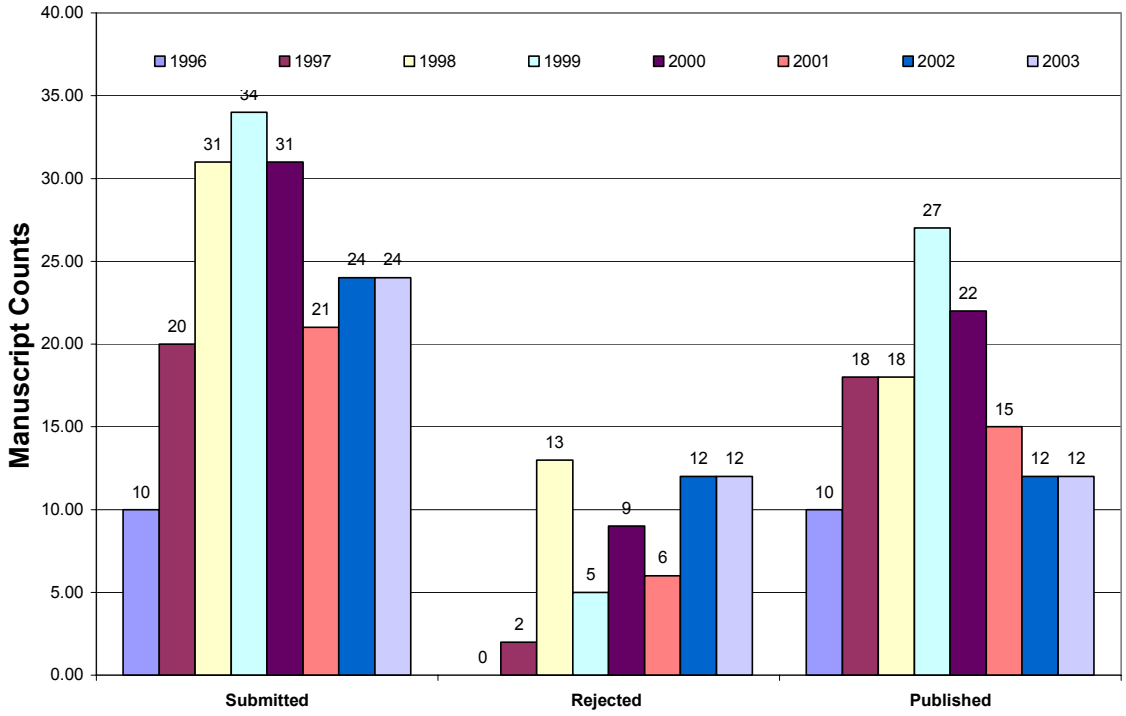

Figure 1: Publication and Submission Data

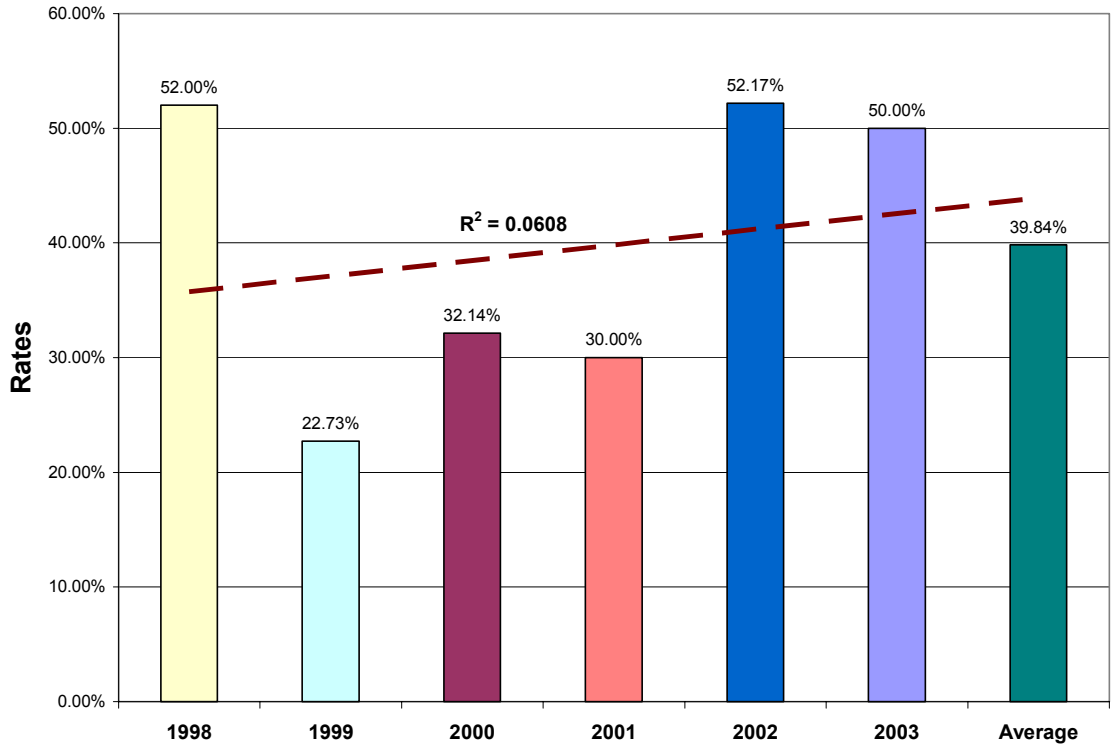

Figure 2: Rejection Rates Data

Evaluation of Teacher-Student Learning Style Disparity in Construction Management Education

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This paper presents results of a research study designed to evaluate the teacher-learning style disparity at Michigan State University's Construction Management Program. The Felder-Solomon Index of Learning Styles (ILS) questionnaire was administered to 5 instructors and 277 students (81 freshman, 71 sophomores, 56 juniors, 63 seniors, and 6 graduate students). The study also investigated the relation between a student's preferred learning style and associated preferred mode of instruction. The results of the study reveal that students preferred the active, sensing, visual, and sequential learning styles. The results also showed that the average disparity in teacher-student learning styles was not significant. Both instructors and students had strong preference to the visual learning style. Empirical evidence is presented suggesting that, irrespective of the preferred learning style, students predominantly preferred active learning as the primary mode of teaching. It was also found that compared to the magnitude of learning style disparity, the primary teaching mode adopted by the instructor had more effect on motivating and helping students learn. This suggests that instructors should solicit input from students on their preferred mode of teaching and work together to achieve it using active learning paradigms.

Key Words: Learning Styles, Construction Education, Active Learning, Instructional Design

Introduction

According to Bloom's cognitive and affective taxonomies, learning begins with the reception of information (Anderson et al. 2000). The instructor's ability to provide a learning environment that will engage the students' interest is crucial to this process. In addition, a student's interest, readiness, and willingness to engage in the learning process are equally critical. Another key factor is the learning style itself of students. Sarasin (1998, pg. 3) defines a learning style as "the preference or predisposition of an individual to perceive and process information in a particular way or combination of ways". A student's predisposition to a preferred and unique learning style is an undisputed fact about how students (at any level) learn (Price 1983, Felder 1988 and Garsha 1996). This predisposition also explains learning style variation among students.

In some respect, the variation in learning style is desirable because it fuels different types of innovation and elicits a wide array of talents. However, from an educational perspective, favoring a learning mode over another potentially results in a mismatch between the learning styles of student and teacher. This mismatch or disparity is frustrating to the student whose learning style is not compatible with that of the teacher. Teaching under such circumstances, and they are almost guaranteed to occur, calls on a teacher to "cater" to all learning modes (Felder and Silverman 1988). This is termed in the literature as teaching "around the cycle" (Kolb 1984).

In the teaching research literature, the topic of learning style variation among students receives ample discussion (Kolb 1984, Schmeck 1988, and Lawrence 1990). The consistent message that

could be gleaned from the literature on addressing learning styles disparity is that calling on teachers to identify the learning styles among students and then design instruction to help students reach a balance in their preferred and less preferred modes of learning (Price 1983, Felder 1993, Grasha 1996, and Lyons et al. 1999).

Numerous descriptive models have been developed over the years to categorize learning styles and to help teachers identify their students' preferential style of learning (McKeachie 1980, Felder 1988, Schmeck 1988, and Tobias 1990). These models originated from different perspectives on what factors affected the learning process. For example, the famous Myers-Briggs Type Indicator considers the effect of personality and character traits on the preferred way of receiving and integrating information. The Herrmann Brain Dominance Instrument (Felder 1996) and the Kolb model (Kolb 1984) consider the cognitive processes preferred by students in acquiring and understanding information. The Reichmann's and Grasha's (see Grasha 1996) typify learners based on how a student's social interactions with peer groups – learners are independent, dependent, collaborative, competitive, participant, and avoidant. Felder (1996) gives examples of how educators have used these learning style models to successfully teach "around the circle".

The learning style models mentioned have been the basis for developing psychometric tools for evaluating the learning style of students and instructors. These tools are typically developed in the form of surveys that elicit the preferred learning style of the respondent through a series of hypothetical questions. The development of these learning style tools has lead to a plethora of research wherein the tools were used as they were intended – to assess learning styles and design instruction accordingly – or the tools were themselves subjected to validation – to establish reliability (consistent and repeatable results) and construct validity (the tool actually measures what it was intended to measure).

As reported in the literature, efforts to understand students' preferential style of learning and to design course instruction to "cater" to all learning modes have resulted in the following (Felder 1996):

- Helping students understand their preferred learning style and to formulate successful learning strategies.
- Improving performance of students with heavy reliance on one mode of learning.
- Providing a framework for instructors to redesign their course to such that they "teach around the cycle".
- Increasing collegial discussions about teaching and interest in enhancing teaching.

This paper describes results of a research project conducted at Michigan State University's Construction Management Program designed to enhance teaching delivery methods through a study of teacher-student learning style disparity. The Index of Learning Styles (ILS) model was used to determine the learning style preference of teachers and their students in the Construction Management Program at both the undergraduate and graduate levels (construction courses only). The ILS model is based on the Felder-Silverman Learning Style Model and is comprised of 44 questions (Felder 1993). The combinations of answers determine the respondent's learning style preference on four different dimensions.

The next section briefly describes the Felder-Silverman Learning Style Model and the Index of Learning Styles (ILS). This is followed by a discussion of the research design and results. The paper concludes with a synthesis of the results and inferences drawn to help guide instructors in redesigning delivery of their subject matter. Areas of future research are also discussed.

Felder-Silverman Learning Style Model

Intended for engineering and science majors, Felder and Silverman (1988) developed a learning style model based on how information is received and processed by a learner. According to Felder and Silverman, and others (McKeachie 1980, Lawrence 1990, and Lyons et al. 1999), optimum learning occurs when the reception of information is congruent with how it will be processed. And not surprisingly, each person will have a favored, and perhaps unique, processing routine or algorithm. For example, some people prefer written directions to a location while others opt for a map. The end result is the same; the final destination will be reached. However, if the communication given or received is mismatched with the favored processing routine, a person will be late to reach the final destination, if reached at all. The metaphor has significant relevance to what may happen to learning when students receive information in a manner or through a modality incongruent with their preferred processing routine.

Using Jung's theory of psychological types (Lawrence 1984), and parts of Kolb's model (Kolb 1984), Felder and Silverman (1988) suggested that a student's learning style is defined and influenced by the following five phases:

1. Information Perception: "What type of information does the student preferentially perceive: *sensory* (external)—sights, sounds, physical sensations, or *intuitive* (internal)—possibilities, insights, hunches?" (pg 675)
2. Input Modality: "Through which sensory channel is external information most effectively perceived: *visual*—pictures, diagrams, graphs, demonstrations, or *auditory* — words, sounds?" (pg 675)
3. Information Organization: "With which organization of information is the student most comfortable: *inductive*—facts and observations are given, underlying principles are inferred, or *deductive*—principles are given, consequences and applications are deduced?" (pg 675)
4. Information Processing: "How does the student prefer to process information: *actively*—through engagement in physical activity or discussion, or *reflectively*— through introspection?" (pg 675)
5. Understanding: "How does the student progress toward understanding: *sequentially*—in continual steps, or *globally*—in large jumps, holistically?" (pg 675)

The use of the 5 questions to encompass a student's learning experience may imply that the Felder and Silverman learning style model classifies learners into one of two possible categories on each of the five dimensions, i.e., the sensing/intuitive, visual/verbal, inductive/deductive, active/reflective, and sequential/global dimensions. This would of course be an oversimplification of the complex and interrelated processes that govern learning, or even

humans for that matter. Recognizing this, Felder (1993) aptly cautions against this by stating that: “The dichotomous learning style dimensions of this model (sensing/intuitive, visual/verbal, inductive/deductive, active/reflective, and sequential/global) are continua and not either/or categories. A student's preference on a given scale (e.g. for inductive or deductive presentation) may be strong, moderate, or almost nonexistent, may change with time, and may vary from one subject or learning environment to another (pg 287).”

Felder and Silverman (1988) also proposed a parallel teaching style model intended to map the instructional methods used by teachers to the corresponding learning style phases. The teaching style model is represented in the following five questions as provided in Felder and Silverman (1988, pg 675):

1. “What type of information is emphasized by the instructor: concrete— factual, or abstract—conceptual, theoretical?
2. What mode of presentation is stressed: visual—pictures, diagrams, films, demonstrations, or verbal— lectures, readings, and discussions?
3. How is the presentation organized: inductively—phenomena leading to principles, or deductively— principles leading to phenomena?
4. What mode of student participation is facilitated by the presentation: active—students talk, move, reflect, or passive—students watch and listen?
5. What type of perspective is provided on the information presented: sequential—step-by-step progression (the trees), or global—context and relevance (the forest)?”

With this teaching model, Felder and Silverman are suggesting that a student favoring the sequential learning style would respond well to an instructor who presents information in a step-by-step fashion. It also follows that a student favoring the global learning style would respond well to an instructor who presents information in a holistic (big-picture) fashion. Similarly, a student favoring the sensing learning style would respond well to an instructor who presents facts and data while a student favoring the intuitive learning style would respond well to an instructor who presents concepts and principles. The same can be inferred for the visual/verbal dimension but not the active/reflective dimension. According to Felder and Silverman (1988), both active and reflective students respond well to an active mode of instruction and not to a passive one. They state that: “Active [student participation] signifies that students do something in class beyond simply listening and watching, e.g., discussing, questioning, arguing, brainstorming, or reflecting. Active student participation thus encompasses the learning processes of active experimentation and reflective observation.”

Felder and Silverman (1988) discuss, at length, the implications of the learning and teaching style models on students’ classroom experience (see also Felder 1993 and Felder 1996). They suggested that instructors can effectively engage students in the learning process by adopting a multi-style approach in instruction such that no one dimension of learning and teaching is favored. Recommendations to achieve this seemingly overwhelming feat were in harmony with those made by advocates of active, collaborative, and cooperative learning (McKeachie 1980, Johnson et al. 1991, Wankat & Oreovicz 1993, Smith & Waller 1997, and Wankat et al. 2002).

To facilitate the practical utilization of the Felder and Silverman learning style model, Felder and Solomon (2001) developed a psychometric evaluation tool known as the Index of Learning Styles (ILS). The ILS is a survey-based self-scoring instrument that assesses preferences on four out of the five learning style model dimensions, namely, the Sensing/Intuitive, Visual/Verbal, Active/Reflective, and Sequential/Global dimensions. The ILS is available as both a web-based and pencil-and-paper version (http://www.ncsu.edu/felder-public/ILSpage.html).

Examples of the ILS survey questions and the dimension they measure are as follows (Felder and Solomon 2001):

- I understand something better after I: (a) try it out; (b) think it through.

This and other similar questions (a total of 11) measure the preference of the respondent on the Active/Reflective dimension of learning. Active learners learn best by doing something with information, explaining it to others while working in groups. Their attitude towards learning is "Let's try it out and see how it works". Reflective learners prefer to work alone and think quietly about presented information. Approaching learning with a "Let's think it through first" mindset is typical for reflective learners.

- I find it easier to: (a) learn facts; (b)learn concepts.

This and 10 other similar questions measure the preference of the respondent on the Sensing/Intuitive dimension of learning. Sensing learners find it easier to learn and retain facts. They prefer structured methodical solutions, which appeals to their detail-oriented nature. They are also better at working with their hands (manipulating instruments and running experiments) and appreciate courses with a real-world connection. Intuitive learners prefer to discover underlying principles and to think of what could be. They are better at grasping new and abstract concepts, and are comfortable with mathematical formulations. Intuitive learners dislike repetition and loath 'plug-and-chug' problems.

- When I think about what I did yesterday, I am most likely to get: (a) a picture; (b) words.

This line of questions (11 in total) captures the preference of the respondent on the Visual/Verbal dimension of learning. Visual learners recall and retain better what they see (e.g., pictures, charts, graphs, demonstrations, etc). Verbal learners recall and retain best what they read and hear, i.e., written and spoken explanations. Felder and Solomon (2001) state that: "Everyone learns more when information is presented both visually and verbally."

- Once I understand: (a) all the parts, I understand the whole thing; (b) the whole thing, I see how the parts fit.

These types of questions (also 11 in total) capture the preference of the respondent on the Sequential/Global dimension. Sequential learners gain understanding in linear methodical and progressive steps without necessarily understating the bigger context. On the other hand, global learners learn in a more holistic fashion and literally make leaps in their learning. Therefore, sequential learners approach and arrive at problem solutions in small methodical and incremental

steps and can articulate their approach quite well. Conversely, global learners are big-picture driven when tackling complex problems but find it difficult to clearly explain their solutions. This difference does not mean that global learners get the proverbial 'light bulb' turned on before the sequential learners. The real distinction between the two is the antecedent thinking process that leads to the 'light bulb' going on.

