AC 2008-312: DEVELOPING TEAM-WORK SKILLS THROUGH A CORE DESIGN THREAD

Keith Sheppard, Stevens Institute of Technology

Keith Sheppard is a Professor of Materials Engineering and Associate Dean of Engineering at Stevens Institute of Technology. He earned the B.Sc. from the University of Leeds, England and Ph.D. from the University of Birmingham, England, both in Metallurgy. As Associate Dean, Sheppard is primarily responsible for undergraduate programs. He is a past Chair of the ASEE Design in Engineering Education Division.

Peter Dominick, Stevens Institute of Technology

Peter G. Dominick is Assistant Professor of Management in the W.J. Howe School of Technology Management at Stevens Institute of Technology. He is coordinator of leadership development education for the School's Executive MBA, Project Management and Undergraduate Business and Technology programs. His research interests focus on leadership and leadership development and his consulting work includes executive coaching, team-building and process consultation. Prof. Dominick received his Ph.D. in Applied Psychology from Stevens, earned his MA in Organizational Psychology from Columbia University, and completed his undergraduate studies in Industrial and Labor Relations at Cornell University.

Edward Blicharz, Stevens Institute of Technology

Edward Blicharz is a Distinguished Service Associate Professor in the Electrical and Computer Engineering Department at Stevens Institute of Technology. He is coordinator of core engineering design courses in Freshman & Sophomore years. Prior to his current position, Blicharz worked for 25 years in project management and systems engineering in the aerospace & telecommunications industries. He has a B.E in Electrical Engineering from Stevens Institute of Technology and an M.B.A. from Fairleigh Dickinson University.

Developing Team-work Skills through a Core Design Thread

Abstract

An approach to evolving teaming skills through a sequence of core design courses starting in Freshman Year is discussed. In the first course in the sequence basic concepts are given for effective teamwork and related individual behaviors. A survey is used at this point to assess students' prior team and group work experience as well as their attitudes toward team-based work. After participation as a team member in the major design project, students are given a first exposure to a peer feedback questionnaire in which they assess their own attitudes and performance on the team and as well as those of their team-mates. This thread in teaming is continued in the second design course by revisiting the peer-feedback questionnaire at mid-semester and the use of team charters where individuals work together in the team to identify and document personal and team development goals. At the end of the semester a final peer-feedback questionnaire is used to assess team development and also to modulate an individual group project grade to reflect the contributions of the individual team members. Extension of the teaming thread into subsequent design courses is planned. In this paper, the experience and assessments from the freshman year part of the teaming thread are discussed. In particular, we provide analysis of the relationships between prior teaming experiences and actual behavior as measured through peer and self-evaluation and provide inferences on how these can be used as assessment tools and for personal development.

Background

The ability to work effectively in teams, and especially multidisciplinary teams, is a key competency needed of engineers to be successful in the 21st Century workplace. The imperative for addressing this issue is reflected in national reports on the future of engineering education[1,2] and also specifically in the ABET Engineering Criteria for accreditation which require all undergraduate engineering programs to include teaming in their educational outcomes and the associated assessment. This need to address teaming has been driven by the advocacy of industry which has long recognized its importance. Not surprisingly, much of the research and skill development approaches related to effective teaming are found in the management literature. It is only relatively recently that we see this area being addressed in the engineering education literature as the profession seeks to understand and implement appropriate means to develop team skills in engineering students. While engineering educators can certainly learn from the body of knowledge associated with teaming in the business world, they also have to respond to the fact that students are not subject to the same contextual issues that teams and team members experience in business. Students are engaged in smaller projects of shorter duration, with significantly less at stake in the success of the team than will typically be the case after graduation. To put it more bluntly, students do not have their livelihood on the line. The maturity and experience of students are also typically limited and these can influence perspective in approaching teamwork and the development of the requisite skills. Thus, addressing effective teaming skills through the undergraduate engineering curriculum represents a significant challenge.

