

Improving Student Confidence and Ability To Cope Under Stress Through Project Based Learning

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The current trend in the construction industry is to build better, faster, and more cost-effectively. Accomplishing this requires the job to be fast-tracked through a team-based approach, such as design-build. This trend requires managers to solve tasks with various team members. These demands exacerbate the need for construction project managers to have “soft skills,” such as communication and conflict resolution, in addition to “hard skills” such as means and methods of construction. This paper analyzes the impact of project based learning on the soft skills in general, and on the student’s confidence and stress coping ability in specific.

Key Words: Project Based Learning, Collaborative Learning, Capstone Education, Interpersonal Skills

Introduction

Despite the known challenges of communications in the construction industry, few accomplishments have been made (Thomas et al 1998). In 1992, Hans J. Thamhain’s research identified thirty potential problems that inhibit a successful project. These items can be classified into the following five groups:

- Problems with organizing a project team
- Weak project leadership
- Communication problems
- Conflict and confusion
- Insufficient upper-management involvement

This list indicates that interpersonal skills are a critical part of a manager’s success. Highly valued managers have these critical soft skills, and use them to make superior decisions under real-world conditions. Having a means to assess aptitude in these areas would be a great asset, as it would facilitate better training for current and future project managers. Such an assessment tool would also allow validation of pedagogical methods used to prepare future construction professionals.

The condition of solving ill-defined problems in team settings, typical of the construction process, can be simulated in an educational environment using PBL. Prince and Felder (2006) define problem-based and project-based in the following manner: the former refers to teams of students provided with open-ended, weakly structured, real world problems with instructors as facilitators; the latter requires students to perform a multitude of tasks to complete a final product and/or design.

The capstone class of Iowa State University’s construction major was crafted using a hybrid of problem- and project-based theories. Teams of students were given ill-defined problems with strictly enforced deadlines; the students selected their own teams, and were provided tasks beyond the capability of any individual team member. This heavy task load required that students develop the communication skills necessary to function as a team, or risk failing to complete the project. These communication skills are those needed to succeed in the construction profession, where engineers and others must work together successfully to produce final designs and concepts.

Assessment of Interpersonal Skills

Previous studies have analyzed the Bar-On Emotional Quotient Inventory as a tool to assess soft skills. Jaeger (2003) focused on teaching Bar-On categories and assessing, only on the condition that pre and post results changed.

Another study of the Bar-On (Songer et al., 2004) focused on the soft tools generally needed in a successful construction project. This study on construction projects identified lower than average interpersonal skills for the General Contracting sector, and the need for methods to improve the communication issues experienced in construction. It did not, however, propose changes to construction education that might address these issues.

Some studies (Johnson and Singh 1998) utilized Meyers-Briggs Type Indicator (MBTI) to help identify personality types of construction engineers and design engineers at a state-run agency. Another study (Carr, et al. 2002) investigated how one's personality may be predictive of their job performance through the use of MBTI. Another investigation (Singh, 2002) provided research into hemisphericity orientation of construction and design engineers at a large public construction organization. A study by Bernold (2004) used the Learning and Study Strategies Inventory (LASSI) to help identify that the method of teaching material is critical to the person being educated. Another study (Zolin et al., 2003) looked specifically at the category of trust, as it related on an interpersonal level, for a problem-based learning environment.

Although numerous articles have listed the benefits of problem-based learning, Prince (2004) posited that little data is available documenting its effectiveness with undergraduate engineers. Gushgari et al (1997) suggested that further research into the makeup of critical skills would provide insight and advantages to professional development. Although others have argued that providing professional competencies in graduates would be a monumental challenge (Coll & Zegwaard, 2006), they also concluded that these competencies are important to a student's potential success.

Importance of Soft Skills to the Construction Industry

In 1956, William A. Klinger helped identify the need for changes in academia and proposed a new Construction Engineering curriculum for contractors. Klinger showed that 88% of the contractors surveyed were dissatisfied with the education of engineers entering their profession. When Klinger proposed developing a special curriculum, he recognized the need for soft skills. His proposal recommended including psychology, humanities, English, and public speaking. He proposed that these types of business-related skill sets could be of more use to the construction than highly technical skills, or cognitive skills that would be more applicable for the purpose of design (Klinger, 1956).

Even educational leaders have questioned schools' focus on cognitive skill sets, when other valuable skills can be learned in a non-traditional method (Resnick, 1987). Along this line of thought, an investigation of Bell Labs indicated that IQ and academic talent were not good indicators of productivity, or star performer success (Kelley & Caplan, 1993). In fact, research has indicated that emotional intelligence may be more important than technical and cognitive abilities combined (Kemper, 1999).

According to research referenced by Goleman (1998), a study from Hay/Bayer of 286 organizations which indicated that of 21 competencies, all but 3 were associated with soft skill items. In fact, over 80% of the competencies that divided superior versus average performers relied on emotional intelligence.