Results of the 44 question ILS survey are provided in four scores that correspond to each of the four dimensions being measured. A sample score is shown in Figure 1. The respondent in this case has a moderate preference for the active and sensing learning styles and is balanced on the other two dimensions, namely, the visual/verbal and sequential/global.

The ILS survey has been widely embraced by national and international engineering professors (Felder 1996, Rosati 1999, Smith et al. 2002). The survey has been translated into many foreign languages and in 2002 the website received 100,000 hits (Zywno 2003). A number of validation studies have been conducted on the ILS reliability and construct validity (Van Zwanenberg et al 2000, Livesay et al 2002, and Zywno 2003). A review of these studies is not in the scope of this paper. These studies generally conclude that the ILS is an acceptable and suitable psychometric assessment tool for learning styles of students in engineering and the sciences (Zywno 2003).

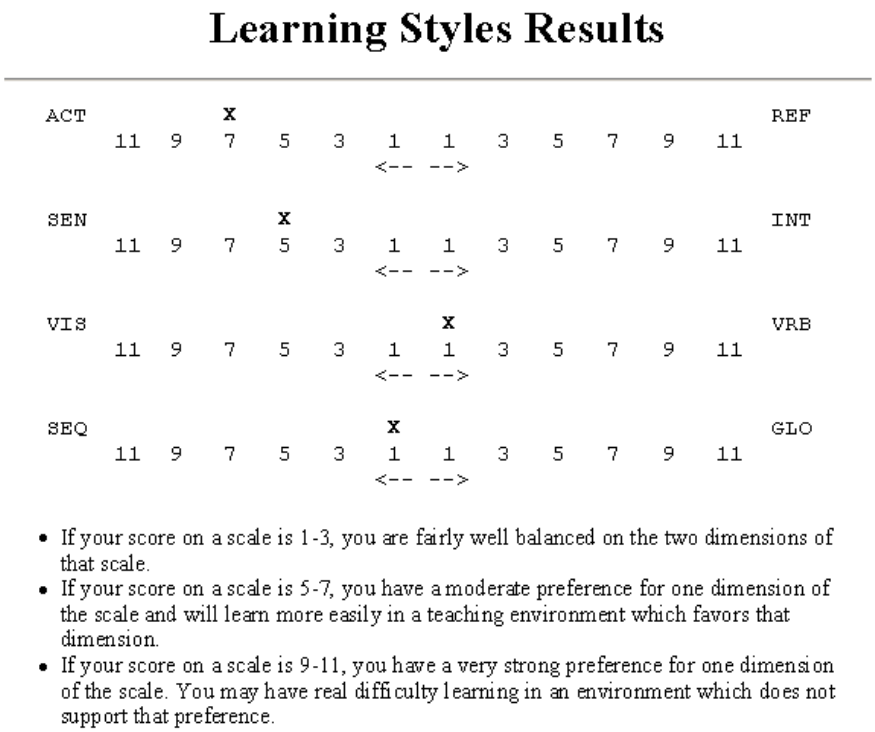

Figure 1: Sample results using the web-based ILS survey

Methods

The study was initially piloted by administering the ILS survey to 7 students and their instructor (the class level is withheld to protect the anonymity of the instructor). The results of the survey

are aggregated as shown in Figure 2. The students shown in Figure 2 are clearly predominantly visual and sensing and equally sequential and global as well as equally active and reflective. It is also apparent that a learning style disparity of an enormous magnitude exists between the students and their instructor. The results were shown and explained to the students. It was emphasized that being on either side of any one dimension of learning preference does not reflect a good or bad thing.

The survey tremendously helped the instructor understand how he and his students learned. The instrument did indeed capture the disparity between instructor and students. This was the diagnostic benefit of the survey and the instructor agreed to adjust the teaching style to bring the students and the instructor closer to a balanced learning mode.

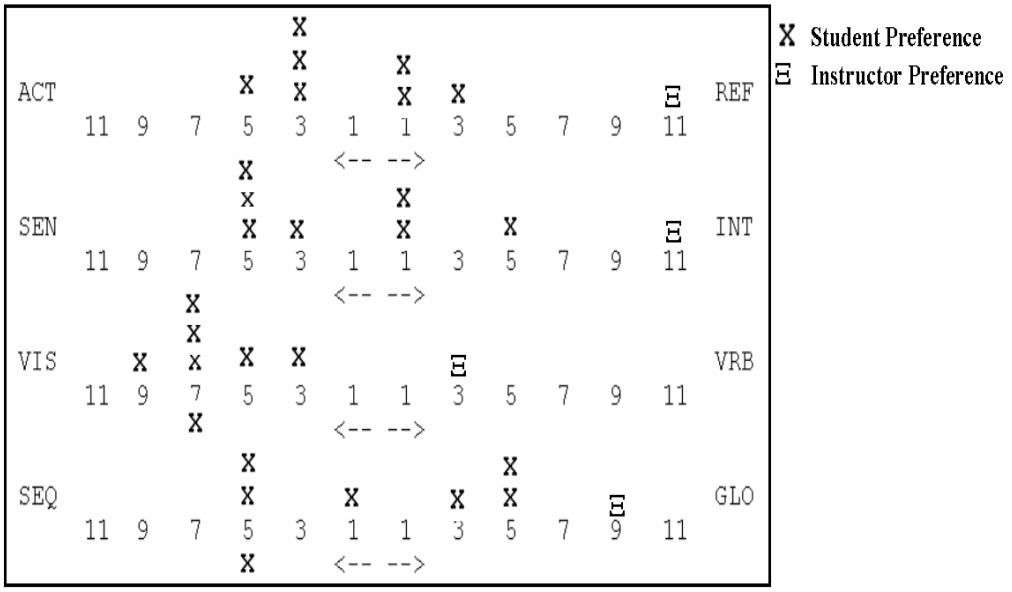

Figure 2: Index of Learning Styles Survey Results – Pilot

Based on the Felder and Silverman learning and teaching style model, the instructor was advised that the subject matter should be presented with *more* emphasis on visual aids and facts while striking a balance between the step-by-step and holistic presentation of these facts in an *active* environment that allowed students to both interact with each other as well as have the time to reflect on what they have learned. In response, the instructor rightfully asserted that he was not clear on which active learning mode to use and expressed apprehension towards some techniques.

The response of the instructor is not surprising. A student's acceptance of a particular mode of instruction is probably driven by the preferred learning style as well as a myriad of inherently interrelated and complicated factors that govern and shape the overall relation between the student and the instructor such as how *natural and effective* the instructor is in a particular mode of instruction and whether this mode creates a truly conducive environment for learning. While the recommendations based on the ILS survey are quite logical, it is unreasonable to expect that all instructors are equally adept at a multi-style approach. As Palmer (1993 and 1997) asserts, great and effective teachers are not necessarily defined by the technique they use but rather by

their ability to be effective in the mode that truly reflects their personalities. Thus, some may be most effective at lecturing and others at facilitating group work, etc. Notwithstanding the instruction mode, the common captivating and mesmerizing factor among these effective instructors is their ability to elicit the participation of their students and in opening the space to the students instead of filling it themselves.

This discussion underscored the need to investigate, even if only empirically, the relation between a student's preferred learning style and associated preferred mode of instruction. An addendum was therefore added to the ILS in which students were asked to indicate (self-declare) the primary and secondary teaching mode they preferred. The students were also asked to classify the adopted primary and secondary teaching mode by the instructor. Finally, The students were asked whether the adopted primary mode of teaching motivated and helped them learn. Figure 3 shows these additions. The teaching modes shown in Figure 3 were adapted from Wankat (2001).

It is worth noting that a '1' represents strong agreement that the primary teaching mode used in the class: (1) motivated the student to learn; (2) helped the students learn. A '6' represents strong disagreement to the same statements. It is important to note that the emphasis is on learning motivation and assistance (help) and not on the efficacy of the learning, i.e., academic performance. Students have, and typically assume, autonomy in determining what effort and, hence, final grade they would like. A student who receives a 'C' as a final grade may be as motivated to learn as a student who receives an 'A'.

Please respond to the following statements about the teaching mode/style in the class:

	Teaching Mode					
	Lecture without break	Lecture with questions	Lecture w/group activity	Entirely group activity	Student selected topics	Other
The teaching mode I prefer most is:						
The teaching mode I prefer second is:						
So far, the primary teaching mode in this class is						
These teachings modes are also used in class:						

Please provide one response to the following questions:

	Response						
Question	SA	A	MA	MD	D	SD	NA
The primary teaching mode used in this class motivates me to learn.							
The primary teaching mode used in this class helps me learn the material.							

SA = Strongly Agree; A = Agree; MA = Moderately Agree; MD = Moderately Disagree; D = Disagree; SD: Strongly Disagree; NA = Not Applicable

Figure 3: Added section to the ILS survey

The difference between 'motivates me to learn' and 'helps me learn' is also important to discuss. On the one hand, the phrase 'Motivates me to learn' refers to whether the instruction mode used in class is creating an intrinsic interest for the student to initiate the process of learning and

studying. On the other hand, the phrase 'helps me learn' refers to whether the instruction mode used in class facilitates the process of learning, i.e., makes the subject matter more accessible and easier to understand. The difference is subtle and was thoroughly explained to the students in both the pilot and actual research phases.

After the study methods and details were finalized, 277 students in five different courses (81 freshman, 71 Sophomores, 56 Juniors, 63 seniors, and 6 graduate student) completed the modified ILS survey. The instructors teaching the five courses were also asked to complete the survey. Discussion of the results and inferences follow.

Results

The high number of participants (the 282 participants; 277 students and 5 instructors) renders a detailed presentation of the data collected and results encyclopedic. Thus, the presentation in the following sections is limited to general trends and aggregated results. It should also be noted that only 266 students have completed the addendum section shown in Figure 3. All 282 participants did complete the ILS in its entirety. Course titles are withheld to protect the identity of instructors.

ILS Survey Results

The ILS survey results are shown in Table 1. The mean and standard deviation (STD) for each of the four learning dimensions is provided for each grade level, individual instructors, and all instructors combined (see Appendix A for example calculation). For example, freshman students had a 1.93 mean score on the active reflective dimension. The "ACT" after the 1.93 indicates that the mean score fell on the active side of the dimension. For this same dimension and same grade level, the instructor scored 1 on the active side.

Table 1

ILS Survey results

Level	Sample	Active / Reflective Score		Sensing / Intuitive Score		Visual / Verbal Score		Sequential / Global Score	
		Mean	STD	Mean	STD	Mean	STD	Mean	STD
Freshman	81	1.93 ACT	3.66	3.14 SEN	3.85	5.9 VIS	4.25	2.14 SEQ	2.98
Instructor	1	1 ACT	NA	5 SEN	NA	9 VIS	NA	3 SEQ	NA
Sophomores	71	2.48 ACT	3.46	3.72 SEN	3.42	5.84 VIS	3.39	1.51 SEQ	2.86
Instructor	1	3 ACT	NA	2 INT	NA	4 VIS	NA	4 SEQ	NA
Juniors	56	3.34 ACT	4.06	4.39 SEN	3.82	6.73 VIS	3.55	2.16 SEQ	3.74
Instructor	1	2 ACT	NA	5 SEN	NA	1 VIS	NA	2 SEQ	NA
Seniors	63	2.71 ACT	3.45	3.65 SEN	4.52	5.98 VIS	3.76	1.3 SEQ	3.69
Instructor	1	11 ACT	NA	11 INT	NA	3 VER	NA	9 GLO	NA
Graduate	6	0.50 ACT	5.78	0.67 SEN	2.19	5.17 VIS	2.97	0.83 GLO	2.51
Instructor	1	2 ACT	NA	2 SEN	NA	11 VIS	NA	3 SEQ	NA
All Instructors	5	1.60 REF	5.00	0.6 SEN	5.95	4.2 VIS	5.26	0.60 SEQ	4.84

Close examination of Table 1 reveals that the disparity in teacher-student learning styles ranges from low to high with the highest occurring between the seniors and their instructor. In addition,

the variation in learning style preference for a particular class level and along any of the dimensions is quite high as evident by the high standard deviation values. To appreciate this variability, Figures 4 to 7 show histograms of the individual scores for the freshman and senior class on the active/reflective and visual/verbal dimension. The scores for the respective instructors on the same dimensions are superimposed in Figures 4-7 (different bar color or an "I").

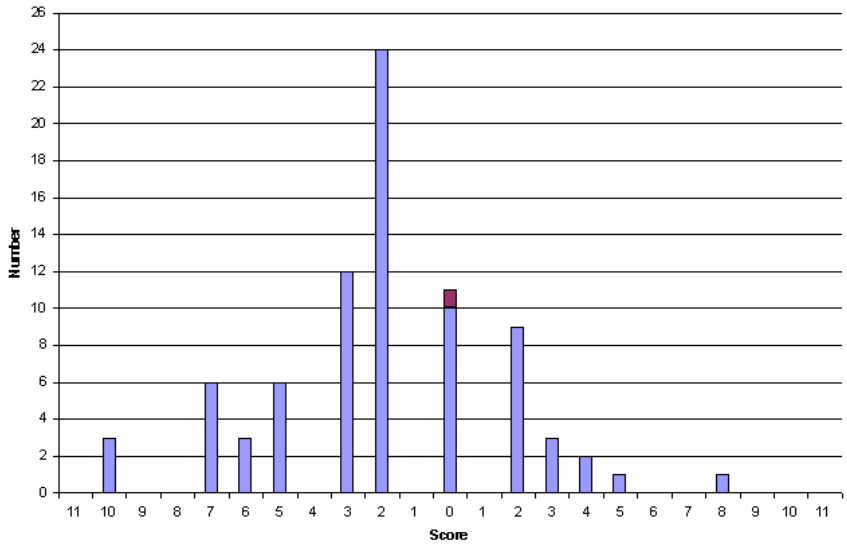

Figure 4: Score distribution on the active/reflective dimension (Freshman)

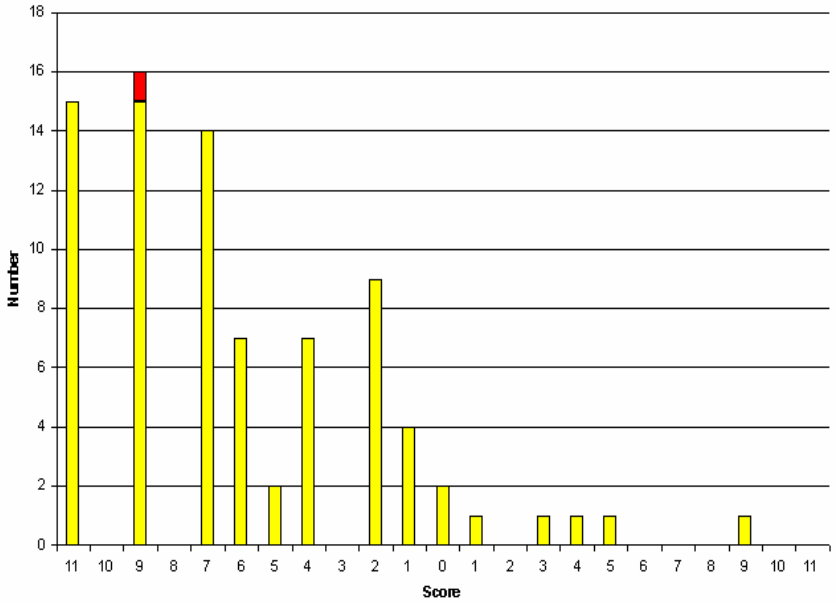

Figure 5: Score distribution on the visual/verbal dimension (Freshman)

The histograms for the sophomores and juniors displayed the same trend shown in Figures 4-7. With the exception of the Visual/Verbal dimension, the score distribution along the other dimensions closely followed a normal distribution. The distribution of the Visual/Verbal

dimension was always skewed to the Visual dimension (see Figure 5 and 7). Because of the small sample of graduate students it was not possible to discern or infer a similar trend.

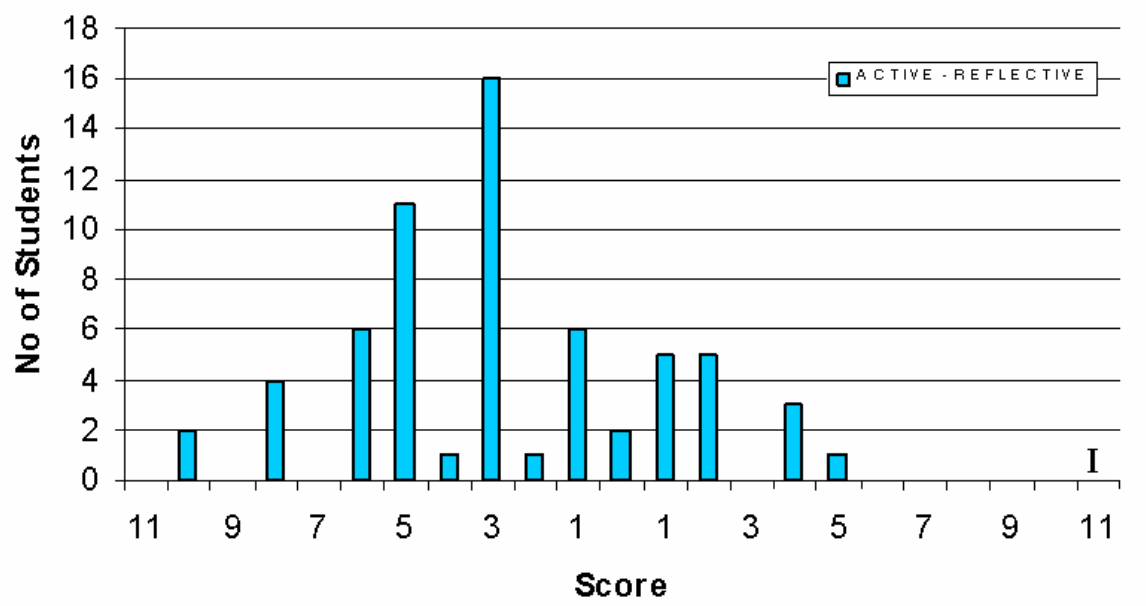

Figure 6: Score distribution on the active/reflective dimension (Seniors)

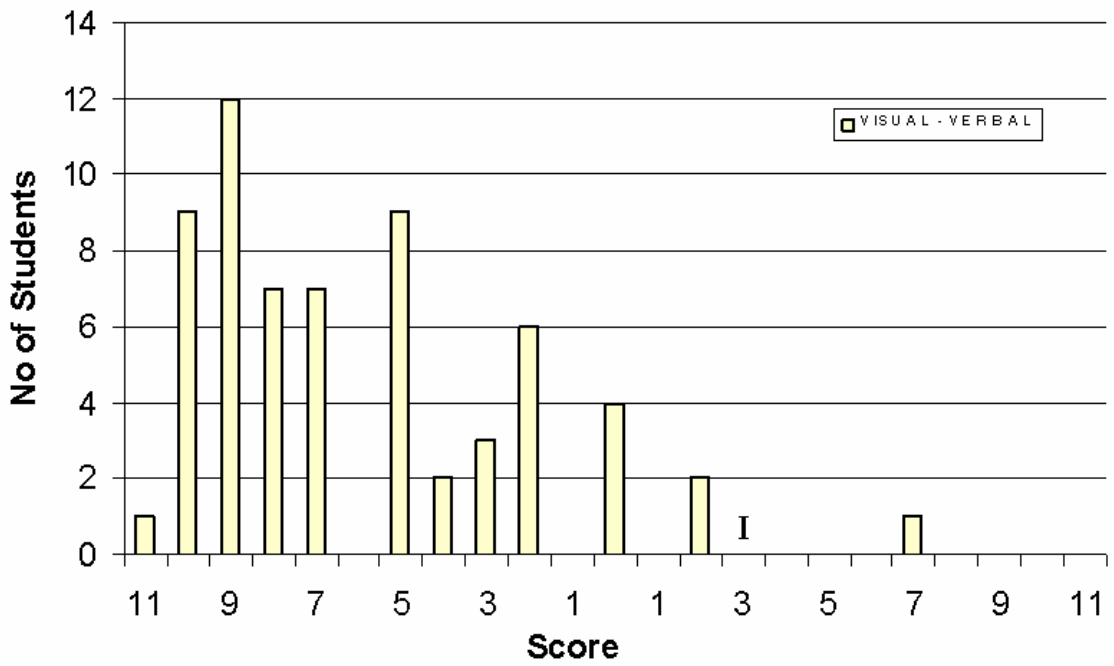

Figure 7: Score distribution on the visual/verbal dimension (Seniors)

Figure 8 shows the results listed in Table 1 in graph form to capture the general trend in the learning style of the different grade levels compared to the instructors group. As illustrated in Figure 8, the average disparity between instructors and students is more pronounced on the Active/Reflective and Sensing/Intuitive dimensions (graduate students are the only exception but

this may be due to the small sample size). The instructors are clearly closer to the students' mean preferred learning style on the Visual/Verbal and Sequential/Global dimensions.

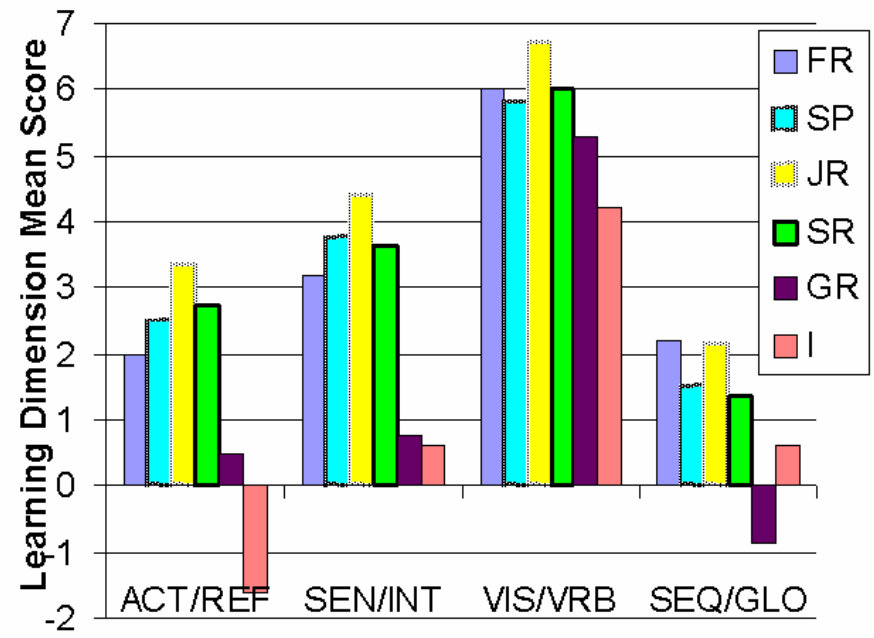

Figure 8: Learning Dimensions Mean Score By Group

Figure 8 also indicates an increasing trend in the Active/Reflective and Sensing/Intuitive dimensions from the freshman to the junior year. This is most likely coincidental especially that this was not the same group of students tracked in a longitudinal fashion. Thus this trend is not necessarily a sign that the curriculum or instructors are causing this trend.

Preferred and Adopted Mode of Teaching

As explained earlier, students were asked to indicate their preferred primary and secondary teaching mode as well as classify the adopted primary and secondary teaching mode by the instructor. Figure 9 shows the responses of the freshman class to the question of preferred teaching mode and that adopted by the instructor.

As indicated by Figure 9, 70 out of 81 respondents classified the primary teaching mode as "Lecture with questions". The rest of the class classified the primary teaching mode used as "Lecture w/o break", i.e., strictly lecturing. It is clear from the responses to the primary mode preferred that a majority of the students (50 out of 81) preferred the "Lecture w/ questions" while others preferred "Lecture with group activity" (20), 'entirely group activity" (5), and "Student selected topics" (5). Only one student preferred the 'lecture w/o break' mode.

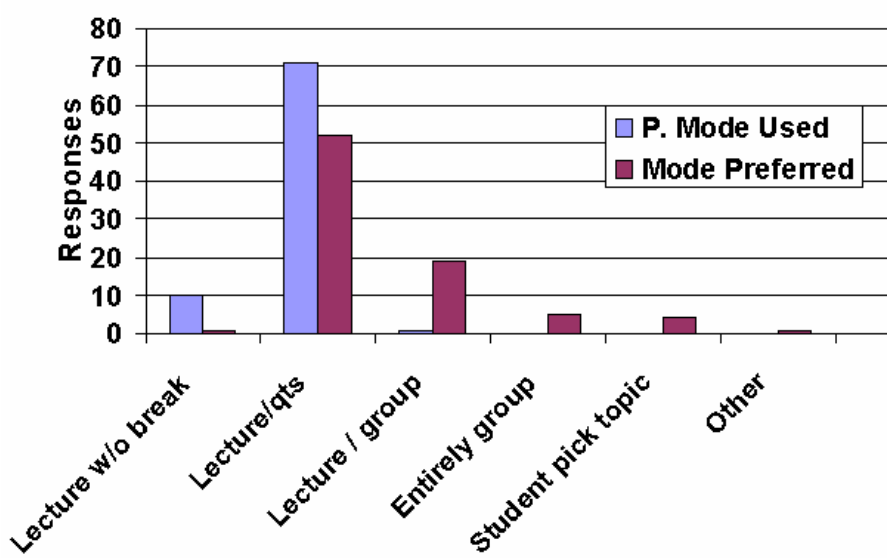

Figure 9: Primary preferred teaching mode and the primary adopted mode (Freshman)

Similar to Figure 9, Figure 10 shows the secondary adopted and preferred teaching mode. It is evident from Figure 10 that, according to the student's of course, the instructor uses lecture only as a secondary mode with only 17 out of 81 students preferring it. Figure 10 also shows that about 25 students prefer the lecture with group activity as a secondary mode but only 5 students classified this as a secondary adopted teaching mode.

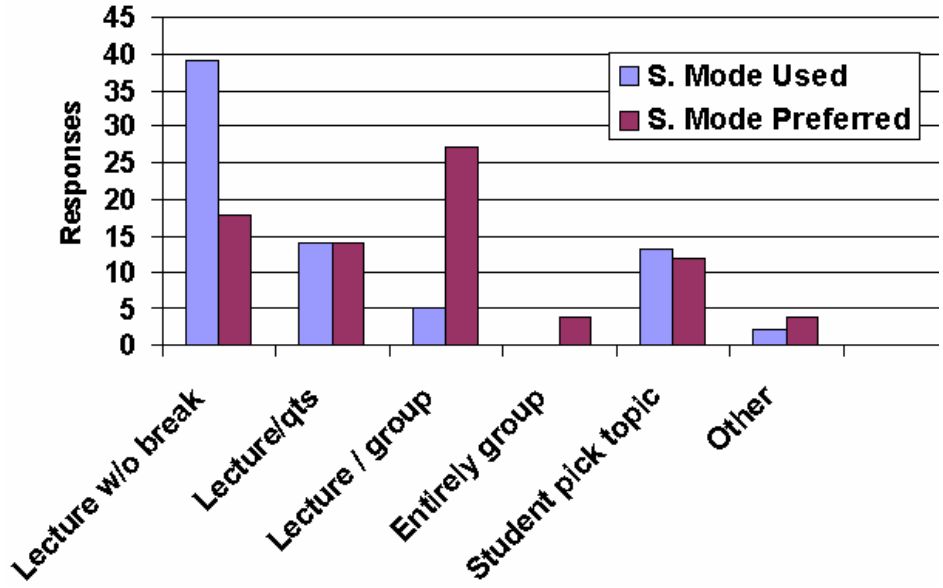

Figure 10: Second preferred teaching mode and the second adopted mode (Freshman)

Together, Figures 9 and 10 are quite useful in providing feedback to the instructor on what the students prefer as a primary and teaching mode as well as how they classify and perceive the mode actually used by the instructor. The figures for the sophomore, junior, senior, and graduate class levels showed essentially similar trends and are therefore not shown.

Adopted Teaching and Learning Motivation

To investigate the effect of using the same primary mode of teaching as that preferred by students on the learning process, the students' responses to whether they agreed that the adopted primary mode of teaching motivated and helped them learn were divided into the following four categories:

1. Students' responses to the statement: "The primary teaching mode used in this class motivates me to learn" and the instructor's adopted mode matched that preferred by the students.
2. Students' responses to the statement: "The primary teaching mode used in this class motivates me to learn" and the instructor's adopted mode did not match that preferred by the students.
3. Students' responses to the statement: "The primary teaching mode used in this class helps me learn" and the instructor's adopted mode matched that preferred by the students.
4. Students' responses to the statement: "The primary teaching mode used in this class helps me learn" and the instructor's adopted mode did not match that preferred by the students.

Table 2 lists students' *average* responses resulting from this grouping as well as results of a two-sided t-test performed on the data. The null and alternative hypothesis were as follows: 1) H_o: $\mu_1 - \mu_2 = 0$; 2) H_a: $\mu_1 - \mu_2 \neq 0$. The results of the graduate students are not shown because the small sample size precluded meaningful statistical analysis. Figures 11 and 12 are a graphical representation of the data shown in Table 2. The x-axis of Figure 11 shows categories 1 and 2 (listed above) and that of Figure 12 shows categories 3 and 4. The y-axis of both Figures 11 and 12 shows the corresponding students' average response.

With the exception of junior students, the t-test results shown in Table 2 (see p-values) confirms, with statistical significance, that students are motivated and helped to learn when the adopted teaching mode matches their preferred learning style. This is of course an expected result. However, this result does not seem to be affected by the learning-style disparity between instructors and students. Consider for example the senior class where the disparity was highest but the students gave similar responses, or trend at least, to those of the freshman and sophomore students where the disparity was small. Moreover, while the disparity in the junior class was less than that in the senior class, the junior students gave opposite responses compared to the senior class. Perhaps the reason lies with the students' expectation from a particular mode of instruction. In other words, the students may have a different expectation of how the teaching mode they prefer should be delivered.

An informal interview with 5 junior students revealed that the instructor was the main source of questions and not the students. While this is merely anecdotal evidence that supports the supposition just made, this also reveals that future research should add "Lecture with instructor-initiated questions" and "Lecture with student-initiated questions" to the list of instruction modes that students select from.

Table 2

Average responses and t-test results for effect of primary teaching mode on learning

Statement	Freshman	Sophomores	Juniors	Seniors
	Average Response	**Average Response**	**Average Response**	**Average Response**
The primary teaching mode used in this class motivates me to learn (Adopted mode *matched* preferred)	$\mu_1 = 1.85$	$\mu_1 = 2.28$	$\mu_1 = 2.37$	$\mu_1 = 1.76$
The primary teaching mode used in this class motivates me to learn (Adopted mode *differed from preferred*)	$\mu_2 = 2.29$	$\mu_2 = 2.77$	$\mu_2 = 2.11$	$\mu_2 = 2.47$
P-value*	0.017 (Significant)	0.04 (Significant)	0.35 (Not Significant)	0.06 (Significant)
The primary teaching mode used in this class helps me learn the material. (Adopted mode *matched* preferred)	$\mu_1 = 1.77$	$\mu_1 = 2.10$	$\mu_1 = 2.56$	$\mu_1 = 1.69$
The primary teaching mode used in this class helps me learn the material. (Adopted mode *differed from* preferred)	$\mu_2 = 2.16$	$\mu_2 = 2.87$	$\mu_2 = 2.44$	$\mu_2 = 2.18$
P-value*	0.013 (Significant)	0.002 (Significant)	0.76 (Not Significant)	0.05 (Significant)

*(two-sided t-test with hypothesized zero mean difference)

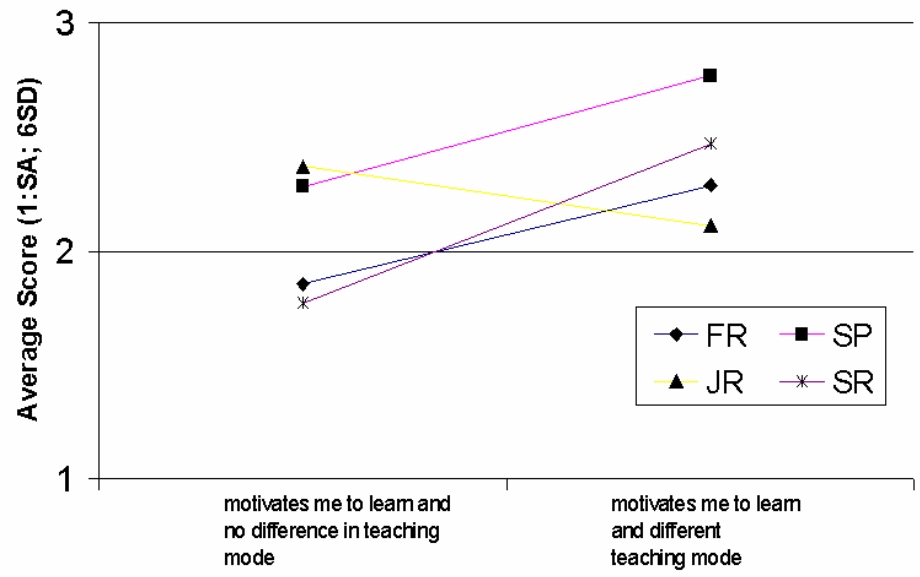

Figure 11: Effect of adopted teaching mode on the motivation to learn

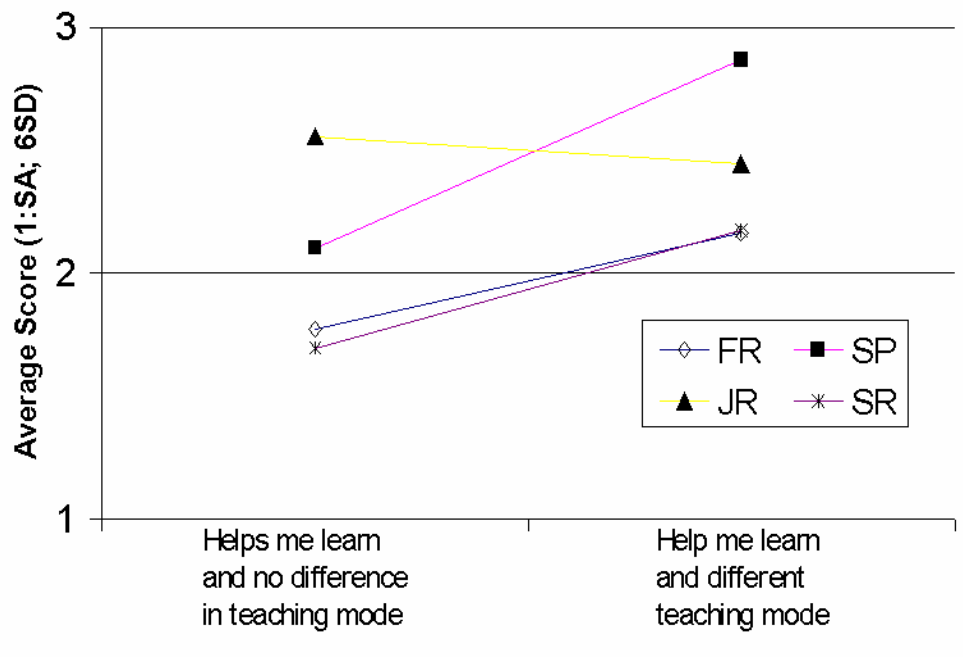

Figure 12: Effect of adopted teaching mode in helping learning

Learning Styles and Preferred Mode of Teaching

As previously mentioned, a close association between preferred learning style and the preferred mode of instruction is assumed for the type of information presented as governed by the visual/verbal, sensing/intuitive, and sequential/global dimensions (Felder and Silverman 1988). However, for the active/reflective dimension, Felder and Silverman (1988) state that *active* participation is the best teaching style for both types of learners. With active participation probably affecting the entire classroom experience and, hence, the other three dimensions, it is not unfounded to surmise that *active* participation is superior to *passive* regardless of the preferential learning style.