Subsequently Goleman (1999) specifically referenced construction firms and recommended that they invest time and effort in developing emotional intelligence. He stated that top performers had professional skill competencies of serving clients through flexibility, teamwork, persuasion, influence, and self-confidence. He further identified current building engineers as needing stronger emotional skills and argued that education and construction companies can no longer ignore this problem.

Although numerous articles, based on surveys, have been published regarding the skill sets required, perhaps one of the more extensive reviews of industry needs was developed in 2002 (Odusami, 2002). Odusami presented a summary of nine papers that investigated this topic showing that, in review of these prior studies, soft skills were consistently leading indicators. Although Odusami's study reviewed effective leaders based on clients, consultants, and contractors, again soft skills dominated the categories. The number one item for contractors is communication, followed by decision-making, planning and goal setting, and leadership/motivation. Technical knowledge ranked 6th.

Hypothesis: PBL methods will change a student's confidence and stress tolerance ability

The EQi's practitioner's handbook provides guidance for defining this hypothesis. According to that resource (Lopez, 2005), Bar-On has identified that some subscales such as assertiveness and stress tolerance have meaningful correlation on behavior outcomes. In fact, the importance of subscale assertiveness was specifically identified by Stein and Book (2000) as one of the most important factors of work success. According to various references (Bar-On, 2005; Stein & Book, 2000), assertiveness is by no means a negative connotation. Instead it is associated with confidence and can also be described as stating one's beliefs confidently with careful consideration and empathy to others. Due to the association between assertiveness and confidence, the word "confidence" was chosen due to its commonality and more familiar connotation.

The other Bar-On subcategory, stress tolerance, measures the ability to positively cope with stressful situations and circumstances. In essence, it indicates a more optimistic view toward change whereby the individual remains calm in stressful situations. In order to properly focus, a person must initiate and deal with their emotions (Sprengler, 1999). In fact, if a person becomes too emotionally inundated, s/he can experience challenges in creative and analytical thinking and subsequent lapses in making decisions, recalling, and learning (Dirkmann & Stanford-Blair, 2002). Learning how to recognize that you can control and influence the situation can provide a powerful tool for success.

While Norman and Schmidt (2000) posited that PBL can provide an improved level in student attitudes, other authors (Prince, 2004; Prince & Felder, 2006; and Bernold, 2007) have noted potential challenges for those not familiar with PBL methods. This hypothesis will also test if the student's ability to cope with stress does in fact change.

Methodology

The participants were undergraduate students from the Fall 2005 and Spring 2006 semesters of the senior capstone class at Iowa State University. This single semester class was crafted using project based learning techniques throughout both semesters of the study. This method of delivery employs an intensive team-based exercise that simulates typical experiences of construction industry professionals.

An example of a project that was assigned to the students was to prepare a submittal in response to a Request for Qualification (RFQ) for a future design-build project. This deliverable consisted of a bound document detailing each team's fictitious company's capacity, capability, and expertise along with various other pertinent attributes. The teams were given a firm deadline for the submittal, which was due one week later. Concurrently with this assignment, the teams were also tasked with several additional team assignments, which required them to multitask. This carefully orchestrated process of tasking the teams with multiple projects that are typical within a construction company identifies the essence of the course.

This study used a pre-experimental pre-test/post-test design (Creswell 2003) with the Bar-On EQi 133 quantitative assessment tool: The Bar-On EQi 133, based on emotional intelligence theory. Furthermore, since this course was a graduating requirement for all students, those enrolled were representative of the undergraduate population in the program.

The instructor, who has over twenty years of industry experience, had taught this course since Fall 2001 and students were typically aware of this fact. Therefore, the possible difference in instructors would be not applicable to this study. This item is mentioned due to prior documentation that argues that there has been evidence of negative effects with facilitators without proper expertise (Prince, 2004).

Since the participants also had Human Subject considerations, the research design adopted the criteria of a prior study (Zolin, et al 2003), and was not allowed to interfere with learning opportunities. This process provided an assurance that involvement would be of no advantage or disadvantage to students.

Since the goal of PBL is to provide realism, this class emulated experiences similar to a real world setting. In this study, a classical control group would not be available since all students were allowed this unique learning

opportunity, a real world environment that can have a great advantage over other study methods. Babbie (2001) states that due to the artificiality, laboratory type experiments can be misleading. The social processes may not be as strong as settings in a natural, real world environment.

Zolin, et al. (2003) further stated that the problem-based learning method can provide value over other methods since it has the best balance of realism and control. Their article further demonstrated the PBL advantage over experimental, semi-natural, and natural styles of study, and identifies PBL's other advantages as realism and balanced control.