To investigate this assumption, a student's preferred learning style on each of the four dimensions measured by the index of learning styles survey were matched with the student's self-declared preferred primary mode of instruction. For example, if a student's ILS results indicated he/she preferred the active/sensing/visual/sequential styles of learning, this was matched to the preferential mode of teaching the student also indicated. The results of this analysis are listed in Table 3.

Table 3 strongly suggests that students did not prefer a teaching mode over another based on the learning style. In fact, the majority of the students predominantly preferred the 'Lecture with questions' and the 'Lecture with group activity' teaching modes. While these modes were not labeled as active, cooperative, and/or collaborative learning, the two modes primarily represent the type of instruction and learning embodied therein. Therefore, it may be concluded that regardless of the learning style preference, the students are clearly gravitating to an active mode of participation. This validates the statement that active participation style is superior to passive

regardless of the preferential learning style. This is also another confirmation of the need to move towards the forms of learning advocated by proponents of active learning.

Table 3

Student Preferred learning and teaching mode

	Teaching Mode*						
	Lecture without break	Lecture with questions	Lecture w/group activity	Entirely group activity	Student selected topics	Other	NA
Active Students	6	101	60	9	5	1	0
Reflective Students	6	57	15	2	0	4	0
Sensing Students	9	135	59	11	5	2	0
Intuitive Students	3	24	14	1	0	3	0
Visual Students	9	137	70	11	5	2	0
Verbal Students	3	20	6	0	0	3	0
Sequential Students	8	117	47	7	4	3	0
Global Students	2	44	29	3	1	1	0

* The figure in each cell represents the number of students selecting the corresponding teaching mode

Conclusions

This paper described the results of a research study designed to evaluate the teacher-learning style disparity at Michigan State University's Construction Management Program. The Index of Learning Styles (ILS) model was used to determine the learning style preference of students and their teachers in the Construction Management Program at both the undergraduate and graduate levels (construction courses only). The study also investigated the relation between a student's preferred learning style and associated preferred mode of instruction. Students were asked to indicate (self-declare) the primary and secondary teaching mode they preferred and to classify the adopted primary and secondary teaching mode by the instructor. The students were also asked whether the adopted primary mode of teaching motivated and helped them learn.

The results of the study reveal that, on average, students in the construction management program preferred the active, sensing, visual, and sequential learning styles. The results (see Table 1) also showed that the existence of disparity in teacher-student learning styles. Both instructors and students had a strong preference to the visual learning style. However, for both students and instructors, the variation in learning style preference along one dimension was quite high. The results also indicate that compared to the magnitude of learning style disparity the primary teaching mode adopted by the instructor had more effect on motivating and helping student learn. Therefore, instructors should solicit input from students on their preferred mode of teaching and work together to achieve it. While certainly only empirical, it was also found that irrespective of the preferred learning style, students preferred instruction with active participation as the primary mode of teaching.

It is important to note that, in many cases, instructors follow a teaching style that suits the time allotted for delivery of class material as well as the physical space constraints imposed by the number of students. For example, in classes with predetermined amounts of material to cover and/or those with large enrollments, instructors often feel forced to trade-off content

understanding for content coverage. Consequently, a lecture mode is selected because it is less time consuming and deemed more efficient for large class sizes. Fortunately, the literature on active learning discusses remedies to both issues, limited time and large class sizes, at great detail (Johnson et al. 1991, Smith and Waller 1997, and Wankat 2001).

The results presented in this research are based on one of many learning styles evaluation tools. The results are also major-specific and to a large extent also instructor-specific. Replication of the study in similar majors or others should consider the following improvements that were naturally learned in retrospect:

- The teaching mode 'Lecture with questions' should be replaced with 'Lecture with student-initiated questions' and 'Lecture with instructor-initiated questions'.
- The teaching mode 'Lecture with individual activity' should be added to the list of teaching modes.
- Investigate why students prefer one teaching mode to another, and how does it motivate or help them learn.
- Investigate the impact of matching students' preferred learning styles and learning outcome (i.e., academic performance or learning efficacy).
- Investigate the impact of realizing one's preferred learning style academic performance (formulation of successful learning strategies).
- Conduct a longitudinal study to investigate the change in preferred learning style over time.

It is critical to note that the Felder and Silverman model was only intended to provide a framework to understand and gain insights to the learning style preferences of students and to the teaching style biases of instructors. This understanding helps both students and instructors to themselves improve the classroom learning experience and increase satisfaction with instruction. However, the Felder and Silverman model, as well as other learning style models, was not intended as a predictor of academic performance, which has a well-established correlation to ability (Ayersman 1996, Zywno and Waalen 2001). In other words, a change in the teaching style to accommodate the different learning styles of students does not guarantee that all students will necessarily score high grades. The change may engage and enthuse students more about the subject matter.

This research confirms that active learning is more desirable compared to passive learning as evident by the overwhelming number of students who preferred this style as the primary style of teaching. The research also provides a framework to tailor courses to the students' preferred learning style and mode of instruction. Last but not least, the study definitely increased collegial discussions about enhancing teaching.

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Appendix A

As shown in Figure 1, The ILS results are provided in the form of a four bipolar scales. A score is generated on each scale based on 11 questions with two possible mutually exclusive answers. The range of possible scores on any one dimension ranges from a +11 on one side of the dimension to a +11 on the other side. Take for example the Active/Reflective scale, the score can range form a +11 on the active side to a +11 on the reflective side. To calculate the mean score and standard deviation for a group of respondents, the possible range of scores has to be manipulated as follows:

1. For each dimension, tally the number of respondents that receive the same score
2. Create a table as that shown in Table A1.
3. Convert the possible scores on each dimension to range from a –11 on one side of the dimension to a +11 on the other side as shown in Table A2.
4. Find the mean and standard deviation using the following formula:
   - Mean Score = ∑(no of Respondents receiving the same score) × Score) / (Total No. of respondents). For the example shown in Table A2, the mean score = [(0×–11 + 2×–10+…+ 1×5+…+0×11) / (0+2+0+4+…+2+5+5+0+…+0) = -2.71. Hence the mean is 2.71 on the active side).
   - Variance = [∑(no of Respondents receiving the same score) * (Score – Mean)$^{\wedge 2}$ / (Total No. of respondents)]. Then the standard deviation = (Variance)$^{\wedge(1/2)}$. For the example shown in Table A2, the variance = [(0×(–11–(–2.71) $^{\wedge 2}$) + (2×(–10–(–2.71) $^{\wedge 2}$) +…+ (1×(5–(–2.71) $^{\wedge 2}$)+…+ (0×(11–(–2.71) $^{\wedge 2}$)] / (0+2+0+4+…+2+5+5+0+…+0) = 11.92. Hence the standard deviation is ± 3.45.

Table A1

Preparing group ILS results for mean and standard deviation calculation

	Active / Reflective Dimension																							
	11	10	9	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8	9	10	11
Frequency*	0	2	0	4	0	6	11	1	16	1	6	2	5	5	0	3	1	0	0	0	0	0	0
*No. of Respondents receiving the same score																							

Group ILS results ready for mean and standard deviation calculation

	Active / Reflective Dimension																							
	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11
Frequency*	0	2	0	4	0	6	11	1	16	1	6	2	5	5	0	3	1	0	0	0	0	0	0
*No. of Respondents receiving the same score																							

Construction Estimating: Student Perceptions vs. Industry Reality

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Construction estimating is a critical component of the construction education curriculum. Construction companies must be able to accurately forecast costs to succeed in their demanding industry. Although the methods used to introduce students to construction estimating seem to be somewhat antiquated, it is necessary for the students to understand the basics of estimating before they can master more advanced estimating techniques. The time spent learning the basics of construction estimating and the pedagogy used may lead to the development of false perceptions and negative attitudes towards construction estimating by students. This paper examines whether students do indeed have false perceptions of the job duties of professional estimators, and if these false perceptions lead to the development of negative attitudes towards entering the construction industry as a professional estimator.

Key Words: Construction education, estimating, attitudes, perceptions, job satisfaction

Introduction

Accurate construction cost estimating is critical in order for construction companies to succeed in the highly competitive construction industry. Cost estimating is a foundation for many of the courses taught in all construction education curriculums. Universities use proven methods to teach students the basics of working drawings and to accurately estimate the quantities of the components that make up a structure. The methods used to teach these skills are proven, yet it could be argued that these methods are somewhat antiquated given the transformation of the education process due to technology. Computers and computer aided software have simplified some processes, but it could also be argued that it has made some students indolent or unmotivated to perform tedious tasks without relying on computers or the software. Regardless of the method used, it is necessary for students to have a strong foundation in working drawings, quantity takeoff, and pricing by hand before they can rely on technology to aid them in the process.

The amount of time spent performing quantity takeoff and pricing by hand varies both in the educational setting and in the industry. However, the time spent learning the skill in an educational setting could influence a students' desire to become a professional construction estimator. Students can easily develop false perceptions of the job duties that are actually involved with an estimator's day-to-day work activities. False perceptions of an estimator's job duties lead to the development of negative attitudes towards the career that many professional estimators find very rewarding. Once these attitudes and opinions of construction estimating are formed, it can be difficult to change them. Therefore, the educator might help to prevent the formation of these attitudes by exposing students to the actual work activities of a professional estimator.

Literature Review

Actual research on student perceptions and attitudes towards construction estimating is virtually non-existent. However, various related sub-topics exist and do give us some information to examine while researching this subject matter. These topics include job satisfaction, attitude formation, and construction education.

The steady growth of the construction industry throughout the 1990's has heightened demand for managerial and craft-level labor (McGraw-Hill 2002). Historically, construction managers have risen through craft level jobs to attain management positions in the industry (Rosenbaum, Ruben, and Powers, 2001). That trend is shifting, as labor shortages exist and are predicted to worsen at the craft level, and construction education programs continue to grow (Swoboda and Cieslik, 1997).

During the 2000-2001 school year, 88 construction education programs enrolled nearly 17,500 students (Rosenbaum 2001). Construction education programs cover a wide range of educational topics including estimating, scheduling, project management, and law; thus employment opportunities exist for graduating students in several areas of the construction industry (Rosenbaum 2001).

Industry growth is a driving force behind an increased demand for construction cost estimators. The accurate forecasting of project costs is critical to the survival and financial growth of a construction company. Estimators must gather, analyze, and compile information on materials, labor, equipment, and subcontractors for each job that a company attempts to be awarded (US Dept. of Labor, 2001).

All cost estimators employ the same basic skills, but the actual methods and job descriptions of estimators can vary significantly from one company to another. Some organizations are much more dependent on information technology, which relieves the estimator of some of the drudgery associated with quantity takeoffs, computations, and calculations (US Dept. of Labor, 2001). The outlook for construction cost estimators is positive because of industry growth.

Job satisfaction and perceived job satisfaction are important factors for employees choosing to gain employment or remain employed by an organization. Bavendam Research Incorporated has researched and determined five factors that are critical to employee job satisfaction. According to BRI, the six factors are as follows:

- *Opportunity*

  Employees report more job satisfaction when they are presented with challenging opportunities. This includes interesting projects that provide challenge and increased responsibility.

- *Stress*

  Continual stress correlates to lower levels of job satisfaction. Jobs that interfere with employees' personal lives ultimately lead to lower job satisfaction.

- *Leadership*

  Employees exhibit higher levels of job satisfaction when their managers exhibit good leadership skills. Employees respond to managers who inspire them to achieve and who are considered trustworthy.

- *Work Standards*

  Employees report higher levels of job satisfaction when fellow co-workers take pride in their work. Higher levels of quality are linked to higher levels of job satisfaction.

- *Fair Rewards*

  Employees report higher levels of job satisfaction when they feel that they are adequately rewarded for the work that they perform. (Bavendam Research Inc., 2002).

The Harvard Professional Group's research into job satisfaction has led them to come up with three hallmarks of career satisfaction. Employees who are presented challenges exhibit higher levels of job satisfaction because they are able to apply their experience and abilities. Furthermore, successful completion of challenging work leads to a sense of achievement, which according to The Harvard Professional Group is the essence of job satisfaction (Harvard Research Group 2001).

Frederick Herzberg, one of the most recognized theorists on job satisfaction, suggests that employee satisfaction is made up of two dimensions: Hygiene factors and Motivation factors. Hygiene factors are factors that cannot motivate and satisfy employees, but can indeed dissatisfy employees if the factors are not addressed. Hygiene factors include company policies, salary, management hierarchy, and working conditions (Hertzberg, 1968).

Herzberg's theory on motivating factors is that they are the factors that actually lead to job satisfaction. Motivating factors address individual needs for meaning and personal growth. Motivating factors, according to Herzberg, are factors such as achievement, recognition, responsibility, and advancement (Herzberg, 1968).

An attitude is usually defined as an enduring disposition or tendency to respond either positively or negatively towards a certain situation, idea, or object. They are closely related to our opinions and beliefs that are based on our past experiences (Triandis, 1971). According to the findings of Kenneth Williamson and Phillip Grankowski, students enter into construction education coursework with negative attitudes and motivation concerning their education. Students develop opinions throughout the education and socialization process. Williamson and Grankowski find

that these cultural values and opinions influence students' desires to enter into certain professions (Williamson and Grankowski, 1997).

According to Janis Hovland and H. Kelley (1953), attitudes can be learned and formed from opinions. They suggest that learning new attitudes is similar to learning any other verbal or motor skill. The change of opinion, and thus the change of attitudes, is dependent upon the presentation and incentives that are offered (Hovland and Kelley, 1953).

Methodology

Two surveys were deployed via Zoomerang.com on the World Wide Web. The first survey was administered to Auburn University Building Science students (n=108) enrolled in Project Controls 1, Project Controls 2, Project Controls 3, and Thesis. The Project control series of classes starts with a student's first semester in the AUBSC program and concludes with Thesis during their final semester. The project controls series is estimating and scheduling, and thesis is a culmination course that uses everything that the students have learned in the program to manage a theoretical project from start to finish.

The student survey consisted of eight questions that probed the attitudes that the students hold regarding a career in estimating. Three of the eight questions were based on a Likert scale of 1 to 5. 1 equaled "No Interest" and 5 equaled "High Interest". The first question was asked to establish the breakdown of the students by their class enrollment. Question #5 was asked to establish in which area students would prefer to start their construction careers. Question #7 was used to establish how much work experience the students had. Finally, question #8 was asked to determine what the students actually believe are an estimator's job duties. A description of all eight questions can be seen in the results section.

The industry survey was also deployed by the Zoomerang.com service and targeted professional estimators (n=54) currently active in the construction industry. The thirteen question survey attempted to determine the average age, job satisfaction, upward mobility, length of time as an estimator, typical work activities and time allotment of each activity, and percentage of executives within their organization that were promoted through the estimating career track.

One day was spent at a medium-sized general contractor's office on bid day, in an attempt to capture some of the work activities on film. A short film was created to show some of these activities, and it attempted to capture some of the excitement of the office in a bid day situation.

Results

The results of the survey yielded good information regarding the students' attitudes towards a career in estimating. The first question on the student survey determined which class the students were currently enrolled in. 22 students in each of the Project Controls 1 and Project Controls 2 classes responded, which is equivalent to 20% of the total respondents for each class. 48 students

responded from the Project Controls 3 class, or 44% of the total respondents. Finally, 16 of the thesis students responded, making up 15% of the total number of respondents.

The second question on the student survey asked the students about their level of interest in career in estimating. 42% of the students responded with only medium interest, which was #3 based upon a Likert scale of 1-5. 32% responded with low interest (2), and 11% responded with no interest (1). These results total 85% of the respondents, and show that 85% of the students have a medium to low interest in the estimating career. Only 14 % of the students indicated a medium high (4) or high (5) interest in a career in estimating.

The third question was asked to support the results of question #2. It asked about the students' interest in a career in project management in the same format as the previous questions. The results were nearly opposite. 95% of the students responded with a medium to high interest in this career. Only 5% had a low interest, and 0% of the students showed no interest.

The fourth question asked about the students' interest in attaining a position as a construction executive. The same Likert scale from the previous two questions was used, and the responses showed that 96% of the students had a medium (3) to high interest (5) in attaining an executive position in the construction industry.

Question #5 asked the students in what position they would prefer to start their career if given the choice. Only 8% of the students responded in estimating. 51% responded in project management, and 43% responded in fieldwork.

Question #6 was asked to the students who answered project management or fieldwork on question #5. The question probed their reasons for choosing project management or fieldwork over estimating. The general consensus among the respondents was a dislike of the work activities.

Question #7 asked about their amount of relevant work or co-op experience to determine if their was a link between any of the previous question based upon work experience. After cross tabulating there does not appear to be a strong link to any of the previous responses.

The final question is the most important for our research. It asked the students to list three to five activities that they believe make up a majority of an estimator's job duties, and to indicate a time allotment to those activities. Only 74 of the 108 responses to this question were considered valid for various reasons. The percentages based on the 74 valid responses are listed below.

97 % of the valid responses included quantity takeoff as a perceived work activity. The students' perceived time allotment to this activity averaged 44.2%.

16% of the valid responses included scheduling and planning as a perceived work activity. The students' perceived time allotment to this activity averaged 27.6%.

59.5% of the valid responses included pricing as a perceived work activity. The students' perceived time allotment to this activity averaged 31.8%.

35.1% of the valid responses included bidding as a perceived work activity. The students' perceived time allotment to this activity averaged 24.3%.
16.2% of the valid responses included subcontractor correspondence as a perceived work activity. The students' perceived time allotment to this activity averaged 48.8%.

51.4% of the valid responses included scheduling and planning as a perceived work activity. The students' perceived time allotment to this activity averaged 29.4%.

The students perceived "Other" activities included the following: field correspondence, travel, job site visits, submittals and shop drawings, and owner / architect correspondence.

The industry surveys asked 13 questions that probed the areas that included age, company information, career track within their organization, job satisfaction, and work activities. Here again the most important question for our research was the question that asked about their actual work activities and time allotment to those activities. The answers were organized so that they could be compared to the student responses.

82.5% of the valid responses from the professional estimators included quantity takeoff as an actual work activity, yet on average only 29.5% of their time is allocated to this activity.

37.5% of the valid responses included scheduling and planning as an actual work activity. The estimators' time allocation to this activity averaged 28.2%.

7.5% of the valid responses included pricing as an actual work activity. The estimators' time allocation to this activity averaged 10%.

17.5% of the valid responses included bidding as an actual work activity. The estimators' time allocation to this activity averaged 19.7%.

62.5% of the valid responses included sub correspondence as an actual work activity. The estimators' time allocation to this activity averaged 30.6%.

45% of the valid responses included "Other" as an actual work activity. The estimators' time allocation to these activities averaged 36.8%.

The "Other" activities listed by the estimators included the following: Purchasing contracts / buying out jobs, plan / specification review, compiling data for operations, researching potential jobs, site study, negotiations, meetings with project managers and superintendents, and value engineering.

The students' perceptions do not exhibit an accurate knowledge of what construction estimators actually do. The following graph illustrates the difference between the student perceptions of the estimators' job duties and the actual job duties as described by the estimators.

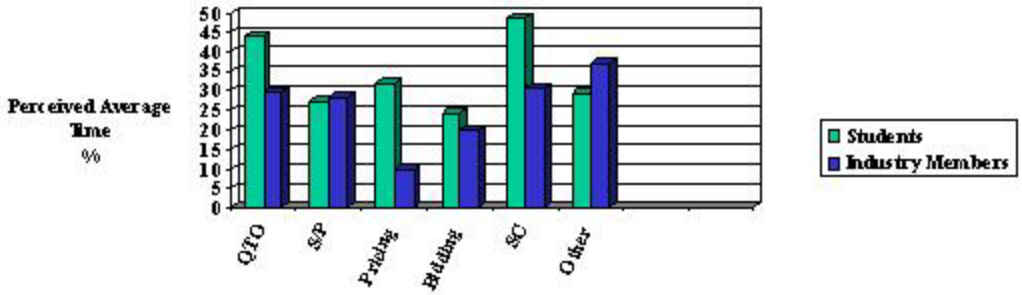

Figure 1: Student Perceptions vs. Industry Reality

The breakdown of the "other" work activities as described by both the students and industry members is as follows:

Table 1

Students Perceptions	*Industry Reality*
• Field Correspondence • Travel • Job Site Visits • Submittals and Shop Drawings • Owner and Architect Correspondence	• Plan and Specifications Review • Compiling Data for Operations • Researching Potential Jobs • Site Study • Negotiations • Meetings with field team • Value Engineering

Several other questions were asked of the estimators while we had the opportunity to survey such a large number of industry members. 92% of the professional estimators report medium (3) to high (5) job satisfaction based upon a Likert scale of 1 to 5. Conversely, only 8% reported low to zero job satisfaction.

75% of the industry members also feel that conceptual estimating should be addressed at the university level.

94% of the industry members also feel that successful advancement through the estimating career track serves as a stepping-stone to get involved with conceptual estimating, design-build projects, conceptual project planning, and negotiation situations.

The 54 industry members surveyed were asked to estimate what percentage of the executives within their organization were promoted through the estimating career track. On average, 38% of the executives were promoted through this career track. The statistical information for this question was as follows:

Median = 28%
Mode = 50%

Min = 0%
Max = 100%

The average age of the 54 respondents was 33.5. The oldest was 53 and the youngest 23. The statistical information for this question was as follows:

Median = 31
Mode = 25
Min = 23
Max =53

Conclusions

The overwhelming conclusion from this study is that the majority of students do indeed have false perceptions regarding the work duties of professional construction estimators. This assumption is derived from the data presented in Figure 1. These false perceptions likely influence attitude formation and prevent students from wanting to enter the profession of construction estimating.

Furthermore, the Occupational Outlook Handbook 2002-03 Edition printed by US Department of Labor Bureau of Labor Statistics, states that regardless of the industry in which they work, estimators compile and analyze data on all the factors that can influence costs—such as materials, labor, location, and special machinery requirements, including computer hardware and software. This description of an estimator's job is indeed accurate, but it does not truly indicate what is involved to perform these tasks. The activities that the industry members gave in response to the survey may be a more accurate portrayal of their actual job and work activities.

According to some, a "glass ceiling" for construction estimators exists that prevents them from attaining some of the high level executive positions in the industry. The results of this research indicate that a "glass ceiling" for estimators may not exist, given the percentage of estimators who were promoted to executive positions in the companies of the industry members surveyed. The estimators also indicate good job satisfaction.

Given these results and conclusions, it is imperative that construction educators attempt to educate students not only on the methods of estimating but also on the work activities of professional construction estimators. This paper should help educators be aware of students' perceptions of estimating as a career versus the reality in industry. Some educators, I am certain already realize this, however, the information in this paper may help those who do not realize these false perceptions exist to help prevent these false perceptions by the students. If educators are more aware of these false perceptions, we are more likely to benefit the students by helping to present the reality of estimating as a career. I think this effort on the educators' part will help create a different attitude on the part of the students and help create a greater desire to learn estimating instead of the students desiring to simply make it through the class.

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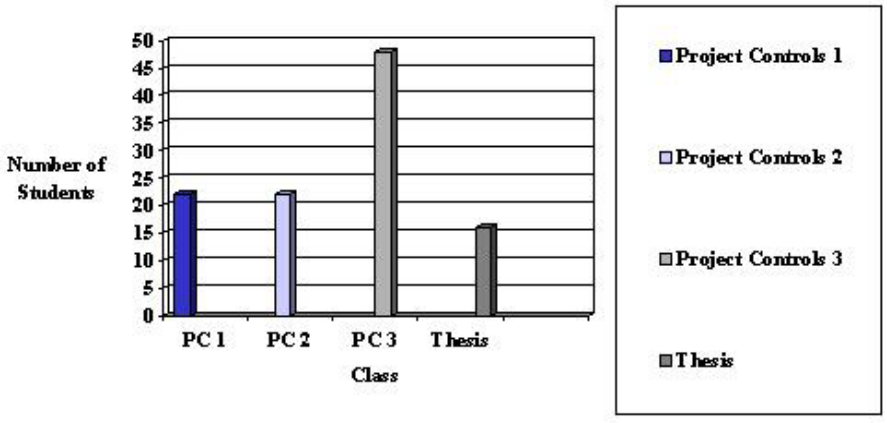
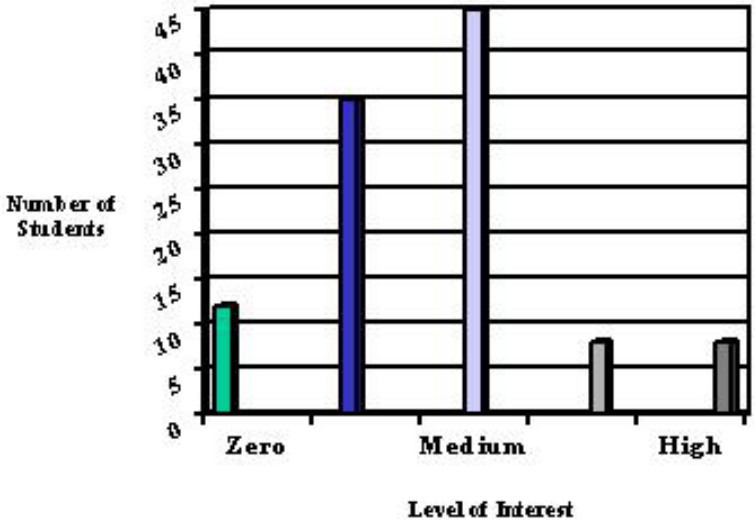
Appendix A

Breakdown of Students by Class



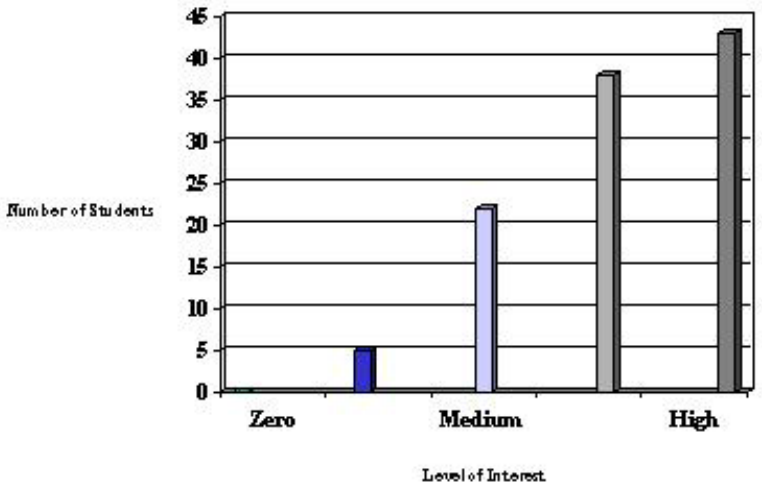
Appendix B

Students Level of Interest in Estimating Career



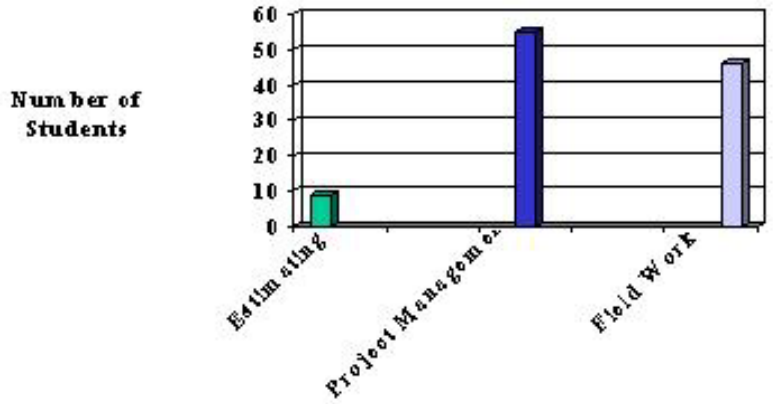
Appendix C

Students Level of Interest in Project Management Career



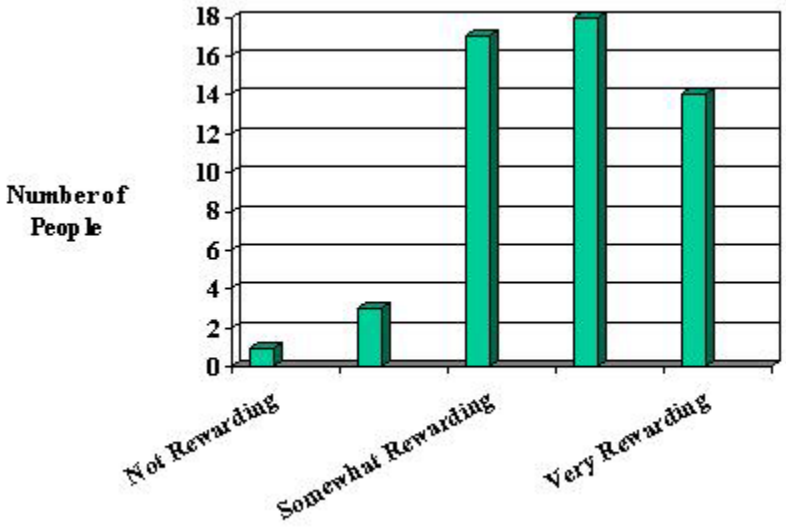
Appendix D

Students preferred starting point for career



Appendix E

Professional Estimators' Reported Job Satisfaction



A Comparison of Four Domain Area Standards for Internships and Implications for Utilization in Undergraduate Construction Education Internship Programs

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This investigation analyzes and compares standards and guidelines for field-based experience internships in the undergraduate program domains of: business, political science, allied health professions, and teacher preparation with construction education. The standards from teacher education were found to be the only standards that specifically define and specify the development and structure of an internship program and its continued improvement. Analyses of the other domain standards, along with a literature review, are portrayed in a structured matrix. The key components shared by the domain areas are evident in this matrix and can be utilized as a guideline for the development or structuring of a construction education internship program.

Key Words: Internship, Construction Education, Standards, Guidelines

Introduction

Internships can provide a window to the actual world of work for construction education students. Internships vary greatly from one construction program to the next -- in length, type of supervision, amount of academic deliverables, and whether the internship is paid or unpaid. According to a Special Report on Construction Education in Engineering News-Record (ENR) (October 29, 2001), many schools encourage students to add internship or cooperative education programs to their academic experience. But, less than half of the eighty-eight schools responding to the ENR survey require internships for graduation. Internship supervisors in the Department of Technology at Southwest Texas State University report that variations in undergraduate internship programs have resulted in frustration and dissatisfaction of the internship program for many employers and students. Companies and students find it difficult to set realistic goals and have success with short internships. It was suggested that a longer internship program would result in a more positive experience for both the employer and the student.

Previous research has shown the value of a practical element such as an internship in education. The importance of combining practical elements into the teaching of any specialty has been long recognized (Senior, 1997). The schools of construction forming the Associated Schools of Construction (ASC), encourage its members to provide a curriculum that produces qualified professionals for the construction industry. Within the ASC there is agreement that a practical component, as well as the classroom curriculum, is needed for the construction student's education (Senior, 1997). The practical experience gained from a structured internship is important to lay groundwork in preparing students for careers in their chosen fields (Hauck, Allen, and Rondinelli, 2000). Internship benefits include: a) opportunities for permanent placement with the sponsoring company, b) clarifying career choices, and c) increasing student's

self-esteem (Flesher, Leach and Westphal, 1996). Other studies report the effects of structured internship programs on subsequent coursework.

In examining accounting students' post-internship scholastic performance, findings indicate that there is a tendency for both accounting and general grades to improve following an internship (Koehler, 1974). Because the Koehler study lacked a control group of non-interns, and the findings did not indicate statistical significance, Knechel and Snowball (1987) replicated the study to include these two design features. In this second study of interns, Knechel and Snow ball found that while average performance across all courses did not differ significantly between the two groups, differences were found in the undergraduate auditing course. In this case, interns performed significantly better than non-interns. In another study of accounting students' post-internship scholastic performance, English and Koeppen (1993) found that internship students perform significantly better than non-internship students in accounting courses and in overall grade point average (GPA) subsequent to the internship semester. These findings contradict prior research and support accounting internships as tools to enhance students' knowledge and motivation. In an expansion of these accounting studies, Hauck et. al (2000) investigated construction management students' performance in subsequent coursework. The GPA's of the internship group increased slightly (1.09%), but was not statistically significant. Results of this research were inconclusive. Overall the internship group outperformed the non-internship group in subsequent academic performance but the between groups was not statistically significant.

The Association of Teacher Educators (ATE, 2000) reports that the importances of field experiences are not disputed among teacher educators. These field experiences, however, vary greatly from program to program. Although some variability is desirable so programs can respond to unique circumstances, some of the differences may reflect variations in the quality of programs. Roth (1996) suggests setting standards for the internship as one way to monitor quality preparation of students and to ensure a minimum level of program quality. In the field of construction education no common set of internship field experience standards has been developed.

Methodology

This paper analyzes and compares standards or guidelines pertaining to internships with a field experience component in undergraduate domain areas of business, political science, allied health professions, and teacher preparation to determines if one model of internship standards or guidelines enhance construction education internship programs. In this analysis, if no standard was found in a particular domain, additional review of literature was conducted to determine the rationale for this omission.

This analysis required the creation of a structure that would allow for grouping standards for each domain area. These standards and guidelines were compared within the structure to help identify similarities and differences that resulted in coherent portrayal of internship programs within each of the domain areas.