Bar-On Assessment tool

The Bar-On EQi 133 has been used to measure emotional intelligence within individuals and organizations. Although there were other EQi assessment tools available (EQi 125, EQi short version, EQ-360) the EQi 133 was chosen due to its extensive questions, online administration, and prior research support. It has been used in previous research in educational, clinical, medical, business and management science research (Bar-On 2005), and was the first empirically constructed assessment of emotional intelligence that was commercially available, and is based on extensive research.

Furthermore, some of the other advantages of this inventory include (Bar-On) a significant statistical database of over four thousand participants (suitable for any gender sixteen years or older), over seventeen years of prior extensive research, various validity and adjustment factors, international implementation and recognition, and a multidimensional scope of composite and subscales. The EQi is composed of 133 items based on a five point response system that provides responses from "Very Seldom or Not True of Me," to "Very Often True of Me or True of Me." Through these responses, the instrument provides a total EQ-i score, five composite category scale scores, and fifteen subscale results.

Quantitative Analysis

The purpose of this study was to gain a better perspective on whether PBL can affect certain soft skills of construction engineers. In particular, this paper discusses the effect of PBL on confidence and stress coping abilities.

Fall 2005 semester included twenty-two students, of whom 2 were female. Of the 22 students available, 21 elected to take the pre-test and post-test. Spring 2006 semester had 48 students, of whom 3 were female. Of these 48 students, 37 elected to take the pre-test and post-test. Combining the two semesters together provided 58 samples. Note that during this testing procedure for Spring 2006, two students elected to take the EQi 133 post-test only, and one other student had testing validity issues. Per the recommendations in the EQi technical manual (Bar-On, 2005) and peer review, these student samples were deleted from the study.

Pretest/Posttest Correlation

Table 1

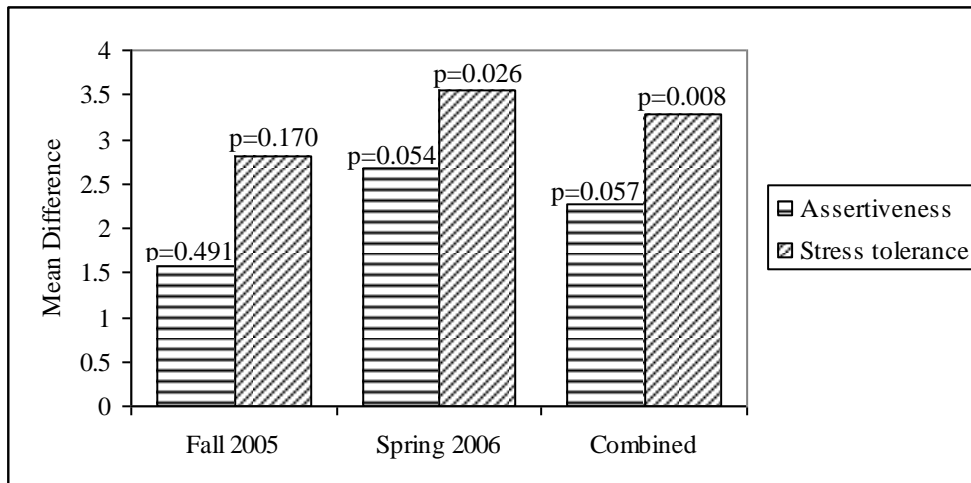
EQi 133 results pertaining to confidence and stress coping

Ability	Fall 2005		Spring 2006		Fall/Spring Combined	
	Corr.	Sig.	Corr.	Sig.	Corr.	Sig.
Assertiveness	0.632	0.002	0.718	0.000	0.679	0.000
Stress Tolerance	0.600	0.004	0.660	0.000	0.635	0.000

Note. Assertiveness and stress tolerance were highly correlated. Assertiveness was the most highly correlated competency in Spring 2006 (.718, $p < .001$), with stress tolerance also highly correlated in Spring 2006 (.660, $p < .001$). The data indicated that the lowest reading for stress tolerance was Fall 2005 (.600, $p < .01$), which is still statistically strong. For the combined data of Fall/Spring, both competencies had a statistical significance of $p < .001$.

In short, the summarized correlations appeared to perform well when compared to other established documentation of assessments such as technical manuals. In respect the hypothesis the studies combined the Fall/Spring confidence

(assertiveness) rating of 0.679, and performed better than the technical manual's listed 0.60 for the 16PF (Personality Assessment Inventory) Factor E (Assertiveness) for North America. The study's combined stress tolerance rating of 0.635 was also close to the prior subscale correlation of the 16PF Factor C (Emotional Stability) of 0.67.



Assertiveness—The ability to feel confident and express beliefs, feelings, and thoughts nondestructively.
 Stress Tolerance—The ability to cope with stressful situations, events, and strong feelings confidently.
 *The mean difference was calculated by subtracting pre-test from the post-test.