Purpose of the study

This article investigates the definition and specifications of internship field experiences within four domain area undergraduate programs. Elements of the internships discussed in this article are: (a) the definitions of internship, (b) a brief review of accreditation standards and guidelines, and (c) the key components and outcomes of internships. This article addresses the following questions: What is the definition of an internship and field experiences? What are the key components of any internship program? Do current accreditation standards for construction education programs address the major components of an internship programs? Can construction education enhance its internship program by utilizing guidelines and standards for field experiences from other domain areas such as business, political science, medicine, or education?

What are field experiences or internships?

Internship is a term often used to identify the phenomenon of the experiential learning component of an academic curriculum. This experiential component is commonly employed to help students utilize classroom knowledge or extend theory into practice or application. Senior (1997) posited that internships immerse the student in an actual supervised professional situation. Internships are probably the oldest and most widely used format for experiential learning. Gross (1981) defined an internship as a practical experience outside the educational institution in an organization that deals with the line of work one hopes to enter. More specifically, an internship is a relationship with a company or organization in which a student is treated as a quasi-employee (Senior, 1997).

The four domain areas analyzed here use various terms to refer to the experiential field-based component of undergraduate curriculum. These include field experience, internship, and clinical laboratory or clinical practice. Definitions or clarification of the nomenclature within each domain is found in each domain description.

In teacher preparation, internships as a part of cooperative learning programs have been in existence for many years (Moriber, 1996). The preservice phase of a teacher education program has two major components: early field experiences (pre-student teaching) and student teaching or internship. The early field experience that precedes student teaching has two major purposes: to explore teaching as a career and to practice the necessary teaching skills needed to carry out the professional role. Student teaching (internship) is the capstone experience during the pre-service phase where the intern is placed in a school site for a prolonged period of time, typically for 10-15 weeks (Paese, 1996, p. 2). These internships are typically undergraduate, but can be found also in post-baccalaureate or alternative programs.

Less consistency exists in business education. Business internships have been defined as any work or field experience undertaken prior to completion of the formal collegiate education, often with little or no university involvement (Smith, 1964). Other reports describe the business internship as the experiential component of an academic curriculum that provides an efficient way to involve students in actual work situations where students can apply and reinforce classroom knowledge; and can evaluate competing employment opportunities before making a permanent commitment (Koehler, 1974).

In political science, internship is defined as the utilization of practical political involvement adjunct to formal classroom coursework (Hedlund, 1973). Hedlund noted that internships have two primary goals – education and research, and one secondary goal – public service. Political science internship experiences have been developed with political officials in local, state and national level offices; sponsored by institutions of higher learning, public and private agencies, elected officials, private organizations and professional associations (1973).

The medical profession has a long history of supporting internships. Students in these internships assist, learn from, and work with more experienced doctors (Moriber, 1996). The formal term of *intern* in this instance typically refers to a phase of the medical education beyond the undergraduate level. But, a great many undergraduate health profession programs do provide students with experiential learning opportunities through clinical laboratory, clinical practice and internship curriculum. Clinical laboratory and clinical practice courses are more directly supervised and controlled than other undergraduate internships. According to the Commission on Accreditation of Allied Health Education Programs, a student's education should end with a capstone experience to integrate knowledge, behaviors, and professional attributes acquired throughout the curriculum that are necessary to the practice of the health profession (CAAHEP, 2003).

Do current accreditation standards for construction education programs address the development and structuring of internship programs?

Douglas, Ward and Dugger (2002) suggest the importance of standards for construction education programs. They stated, "An objective of accreditation, no matter what the academic discipline, is to ensure that certain predetermined sets of standards that have been established by the particular profession are being followed. Accrediting bodies address the need to establish program benchmarks such as student admission requirements, retention, scholastic success and graduate placement data. While not directly affecting the discipline development, the collection and analysis of these data, where appropriate, play a key role in ensuring that the needs of industry as well as students and society are being met."

According to ENR (2001), two accrediting organizations, the American Council for Construction Education (ACCE) and the Accreditation Board for Engineering and Technology (ABET) represent construction education curricula. The ACCE emphasizes construction management and ABET focuses on construction engineering programs. Another accrediting agency, the National Association for Industrial Technology (NAIT), provides accreditation of construction programs housed within Industrial Technology programs.

It was disappointing to find that a review of these accrediting agency standards found no method for developing or structuring an internship program for construction education. ABET stated that it has no authority to impose any restriction or standardization upon educational programs, nor does it desire to do so. ABET aims to preserve the independence of action of individual institutions and thereby, promotes the general advancement of engineering, technology, computing and applied science education (ABET, 2003). The *ACCE Standards and Criteria for Baccalaureate Programs* simply suggest that students *should* work to obtain construction related experience through participation in internships and cooperative education programs (ACCE,

2002). The *NAIT Accreditation Handbook – 2003* suggests that each major program shall include appropriate industrial experiences such as industrial tours, work-study options and cooperative education, or senior seminars focusing on problem-solving activities related to industrial situations. The industrial experiences shall be designed to provide an understanding of the industrial environment and what industry expects of students upon employment (NAIT, 2003). Additionally NAIT urges that if cooperative education is either a required or an elective part of the program, then appropriate services be provided to assist the placement and supervision of cooperative education students (NAIT, 2003).

In summary, it was found that accrediting agencies governing construction education programs do not specifically address the development and structuring of internship programs in their accreditation standards.

Why Study Business, Political Science, Health Professions and Teacher Education Standards?

Because accrediting agencies concerned with construction education provided little or no guidance in the development or structure of internship programs, it was necessary to investigate or review other domain programs. Originally concerned with internships within an industrial technology program, investigation of other disciplines *related* to industrial technology became appropriate. Industrial technology is defined as a field of study designed to prepare technical and/or technical management-oriented professionals for employment in business, industry, education and government (NAIT Handbook, 2003). Following this suggestion, this review investigated domain area standards in undergraduate programs in business, political science, allied health professions and teacher preparation was conducted.

Business was selected for investigation because the constructor is a manager. A construction manager is defined by the construction industry and university construction management programs as a manager who can effectively coordinate activities, people, subcontractors, materials, and financial aspects of a project to bring about a company's continued growth and performance (Adcox, 2000). Utilizing standards associated with economics, finance, principles of management, accounting and business regulations would be beneficial to construction education.

Political Science was selected for investigation because construction is concerned with people, their interrelationships, and the allocation of resources. Construction involves human interaction at several levels, often aligned with economic resources and development. The ability to communicate and understand human behavior are essential assets to the constructor. The greatest challenge in construction management is to bring together all the project resources, in the correct quantity, at the optimum time.

Allied Health Professions (CAAHEP) was selected for investigation because construction is a practice-oriented profession much like health professions. Although the traditional medical internship occurs beyond the undergraduate education, the allied health professions complete an experiential component during undergraduate study.

Teacher preparation was selected as a domain of investigation because similar to construction, teaching is also a practice-oriented profession. Additionally, teacher preparation programs have conducted extensive research concerning internships that involve the student, the faculty supervisor, and the practitioner. Teacher education programs are also dedicated to the continuous improvement of their teacher preparation programs and provide invaluable information concerning program improvement.

Results

Can construction education enhance its internship program by utilizing guidelines and standards for field experiences from other domain areas such as business, political science, medicine, or education?

See Appendix A: Key components of internship programs in four domain areas

This investigation analyzes and compares standards and guidelines for internships or field experiences in undergraduate university domain areas of: business, political science, allied health professions, teacher preparation, with construction education.

Analysis of the Four Domain Areas and Construction Education

Business

The accreditation agency for business education is the Association to Advance Collegiate Schools of Business (AACSB), formerly the American Assembly of Collegiate Schools of Business. This agency promotes continuous quality improvement in collegiate schools of business. Standards for business administration were first set in 1919. In 1980, AACSB adopted additional standards for undergraduate and master's degree programs in accountancy. In 1991, mission-linked accreditation standards and procedures for undergraduate, master's, and doctoral degree programs were created. According to the Preamble of AACSB, "member schools reflect a diverse range of missions. Diversity is viewed as a positive characteristic to be fostered, not a disadvantage to be reduced or minimized. Therefore, one of accreditation's guiding principles is the tolerance, and even encouragement, of diverse paths to achieving high quality in management education."

No standards directly specifying the development or structure of business internship programs were found, therefore a review of literature concerning business internships was conducted. The literature concerning business internships provided a generous amount of information related to more specific "accounting" internships, with most of that literature investigating the effects of internship programs on subsequent college performance. English and Koeppen (1993) cited earlier literature supporting the benefits of accounting internships. A study by the American Accounting Association (AAA, 1952) noted the benefits to include: broader exposure to accounting techniques and problems not possible in the classroom, improved understanding of the business world, and the improved ability to evaluate and assimilate classroom experience. Lowe (1965) found that interns felt the internship clarified accounting theory, while Koehler

(1974) asserted that internships motivate students to work hard early in their academic programs in order to secure internships and result in improved grades upon conclusion of those internships. Smith (1964) reviewed accounting education internships, citing the 1959 Council of the A.I.C.P.A.'s advice that "plans be developed so that internship be well organized and supervised by schools and practitioners."

In 1964, Smith gave six reasons for the loss of interest in the academic internship: a) industry demand for graduates (permanent positions could be secured without the contact provided by internship, b) student inconvenience to move from school to work locations and back before graduation, c) the university semester plan does not complement the work environment, d) firms, for what ever reason, are less responsive to accepting undergraduate students than in earlier years, e) new educational techniques and improvements in teaching methods and materials tend to reduce the necessity for a field experience, and f) many schools have failed to name a faculty member to be responsible for supervising and generating student interest in the internship program.

In order to overcome this lack of interest, it is important to clarify the elements that make up the business internship and the benefits that might be realized. Smith (1964) points out that the internship should provide students with a broad perspective of accounting practices by assigning students to a variety of jobs, projects, activities, companies or programs. Further, the internship should be a requirement for either a bachelor or master degree, but not granted prior to completion of the junior year (1964). However, credit toward graduation for successful completion is a matter to be resolved by the respective college or university. Smith concluded that in order to have a successful program, a faculty member should be assigned the responsibility of supervising the program, conferring with students and working with practitioners and industry personnel on all matters of common interest to the intern, the employer and the college. Lowe (1965) revealed weaknesses of some programs to include: programs were too brief to be of great value, programs did not diversify activities, and results of work not viewed by interns. While supervision from the field placement company was generally complimentary, additional instruction was often needed for the supervisor. Supervision from the college was a weakness in a number of programs, with little contact with interns in the field and little control over the quality of their experience. More reflection and reactions to the program (from students, faculty and practitioners) are necessary to improve the program (Lowe, 1965).

Political Science

Finding no accrediting agency associated with political science, or any standards or guidelines offered by the American Political Science Association (APSA), a brief review of literature was conducted. In research during the early 1970's in Political Science (*PS* – the professional journal of the APSA), Hirschfield and Adler (1973) point out that political science literature largely ignored questions regarding the scope, structure, and strategies of internship programs. Hedlund (1973) described how little assistance was available in journals or books of political science dedicated to understanding how students respond to the internship experience or what can be done to maximize student learning. Until the 1970's there was no central source to coordinate the national, state and local political internship programs or their sponsors. The communication regarding internship was fragmented and haphazard. These two 1973 reports in *PS*, along with

publication of the book, *Government Management Internships and Executive Development*; and a new journal, *Teaching Political Science*, plus the formation of a center for disseminating internship information, the National Center for Public Service Internship Newsletter (NCPSI), indicated a new stage in the evolution of political science concern with internships. Hedlund (1973) briefly reviewed the goals of internships and considered observations of program directors and participants, qualities of offices, qualities of the intern and educational structuring.

The conclusion of the NCPSI was that only after program supporters, interns and directors undertake systematic reflection and analysis regarding internship goals and methods are internships likely to maximize their learning potential. Hennessey gives the three critical elements required in any useful internship: a) it must be a "real work" situation, b) the student must participate on the same basis as other workers, and c) there must be systematic and continuous examination of the experience in relation to generalization of political science (Hirschfield and Adler, 1973). Of the three components of a good internship program – student, principal and faculty member – the last is deemed the most important. The faculty member finds a field placement for the intern, informs principals of their responsibilities, makes on-site visits, and continually communicates with the intern. The selection and training of the internship supervisor is critical to the success of the program. Hirschfield & Adler (1973), concluded that an effective internship program should include the following essential elements: a) highly motivated, professionally competent, and politically attuned faculty, b) understanding of and commitment to the educational purposes of the internship program on the part of principals, as well as faculty and students, c) well-structured and discipline-related academic input through regular seminars or class work, d) the assignment of written work so that the student can organize his perceptions of his internship experience, e) academic credit for participating so that the internship is regarded as a legitimate part of the student's curriculum, f) continuing communication among students, faculty and principals through regular meetings and newsletter distribution so that an atmosphere of common purpose is maintained, and g) adequate funding to meet the program's administrative needs and to make possible the inclusion of any students who would gain from an internship.

The APSA website provides access to, *Studying in Washington: A Guide to Academic Internships in the Nation's Capital (Frantzich, 1977)*. The first as well as the next three editions, entitled *Storming Washington: An Intern's Guide to the National Government.* The guide introduces students to the objectives, procedures, and anticipated outcomes of an internship in the United States capital. Information assists faculty in advising students and informs academic administrators and students' families about why internships make a significant contribution to education and career preparation. Although this book's main focus is an overview of the city of Washington, D.C., the advice to students about how to benefit from an internship can be adapted to internships in state and local politics and government as well.

Allied Health Professions

The Commission on Accreditation of Allied Health Education Programs (CAAHEP) is the non-profit agency established July 1, 1994, which accredits programs representing 18 allied health professions in over 1900 allied health education programs in more than 1300 institutions. These institutions include universities and colleges, academic health centers, junior and community

colleges, hospitals, clinics, blood banks, vocational-technical schools, proprietary institutions, and government institutions and agencies.

CAAHEP cooperates with Committees on Accreditation sponsored by various allied health and medical specialty organizations. Each of the program accreditation standards are the minimum measures of quality to be used in accrediting programs that prepare individuals to enter the respective health care professions. Standards therefore constitute the minimum requirements to which an educational program shall be held accountable.

Although specific standards regarding structuring internship programs were not found, a commonality within the many program standards was found in their respective instructional plans. Each discipline within CAAHEP expects "that the curriculum must include an appropriate sequence of learning experiences consisting of classroom and laboratory presentations, discussions, demonstrations, and *supervised laboratory* and *clinical practice"* and "clearly written course syllabi which describe learning objectives and competencies must be developed for each of the didactic, *laboratory*, and *supervised clinical* education components" (CAAHEP, 2003).

Curriculum requirements for health information management states that programs should provide, "Appropriate learning experiences and curriculum sequencing to develop the competencies necessary for graduation, including appropriate instructional materials, classroom presentations, discussions, demonstrations, and *professional practice experiences*." Another requirement is, "a) There must be supervised professional practice experience designed to reinforce learning experiences. b) The instructional staff shall be responsible for assuring that the activities assigned to students in the professional practice setting are consistent with program goals and standards. c) Supervised professional practice assignments for students shall be structured to gain experiences in applying knowledge to technical procedures and in developing professional attitudes for interacting with other professionals and consumers in the healthcare field. Professional practice experiences may be included in the curriculum as separate courses, incorporated within courses, and/or developed as simulated professional practice modules. Off-campus assignments shall be in facilities, organizations, or agencies related to healthcare. The student's education should end with a capstone experience to integrate knowledge, behaviors, and professional attitudes acquired throughout the curriculum that are necessary to the practice of health information administration (CAAHEP, 2003).

Teacher Preparation

The National Council of Accreditation of Teacher Education (NCATE) is an agency that accredits colleges, schools, or departments of education in the United States. The U.S. Department of Education and the Council for Higher Education Accreditation recognize NCATE as a professional accrediting body for teacher preparation.

NCATE Standards. NCATE's Standard 3, directly addresses field experiences and clinical practice. Clinical practice is defined as either preservice student teaching or internship for administrators. The standard states, "The unit and its school partners design, implement, and evaluate field experiences and clinical practice so that teacher candidates and other school

personnel develop and demonstrate the knowledge, skills, and dispositions necessary to help all students learn" (2003).

The following are excerpts from the NCATE Standard 3: Field Experiences and Clinical Practice.

> *Collaboration.* The standard calls for collaboration between the "unit" (teacher preparation program) and the "triad" (university faculty, campus faculty and teacher candidate), with shared and integrated resources and expertise to support candidates' learning in field experiences and clinical practice. Both faculty are involved in designing, implementing, and evaluating the unit conceptual framework(s) and the school program; they each participate in the faculty professional development activities and instructional programs for candidates and children. The faculty jointly determine specific placements of student teachers and interns for other professional roles to maximize the learning experience for candidates and P-12 students.
>
> *Partnering.* Field experiences allow candidates to apply and reflect on their content, professional, and pedagogical knowledge, skills and dispositions in a variety of settings with students and adults. Both field experiences and clinical practice extend the conceptual framework(s) into practice through *modeling* by clinical faculty and well-designed opportunities to learn through *doing*. During clinical practice, candidate learning is integrated into the school program and into teaching practice. Candidates observe and are observed by others. They interact with teachers, college or university supervisors, and other interns about their practice regularly and continually. They reflect on and can justify their own practice. Candidates are members of instructional teams in the school and are active participants in professional decisions. They are involved in a variety of school-based activities directed at the improvement of teaching and learning, including the use of information technology. Candidates collect data on student learning, analyze them, reflect on their work, and develop strategies for improving learning.
>
> *Faculty Development.* Clinical faculty are accomplished school professionals who are jointly selected by the unit and partnering schools. Clinical faculty include both school and higher education faculty responsible for the field experience or internship. Clinical faculty are selected and prepared for their roles as mentors and supervisors and demonstrate the skills, knowledge, and dispositions of highly accomplished school professionals.
>
> *Candidate Development.* Entry and exit criteria exist for candidates in clinical practice. Assessments used in clinical practice are linked to candidate competencies delineated in professional, state, and institutional standards. Multiple assessment strategies are used to evaluate candidates' performance and effect on student learning. Candidates, school faculty, and college or university faculty jointly conduct assessments of candidate performance throughout clinical

practice. Both field experiences and clinical practice allow time for reflection and include feedback from peers and clinical faculty. Field experience and clinical practice provide opportunities for candidates to develop and demonstrate knowledge, skills, and dispositions for helping *all* students learn. All candidates participate in field experiences or clinical practice that include students with exceptionalities and students from diverse ethnic, racial, gender, and socioeconomic groups.