Figure 1. Summarized assertiveness (confidence) and stress tolerance (coping)

Figure 1 shows statistical differences of confidence and stress coping skills for Fall 2005, Spring 2006, and combined Fall/Spring. On average, post-test total skills increased for all participants during the study period. Of the two variables, paired t tests revealed statistically significant evidence between stress tolerance pre-test and post-test mean scores for Spring 2006, $t(36) = -2.324, p < .05$ and F05/S06, $t(57) = -2.737, p < .01$. In respect to assertiveness (confidence) skill, the paired sample t tests indicated suggestive evidence between for Spring 2006— $t(36) = -1.990, p = .054$ —and Fall/Spring combined— $t(57) = -1.943, p = .057$.

Since the observation of confidence and stress coping skills is identified in the EQi's practitioner's handbook, the association appears very relevant to this study. A lack of stress coping skills can lead to poor decisions and subsequent erosion in confidence. PBL has been previously identified as a learning method that may affect stress in a variety of ways.

Reviewing the combined quantitative data for confidence and the ability to cope under stress indicates suggestive evidence for the confidence portion. Although the quantitative data indicates suggestive evidence for the confidence or assertiveness portion, the qualitative data provides the additional supporting evidence that the participants did experience a positive change. Through the participants' written reflections, students acknowledged their growth of confidence and directly related it to the class. This realization further supported the previously argued theory that a project based learning process, a method of active learning, could enhance non-cognitive behavior skills (Weiner 1992).

Since the students attested that they saw themselves grow in their abilities, they supported the argument (Brown 2004) that the freedom to experiment that project based learning provides can assist in the development of soft skills. Even those that initially acknowledged some need for improvement, also realized the importance of the process and the need for their development, and conjectured that it was an item that they could improve over time. This realization, and the plan to improve, follows an important stage in a person's future growth (Quinn 2004, Stein and Book 2000, Bar-on 2005).

The quantitative results for the ability to cope under stress indicated significant evidence for positive change. Again, the qualitative data of the mix design provided further insight and support for this documented improvement. While several qualitative comments addressed the time commitment, workload, team interactions and management aspects that contributed stress, several students appeared to appreciate the real life nature of the constraints and pressures that they experienced near the end.

Although some acknowledged challenges while dealing with the personal and professional balance, most recognized that the major portion of their stress dealt with dealing with people. This observation provides additional support for other authors (Cano et al., 2006) who indicated that interpersonal problems were a major cause of team failure. However, the real world situation, and the opportunity to experiment with a variety of techniques, again gave participants the realization that this experience had helped them improve by the end of the class. Not only did some students realize their own personal growth in this area, they also acknowledged that this was an item that they would have to contend with in their future careers.

Overall, the participants not only recognized their improvement in confidence and stress coping skills, but it appears that they also realized that this class helped influenced their improvement in these soft skills. Through these observations, this study provides data which further supports other authors (Prince & Felder, 2006; Brown, 2004), and indicates that PBL is a method which can enhance the soft skills of confidence and stress coping.

Conclusion

Although providing soft skill competencies in students can be a monumental task (Coll & Zegwaard, 2006), these skills are critical components to a student's success. Previous studies have posited that project based learning is a viable technique to teach these skills. The results of this research have shown a student's confidence and stress tolerance ability can be increased during a project based learning taught class. One question that remains is one that typically challenges social research such as this study. That question is: what outside influences, if any, might also have an impact on confidence and the stress tolerance ability.

Although project based learning shows promise as a teaching method, there are obstacles to address. Students that are unfamiliar with this method may struggle to determine the instructor's performance expectations. Fellow faculty may not embrace alternative teaching styles.

All parties have a significant vested interest in improving the educational system. If properly implemented, any challenge can be eliminated through the use of soft skill competencies. As people become better informed of the importance and value of project based learning, collaborative teamwork will assure its success.

During the review of the quantitative and qualitative data, it quickly became apparent that several competencies are affected by project based learning. In some cases, it appeared that students obtained a holistic experience that offered growth in several different categories beyond the hypothesis tested. Prior authors (Prince & Felder, Brown, Ribeiro and Mizukami) have suggested that project based learning can increase such soft skills as communication, problem solving, and improved teamwork. Research could be conducted into what additional factors beyond the tested hypothesis are affected.

Further studies could also be conducted to review potential interaction of competencies through factor analysis. This method, which is based on the assumption that underlying factors affect the observed variables (Kim & Mueller, 1978), can further provide additional information on what factor may best determine the growth of soft skill competencies. Such a study could provide further insight into the interactions of various competencies, and be of further value to educational research.

The purpose of this study was to determine if project based learning can affect certain soft skills of construction students. The results of this study suggest that project based learning can positively influence several soft skills of senior construction students. As the advantages of project based learning come more to the forefront, more educators can take advantages of its strengths and add to the growing research.

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