ATE Standards. Additional standards reviewed in the area of Teacher Preparation include the Association of Teacher Educators (ATE), *Standards for Field Experiences in Teacher Education* (2000). The Association of Teacher Educators, founded in 1920, is an individual membership organization devoted solely to the improvement of teacher education both for school-based and post secondary teacher educators. ATE members represent over 700 colleges and universities, over 500 major school systems, and the majority of state departments of education. In addition, ATE has representatives on the National Council for Accreditation of Teacher Education (NCATE), the Holmes Partnership (for Professional Development Schools), and the Educational Research Information Clearinghouse (ERIC) on Teacher Education. The recent development of new "National Standards for Field Experiences in Teacher Education" was completed in collaboration with the executive board of ATE. Standards developed by the ATE correspond with, complement, and extend the NCATE standards.

The ATE *Standards for Field Experience in Teacher Education* (2000), include twelve standards: 1) collaboration of universities and schools with a commitment to simultaneous review and reform; 2) assessment of the internship program; 3) selection, preparation and assignment of university faculty; 4) selection, preparation and assignment of cooperating faculty; 5) the roles of the triad – candidate, cooperating school supervisor, and university supervisor; 6) feedback to candidates – verbal and written based on agreed upon outcomes by university and school supervisors; 7) continuous communication and interaction through on-site observation, cross-site interactions, and use of communications technology; 8) opportunities for ongoing reflection on and analysis of teaching and learning, school conditions, and candidate development; 9) context and sequence of the field experience; 10) school contexts provide supportive environments; 11) diverse student populations and diverse settings; and 12) adequate resources (expertise and financial) for administration and implementation.

The following are excerpts from the ATE *Standards for Field Experiences in Teacher Education,* providing the elements necessary for a successful field experience:

1. University/School Collaboration with commitment to simultaneous review and reform -- the goals and mission of the teacher preparation program and the goals and processes of the field experiences are developed and agreed upon collaboratively by the university and cooperating teacher educators and administrators.

2. Assessment of the Internship Program – uses a model of assessment that addresses realistic goals and objectives and promotes high expectations. Assessment is ongoing and used for program improvement. The program model is

developed by those involved in the field experience (triad) regarding the following areas: context or setting, placement process, collaborative fostering, professionalism, program goals, candidate outcomes, benefits to students, resources, rewards and accountability, and compliance with state and local policies/practices.

3. Selection, preparation and assignment of university faculty – is systematic, collaborative, and based on the agreed upon internship program framework.

4. Selection, preparation, and assignment of cooperating faculty – is systematic, collaborative, and based on the agreed upon internship program framework.

5. The focus of the roles of the triad – candidate, school supervisor, and university supervisor. All field experience participants demonstrate pedagogical and content knowledge, skills and dispositions that are congruent with teacher education program outcomes. Field experiences are aligned to meet program and/or national standards.

6. Feedback to candidates – verbal and written formative and summative feedback regarding progress demonstrating professional learning in relation to explicitly stated program outcomes agreed upon by university and school supervisors. Multiple assessment procedures include professional portfolios, self-assessment and peer-assessment.

7. Continuous communication and interaction through on-site observation, cross-site interactions, and use of communications technology – the triad communicates with each other in some way at least once a week. Quality interactions facilitate a professional learning community and decrease communication problems. Candidates demonstrate increased self-confidence and skills in communication.

8. Opportunities for ongoing reflection on and analysis of teaching and learning, school conditions, and candidate development – reflection tools include journals and portfolios.

9. Context and sequence of the field experience – the triad unit hold compatible views and philosophies about teaching and learning, with varied field experiences designed to meet varied and sequential goals of the teacher education program. Field experiences are sequential and cumulative and based on models of professional development. Placements meet goals of the teacher education program and are sequenced to meet the developmental needs of the teacher candidate.

10. School contexts provide supportive environments – teacher candidates feel comfortable in the schools in which they are placed. Administrators, teachers, students, and parents in the school setting want and support teacher candidates.

Candidates participate in the life of the school as member of a learning community.

11. Diverse student populations and diverse settings – extended field experiences with diverse school populations include students of different age levels, diverse racial and ethnic groups, diverse socio-economic backgrounds and diverse special needs. The internship program provides diverse placements in schools with diverse administrative, curricular, and structural features. Candidates have opportunities to work with different students in different school structures.

12. Adequate resources (expertise and financial) for administration and implementation – both university and school resources are necessary. Administration of the field experience is a shared expense. Personnel are designated and compensated for handling logistical responsibilities of the program including: candidate clearance; procurement and placement of candidates; development of field experience guidelines, handbooks, etc.; arranging seminars and meetings; and developing and implementing assessment and research procedures.

Because an extensive review of literature was included in the preparation of the NCATE and ATE standards for teacher education field experiences, an additional review of literature concerning teacher education internship was not necessary.

Construction Education

In order to *compare* the above four domain areas with construction education, and because accrediting agencies concerned with construction education provided little or no guidance in the development or structure of internship programs, it was necessary to review literature regarding construction education internships. An analysis of construction education literature follows.

Senior (1997) reported the need for an internship as part of the construction curriculum to be almost universally supported by ASC faculty across the country. The level of intervention, however, was found to be quite different among colleges. Some programs like Purdue University's Construction Engineering and Management, require the internship component of the curriculum. Purdue's full-time internship director, recruits sponsors and is the liaison between them and their interns. Other programs are minimalist in approach to internships. These programs allow the campus Coop program to administer the internship. Students are responsible for contacting sponsors. The number of interns hired and their work conditions are organized at the discretion of the sponsors.

According to Adcox (2000), the internship experience is generally the most important single part of a construction management student's professional preparation. Internships should be a competency-based program with pre-stated instructional goals and outcome performance behaviors designed to specifically represent the competencies necessary for the construction manager to function efficiently". Adcox (2000) posits that the internship experience is conceptualized as a partnership between construction industry work sites and the university's

academic environment. Each partner brings a special and necessary area of expertise to the partnership, thus enabling on-site directing managers to assist and direct the construction management student to progress from novice to productive construction manager.

Marshall (1999) provided a rationale for implementing a required professional internship and presented the typical elements of an internship portfolio, and examined the crucial role of the professional internship coordinator. Marshall stated that the benefit of a well designed and carefully structured internship would not only provide job placement for graduates, but is also a recruiting tool for potential students with a desire to upgrade their skill sets. The internship partnership also affords opportunities for equipment donation, scholarships, faculty sabbaticals and is a source of members for advisory boards. Marshall (1999) reported that internship provides an opportunity for the student to link theory to practice and to reflect on situations outside the classroom where problems are real, solutions are complex, and individualized challenges are possible. Upper class standing is important to optimize the internship experience. Securing employment is the student's responsibility. Portfolio assessment is recommended with typical elements including: student resume, company organization chart with mission statement or goals, student performance goals, daily logs, self-evaluation with reflection, and a final written evaluative report. Marshall reported that the hosting firm plays a vital role toward the success of the internship program by the assignment of intern's professional responsibilities and providing the industry supervisor for guidance.

The student is expected to be exposed to various aspects within the company and will be paid at a level agreed upon, while no permanent employment is being offered. The intern's industry supervisor also completes intern performance evaluations. According to Marshall (1999), the university coordinator's role involves recruitment, administration, guidance, coordination, and a great deal of quality control. The coordinator must be readily available to assist the student or the hosting firm. The communication process between the "triad" – student, hosting firm and university coordinator, must occur prior to and continuously throughout the experience. The coordinator is the established liaison with the industry, maintains the historical relationship, and insures the quality and consistency of the program. The university coordinator conducts site visitations and develops a written evaluation of the intern.

The answer to the question, "Can construction education enhance its internship program by utilizing guidelines and standards for field experiences from other domain areas such as business, political science, medicine, or education?" is, not from accreditation standards alone. Construction education can however gain some insight for structuring internship programs by reviewing literature in each domain area, and placing the data collected into a structured matrix (see Appendix A), revealing the key components shared by the different domains areas of interest.

Comparison of the Four Domain Areas with Construction Education

Although the standards from teacher education were found to be the only domain area that specifically define and specify the development or structure of an internship program and its continued improvement, the analysis of the standards along with a review of literature in each domain area, provided data for placement in the following structured matrix (see Appendix A).

This matrix provides for the comparison of program variables of the four domain areas with construction education.

It was interesting to find that all domain areas except political science have accreditation agencies associated with their discipline. In construction education, not one of its three governing accreditation agencies was found to address in their standards the structuring of field experience or internship. The allied health professions, on the other hand, set standards for each and every specific discipline within their domain. Teacher preparation was the only domain area to write formal standards addressing the structure, development and continued improvement of field experiences and internships.

When comparing across domains whether internship is "required" for graduation, only teacher preparation and the allied health professions make internship a requirement. Within construction education, the ACCE makes internship mandatory for program accreditation, but does not provide any guidance for the structure or development of that internship experience.

Across domains, all were found to have certification exams or licensure (except political science), with the allied health professions having a board of examiners overseeing each separate discipline. Interestingly enough, only the allied health professions require these examinations for college graduation. The allied health professions programs also require these examinations for employment. Teacher education programs do not require the examinations for employment, but typically states require the exam for teacher certification. Teacher ed programs organize their programs to respond to state program requirements and in order for graduates to pass the state teacher certification examination. Alternative teacher certification does exist and programs vary among states. However, alternative certification programs include some measure of supervised field experience (U. S. Department of Education, 2002).

Paid internships are allowed and are considered the "norm" in business, political science, and construction education, while internships in the allied health professions and teacher preparation are not paid.

Collaboration between university programs and their respective industries are found in all domain areas with more formal partnerships in the allied health professions and teacher preparation. Construction education has shown increased interest in collaboration and partnering.

While placement of students in specific internships is not typically provided by construction education, allied health professions and teacher preparation have provided placement for students.

While all domain areas including construction education, provide for specifically selected university faculty supervisors to administer their respective internship programs, construction education does not select the cooperating industry supervisors nor do they provide any special training for those supervisors.

University supervisor site visitations are not mandatory across all domains (except teacher preparation).

Evaluation and deliverables across all domains vary. Evaluation and deliverables for the construction internship experience vary as greatly as the many different names of their programs. On one end of the spectrum, some programs require the majority of the following deliverables: self evaluation, university supervisor evaluation, cooperating industry supervisor evaluation, written reports, daily logs, portfolios and written reflections or perceptions. While on the other end of the spectrum, a minimal account of the whole experience may be required in one short written report.

Course credit for the internship was found to influence the amount of evaluation and deliverables required for the internship experience across all domains.

Although an industry advisory council was found to be required for only the allied health professions and teacher preparation, all domains showed evidence that these councils are being considered to improve university program and related industry relationships.

All domain area literature revealed an interest in collaboration between the university and the triad members, and collaboration on the internship structure and improvement. Across all domains, continuous communication between the triad members was considered important.

Construction education does not choose the work context for its students, nor does it formally promote work in "diverse populations". The construction education literature suggests that construction by its very nature is diverse and therefore provides a diverse working environment. On the other hand, the other domain areas promote work in diverse populations, and the allied health professions and teacher preparation programs have often chosen the context for their students. All domains suggest that a diverse work environment is important for the student's education.

All domain areas consider the appropriate sequencing of the internship to occur in the upper-level years of a student's education. Construction education literature suggests that the experiential component being implemented in the Junior year helps the student to clarify career choices, direct subsequent coursework interests, and integrate classroom knowledge with real world work experiences.

Across domain areas, not all literature suggested that internship administration be adequately funded.

When comparing the length or duration of the internship field experiences across domains, considerable variation was found. In business, political science and construction education the length of an internship varied from none, to one summer session, to two summer sessions, up to one long semester. Political science additionally allowed one- and two-month internships while students were concurrently enrolled full-time students. Only allied health professions and teacher preparation required long semester internships.

From this comparison of domain areas with construction education, Figure 1 reveals the key components of internship shared by all domain areas (see Figure 1).

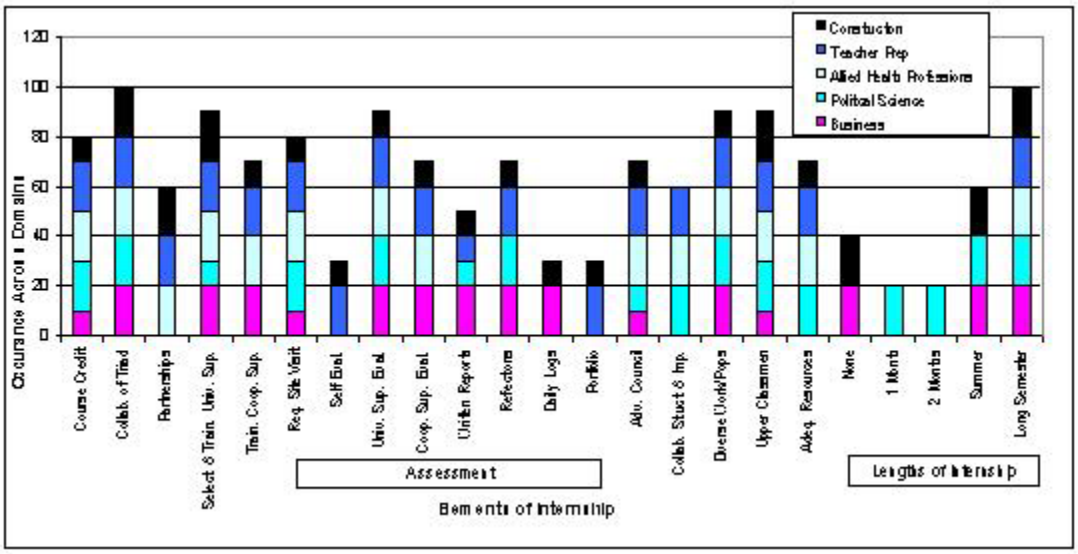

Figure 1: Key Elements of Internship Shared Across Domains

The key elements of internship shared across domain areas included: course credit; collaboration of triad members to design, implement and evaluate internship programs; formation of university-industry partnerships; selection and training of university faculty; providing adequate guidance for cooperating supervisors; required site visitations; evaluation methods to include: self-evaluation, university faculty and cooperating supervisor evaluations, written reflections of student on performance, program, and improvement, daily logs and a portfolio; creation of industry advisory councils; collaboration for internship structure and continued improvement; diverse context of work with diverse populations; sequencing within academic program to be at least upper class standing; adequate resources (both expertise and financial); and adequate length of internship programs.

Conclusion

This investigation analyzed and compared standards and guidelines for internships or field experiences in undergraduate university domain areas of: business, political science, allied health professions, teacher preparation, with construction education. The standards from teacher education were found to be the only domain area that specifically define and specify the development or structure of an internship program and its continued improvement. An analysis of the standards, along with a review of literature, provided the data for placement in the structured matrix (see Appendix A). Figure 1 reveals the key components shared by the different domains of interest.

Although the many issues that the teacher education field experience standards address are essential in a teacher preparation program, it is unlikely that construction education programs or the pragmatic hosting firms will see the necessity to consider *all* the issues addressed.

While the information revealed in Figure 1 provides a list of key components for utilization in a construction education internship program, additional research is necessary before a set of "best practices" guidelines can be suggested.

Further Discussion

More important than arguing for just one model to enhance construction education internship programs, the construction education discipline needs to research in depth, internship programs currently being implemented at the undergraduate university level. And, because the interactions of the "triad" (student, university faculty supervisor and industry supervisor) were found to be important in developing and structuring internship programs, research concerning the triad's perceptions regarding internship needs to be conducted. Additional research in this are is now being conducted and will appear in a follow-xup report. It will then be possible, through the integration of the investigated standards and guidelines, information gathered concerning currently implemented construction education internship programs, and the perceptions of the triad members, that a set of "best-practices" guidelines or standards can be developed for the construction education discipline.

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Appendix A

Key components of internship programs in four domain areas:

Variables	Business	Political Science	Allied Health Professions	Teacher Preparation	Construction Education
Accreditation Agency	AACSB	No	CAAHEP	NCATE	ACCE, ABET, NAIT
Experiential Learning Nomenclature	Intern	Intern	Clinical Lab Clinical Practice Internship	Field Experience Student Teacher Clinical Practice Internship	Intern
Required	Required	Optional	Required	Required7,8	Yes11/No9
Optional	Yes	Yes			Yes11/No9
Course Credit	Yes/No3	Yes1	Yes7,8	Yes7,8	Yes/No
Standards for Internship Program Structure			Discipline Specific	NCATE, ATE	
Certification Exam/Licensure	CPA CMA		Board of Examiners (each discipline)	ExCET in TX (each State)	AIC
Required for Graduation	No	No	Yes	No	No
Optional for Graduation	Yes		No	Yes	Yes
Required for Employment	No	No	Yes	Yes	No
Internship (Can be PAID)	Yes	Yes	No	No	Yes11
Partnerships			Healthcare facilities, Organizations, or Agencies	Schools7	Yes10,11
Placement Provided	No	No	Yes	Yes7,8	No9,11
Selected University Faculty	Yes3	Yes1,5	Yes6	Yes7,8	Yes9
Selected Cooperating Supervisor	Yes	Yes	Yes6	Yes7,8	No
Special Training	Yes4	No	Yes	Yes7,8	No

University Supervisor Special Training Cooperating Supervisor	Yes4	No	Yes6	Yes7,8	No
University Supervisor Site Visit					
Required	No	Yes5	Yes6	Yes7,8	Yes11/No
Optional	Yes	Yes	Yes	No	Yes
Evaluation of Internship Required			Each discipline requirements		
Self Evaluation				Yes7,8	Yes11/No
Coop. Sup Eval.	Yes2		Yes6	Yes7,8	Yes11/No
Univ. Sup. Eval.	Yes2	Yes5	Yes6	Yes7,8	Yes11/No
Written Report	Yes2	Yes/No		Yes/No	Yes11/No
Daily Logs	Yes2			No	Yes
Portfolio				Yes7,8	Yes11/No
Written Reflections/ Perceptions	Yes2,3	Yes1	No	Yes7,8	Yes11/No
Industry Advisory Council					
Required	No	No	Yes6	Yes7,8	
Optional	Yes	Yes			Yes11
Collaboration of Univ. w/Triad	Yes3	Yes1,5	Yes6	Yes7,8	Yes10,11
Collaboration on Internship Structure and Improvement	No	Yes1	Yes6	Yes7,8	Yes10,11
Promotes Work in Diverse Populations	Yes3	Yes	Yes6	Yes7,8	No
Context chosen For Student	No	No	Yes/No	Yes7,8/No	No9,10,11

Context Diverse	Yes3,4	Yes	Yes6	Yes7,8	Yes11
Continuous Triad Communication	No	Yes1,5	Yes6	Yes7,8	Yes11
Sequencing of Internship	Jr.3	Jr.	Jr./Sr.	Jr./Sr.7,8	Jr.11
Adequate Funding for Administration	No	Yes1	Yes6	Yes7,8	Yes/No
Length of Internship	None Summer Long Semester	1 month 2 months Summer Long Semester	Long Semester	Long Semester	None Summer Long Semester

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2. Moriber, A. C. (1996)
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5. Hedlund, R. D. (1973)
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11. Marshall, J. A. (1999)

Technical Writing for Construction Science Graduates

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The purpose of this study was to determine the perceptions of the construction industry as well as the construction educators regarding the need for technical writing skills among Construction Science graduates. An instrument was prepared to gather the data related to the technical writing skill set of construction science graduates. This instrument was sent to the CEO's of the construction companies, identified from the career fair database of a large south-central university, and faculty members of in the Associated Schools of Construction. The results of the survey were used to determine the importance of different construction documents used within the construction industry for which good technical writing skills are essential. The data was analyzed using stepwise and multiple regression techniques. The results from the study indicate that capability of writing business letters, request for bid information, e-mails, and schedule of values are important in terms of technical writing. All these factors were found to be related to the overall capability of technical writing skills among Construction Science graduates at a level of significance of 0.05.

Key Words: Construction Science, Construction Documents, Technical Writing, Undergraduate Education.

Statement of the Problem

Ability to communicate effectively through the use of technical, written, communication skills can greatly affect a person's career. An individual's capacity to write effectively is usually regarded as a first-rate attribute. It can be categorized equally with a person's professional skills and knowledge. Professionals in all disciplines, including construction, spend a considerable amount of their time in writing technical reports. It is a critical component to all tasks of significant importance.

Given this importance, industries report that students graduating from technical programs are generally not well prepared for the writing requirements of the contemporary workplace (Bradney & Courbat, 1998). Industries naturally have their own set of terminology committed to the specific requirements and situations exclusive to their form of business. Communicating effectively within an industry is a direct result of an individual's ability to understand and use the industry's vocabulary and communication practices. Effective written communication skills can assist in the acquisition of sought-after contracts and clients as well as assist in maintaining optimal relationships with vital customers.

Project documentation is critical to the success of many companies. Understanding and learning how to prepare a variety of construction documents is of utmost importance to construction professionals. The purpose of this study was to ascertain the importance of technical writing skills for construction science graduates and to identify the particular topics that are perceived to be important both by the industry and the academia that may be included in a technical writing course in a construction science curriculum.

Literature Review

Overview

With the growth of the U.S. college student population in the 1960s and early 1970s universities and community colleges recognized that a high percentage of students had problems writing effectively (Ray & Stilter, 2000). Leaders in industry have stated that for nearly 50 years that a major weakness of graduating technical students is their lack of written communication skills (Bradney & Courbat, 1998).

The inability to communicate effectively does little to enhance the image of a company. In fact, it proves to be detrimental. Good writing skills are necessary in order to communicate with clients, as well as with partners and co-workers. How successfully a company communicates potential problems and issues will largely depend on the writing and communication skills of the company employees (Ray, 1999). In the construction profession, reading and writing are paramount to an individual's performance in successfully completing a project (Ray, 1998).

Every industry has an undefined list of terms that are essential to the specific requirements and situations unique to that industry. An individual can successfully communicate within an industry when they have mastered the terminology and methods of communication relevant to that industry. When students graduate from their respective programs, they will be given a wide range of activities and projects that will require them to exhibit acceptable documentation and writing skills (Ray & Stilter, 2000). There are few commercial endeavors that use and rely on written language skills as much as construction contracting does (Maher, 1990).

Being unable to acceptably execute these basic skills, new graduates will find themselves at a considerable disadvantage (Maher, 1990). Many construction programs offer courses in subject areas ranging from building materials and methods to structures and environmental systems. It would be logical to believe that these are the skills essential to one's success in the construction industry (Maher, 1990). In reality, the most important skill to be taught is the ability to write effectively (Maher, 1990).

It is no secret that construction education graduates are deficient in possessing adequate writing skills for entering the business community (Wright, 1987). Understanding that these skills need to be improved is the first step in correcting the problem (Ray, 1998).

Teaching Relevant Material

In order to fill the void in writing skills educators must focus their attention on writing as a fundamental communication skill (Wright, 1987). It is important not only to make students write, but to have them write on subject areas relevant to their studies (Ray, 1998). It appears to be nonproductive to teach writing without concurrently teaching the subject matter (Wright, 1987). If educators expect writing skills to be developed only in English specific-type courses, it is imperative that such courses be provided relevant content and set the context in the students' limited experience in language usage (Wright, 1987).

Employers expect entry-level employees to be capable of writing effectively the matters related to specific conditions of a particular project (Ray, 1998). Professionals spend approximately 20 percent of their time writing reports of some sort. Graduates must know how to write competently and exhibit this competency immediately on entering the industry in order to be successful (Maher, 1990).

If the problem has been readily identified it would be the assumption of many that colleges and universities would make the development of first-rate writing skills an important goal and assign some of their best instructors to the accomplish the task. Unfortunately, this is typically not the case (Bradney & Courbat, 1998).

Many professors in English departments usually specialize in a particular form of literature and not in English composition. Many will privately admit that they do not nor want to know how to teach composition writing courses. Many of these professors are not adequately prepared to evaluate the obscure information usually entailed in technical topics. Since the information cannot be judged on content, most instructors will invariably revert to issues of format and technique. In short, the writing in many areas of composition and technical writing courses does not reflect the kinds of writing that the modern workplace expects students to do (Bradney & Courbat, 1998).

Writing Across the Curriculum

Regardless of the style and amount of writing in specific English courses, the evidence was apparent. A "gap" appeared between the writing competency displayed in a composition course and the writing performance in the type used by the individual students' professional disciplines (Ray & Stilter, 2000). The response to this performance gap has led to what is now termed as writing in the discipline (WID) (Ray & Stilter, 2000), which part of a broader pedagogical movement known as writing across the curriculum (WAC). This method of writing allows students to become accustomed to the style of writing associated with their disciplines and immerses them in the professional dialogue of their field.
Writing across the curriculum at its onset uses the approach that every teacher, instructor or professor should become aware and should introduce into the respective classroom and curriculum, the requirement of student participation by writing (Ray & Stilter, 2000).

Writing across the curriculum is a theory of writing rested on the basis of deeming writing as a revised process, not a consecutively manufactured product. Other theoretical components of writing across the curriculum can be summarized as follows:

- An interdisciplinary dialogue on writing that brings writing into as many classrooms as possible.
- Brief and varied (cross-disciplinary) writing forms that receive both instructor and peer responses.
- A focus on writing as learning – the principle that cognitive processes involved in writing and knowledge acquisition are very similar (Ray & Stilter, 2000).

Without a requirement to master writing skills, the graduate is initially handicapped in his/her chosen professional world. This handicap continues until these skills are acquired (Wright, 1987). This is despite dramatic increases in mandatory reading, writing, and speech courses; writing across the curriculum initiatives; and the heavy emphasis placed on writing skills by business and industry. It is unknown as to why this crucial skill has been and is still being so inadequately addressed. This is considered by some to be the greatest failure of the higher educational system (Bradney & Courbat, 1998).

Need and Promotion

By not teaching our students to read critically and to write logically and clearly, we unsuspectingly limit their personal and professional horizons (Bradney & Courbat, 1998). An employee's ability to advance in an organization may be dependent on that person's ability to communicate both verbally and with the written word (Maher, 1990). Most help-wanted advertisements for technical people specifically require well-developed written communication skills (Bradney & Courbat, 1998). It is important to note that the ability to write effectively assumes a much larger role as one advances in a technical career. This causes the problem to grow to unsuspected heights.

Without adequate written communication skills, an employee may be passed over for promotion (Ray, 1999). Almost every technical person can recall cases of ambitious and technically adept colleagues passed over for promotion because they could not write well enough to meet the demands of a higher position (Bradney & Courbat, 1998).

Methodology

Data Collection Procedure

A total of 400 Chief Executive Officers were selected from the career fair database of a large south-central university, using simple random sampling procedure. Another 400 of faculty members teaching at different schools of construction were selected from the web site of Associated Schools of Construction using the same procedure. A survey instrument was prepared to collect the data. It was administered via email in hopes for a speedy response, but individuals had the opportunity to mail in their responses as well. Some chose this option. Respondents were given two weeks to respond. A few days prior to the deadline, an email reminder was sent. Due to a poor response rate relative to the population, an extension of a week was given to those who had not yet had the opportunity to respond. The total number of responses was 81—57 from the industry and 24 from the faculty.

Variables and Their Operationalization

Overall Technical Writing Skills (*TECWRITE*): It is the reported importance of overall technical writing skills for construction science graduates.

Bid package (*BID*): It is the reported importance of skill for writing complete bid proposals by construction science graduates.

Business Letters (*LETTER*): It is the reported importance of skill for writing business letters by construction science graduates.

Change order (*CHANGE*): It is the reported importance of skill for writing requests for changes in construction items by construction science graduates.

E-mail (*EMAIL*): It is the reported importance of skill for writing e-mail by construction science graduates.

Internal memorandum (*MEMO*): It is the reported importance of skill for writing internal correspondence documents of specific project information by construction science graduates.

List (*LIST*): It is the reported importance of skill for writing comprehensive crew and drawing distribution lists by construction science graduates.

Log (*LOG*): It is the reported importance of skill for recording written accounts of inspections, meetings, or telephonic communications by construction science graduates.

Notices (*NOTICE*): It is the reported importance of skill for notices of safety, compliance, etc. by construction science graduates.

Report (*REPORT*): It is the reported importance of skill for writing job-related reports by construction science graduates.

Request for Information (*RFI*): It is the reported importance of skill for writing request for information by construction science graduates.

Schedule of Values (*VALUE*): It is the reported importance of skill for writing schedule of values by construction science graduates.

All the variables were measured using a 5-point unidimensional scale, ranging from "strongly disagree" to "strongly agree." A value of 1 was assigned if the respondents "strongly disagreed" with a particular statement, elevating to a value of 5 if the respondents "strongly agreed" with the statement.

Analysis and Results

A stepwise regression analysis was performed using a forward-selection procedure setting the significance level of entry at 0.2. This was done in order to determine the relative importance of the predictor variables with respect to their contribution in explaining the variance of overall technical writing skills (*TECWRITE*) of construction science graduates. The following model was used for the analysis;

$$TECWRITE = \beta_0 + \beta_1 BID + \beta_2 LETTER + \beta_3 CHANGE + \beta_4 EMAIL + \beta_5 MEMO + \beta_6 LIST + \beta_7 LOG + \beta_8 NOTICE + \beta_9 REPORT + \beta_{10} RFI + \beta_{11} VALUE + e \quad (1)$$

where

β_0 = Intercept
β_1, β_2, etc. = Regression coefficients, and
e = error term.

The results of the analysis indicated that only the skills for writing business letters, schedule of values, request for information, e-mail, and notices (entered in the model in that order) are correlated with overall technical writing skills at the level of significance of 0.2. The results are shown in Table 1.

TABLE 1

Summary of Stepwise Regression Analysis for *TECWRITE*

Variable Entered	**Step**	**Partial R^2**	**Model R^2**	***F*-Value**
LETTER	1	0.4174	0.4174	56.60
VALUE	2	0.1002	0.5176	16.21
RFI	3	0.0400	0.5576	6.95
EMAIL	4	0.0141	0.5717	2.50
NOTICE	5	0.0153	0.5870	2.79

Further analysis was performed using a multiple regression analysis for a reduced model that included only the variables selected by the stepwise regression procedure. The results of the analysis are shown in Table 2.

TABLE 2

Summary of Multiple Regression Analysis for *TECWRITE*

Variable	**Intercept**	**Regression coefficients**	***T***	***p*>|*T*|**	**Critical value of |*T*| @ *p*<=0.5**
Intercept	0.64141		1.48	0.143	1.98
LETTER		0.31447	3.30	**0.002**	
RFI		0.27084	2.46	**0.016**	
EMAIL		0.29769	2.26	**0.027**	
VALUE		0.19502	2.20	**0.031**	
NOTICE		0.19178	1.67	0.099	
F-value of the model		p>F		Model R^2	Adjusted R^2
21.32		<0.0001		0.59	0.56

The *F*-value of the model used for the multiple regression analysis was found to be statistically significant at a level much lower than 0.05. This statistic basically tests how well the model, as a whole, accounts for the dependent variable's behavior. The predictive efficacy of the model was found to be moderately high with an R^2 of 0.59 and an adjusted R^2 of 0.56. R^2 is the coefficient of determination of the model. The larger the value of R^2, the better the fit of the model, and higher is its predictive efficacy.

The results indicated that writing skills for business letters, requests for information, e-mail, and schedules of values were perceived to be important for construction science graduates. These independent variables were related to overall technical writing skill at the level of significance lower than 0.05. The only variable included in the reduced model found not related to overall technical writing skill at this level of significance was writing of notices.

Discussion

The results of the study indicate that the construction science graduates are expected to be efficient in writing business letters, requests for information, e-mail, and schedules of values. This is not surprising in view of the evidence obtained from the literature in support of the need for teaching the students to write effectively on subject areas relevant to their discipline.

Business letters are a basic means of communication between organizations. Even at entry-level positions, people are expected to write letters on a regular basis. The message is expected to be persuasive. Like any other type of technical communication, it is also required to be accessible, concise, correct, professional, and accurate. A skilled writer of business letters is expected to thrive in the industry.

Most construction projects undertaken by organizations begin with a proposal. To write a good proposal, one has to clearly ascertain the requirements of the client. This calls for a request for information. A requestor should specify as clearly as possible the particular information sought. The request should allow the client to clarify what documents or information is being sought. Without any clear information, it is not possible to submit a winning proposal. It is, therefore, only logical that writing skills for request for information was found to be important for construction science graduates.

Electronic mail, in both corporate and personal domains, is gradually becoming a communication medium of choice. It is cheaper and faster than a letter, less intrusive than a phone call, less hassle than sending a fax. Differences in location and time zone are less of an obstacle to communication when email is used. There is also evidence that an email leads to a more egalitarian information structure. Like other forms of communication, an email has to be read and understood. There are certain principles that are required to be followed while writing an email. Among other principles, one must follow the netiquette (etiquette on a network) appropriate for the medium, and this skill has to be learned.

The finding of a statistically significant relationship between overall technical writing skills and preparation of schedule of values is also quite logical. For every construction project, a contractor has to furnish a schedule of values for review and approval of the client. It shows the amount included for each principal category of work. Unit price items in the schedule of values should be consistent with any bid item listing contained in the contract. No progress payment is usually made to the contractor unless this schedule has been submitted and approved. A graduate in construction science should have adequate knowledge of how to prepare a schedule of values.

Conclusion

Effective skills are important for any professional. An industry depends on the ability of the skillful use of its communication practices by individuals employed by it. The study reveals that writing of construction related business letters, requests for information, skillful use of electronic communications, and preparation of schedules of values are important for construction science graduates. Both the construction industry and faculty perceive that in order to achieve technical writing skills with reference to the industry, the construction science graduates should focus on achieving excellence in these industry-specific areas.
It may be worthwhile to include the topics that have been found to be important in the curriculum for technical writing for Construction Science students. A longitudinal study may be done to assess the impact that the modified technical writing course has had on the industry.

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Author Index to Volume 8

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