Recently Besterfield et al.[3] have provided an overview of some of the engineering education teamwork research of recent years particularly as it relates to cognition and behavioral issues, so this is not repeated here. Their research has focused on developing direct assessment methods for teamwork, particularly to assess process rather than outcome as a means to ascertain the factors than can improve learning and skill development. They have demonstrated the validity of a work-sampling approach to assessing behaviors with respect to teaming in a relatively efficient manner. They look to future work to establish rubrics to assess each of the attributes that contribute to effective teamwork. While Besterfield et al. looked at process; most work in the engineering education literature related to teaming has been focused on outcomes assessment. Rubrics in this context are the focus of an interesting recent study[4]. It describes progress in rubric development specifically aimed at assessing outcomes for multi-disciplinary teams. A future use of such a rubric is posited as a development tool; sharing the rubric with students early in a design course will assist them to understand the factors that influence effective teamwork and on which they will later be judged. This is of relevance to the present paper in which we describe efforts to develop team skills over a series of design courses and to use the assessment methods both as outcomes measures and for student development within and across courses.

A particular focus of our approach has been to build on work that has shown the merits of peer and self assessment to achieve both assessment and development goals. McGourty et al.[5] have described a computer-based approach that provides an automated means for students to obtain feedback on their effectiveness on specific cognitive and behavioral skills important to teaming. In an online survey tool, students rate both themselves and their teammates. Each student receives a developmental feedback report showing self and team ratings on each survey item. It was shown that self and peer assessment can align with independent assessment on these items by the faculty member and that multiple use of the feedback can lead to improved outcomes. In fact a related study[6] has shown that even without direct feedback, students using the self and peer assessment tool showed improved performance. Self awareness development has also been addressed in the work of the BESTEAMS project[7]. This multi-institutional effort has produced three modules that can be incorporated into a thread. The first module has students determine their learning style to better understand how they and their teammates view learning and tasks. The second module addresses communication, feedback and team dynamics with the third module on project management. This threaded approach is also seen in a recent paper[8] which describes how team skills are developed through two lecture courses and then implemented in team projects throughout the curriculum. In our work we also integrate the development of team skills through the curriculum as a means to reinforce the process of developing the requisite cognitive and behavioral skills and attributes.

Development of a Teaming Thread

This paper describes an approach to developing team skills through a series of engineering design courses. The curriculum at Stevens Institute of Technology has a design or design-related course every semester[9] with the four courses in the freshman and sophomore years (Engineering Design 1 thru 4) being of particular importance to the early development of various “soft skill” threads, including teaming. These first four design courses are core engineering curriculum courses; later design courses in the sequence are disciplinary, culminating in the two-semester capstone design project. In the first four courses the students are assigned by the instructor to

teams rather than allowed to choose their team-mates. This produces diversity of interests and skills and as such is reflective of the reality of the teams that graduates will experience in business and industry. In fact the instructors typically try to mix skills and interests based on a questionnaire given at the start of the course, especially for the incoming Freshman. It should be noted that the major is not declared until close to the end of the third semester, so all students take a common set of courses. Even in the fourth semester only one or two discipline-specific technical electives are taken. So for four semesters students are in teams where their teammates have differing engineering interests and goals and so to a degree these teams are "multi-disciplinary" even if the members have not yet developed significant technical knowledge in their field of interest.

Students work in teams for most activities in the design courses, including short duration experiments and longer term design projects. Certain activities require individual deliverables which may be in addition to those of the team so that appropriate individual assessments may be made during the course. The design courses are taught in multiple sections of approximately 24 students with typically three or four students on a team. It should be noted that the instructors in the first four design courses are all adjunct engineers, so they bring their individual experience and perspective into the classroom and this has been well appreciated by the students.

Unlike the approach of the BESTEAMS initiative[7], in which other related skills such as project management and communications are developed through specific modules, these skills are developed throughout the design sequence at Stevens Institute of Technology. For example, project management concepts are introduced in Design 1, including use of Microsoft Project to develop work breakdowns and project Gantt charts. This is reinforced in later design courses. Communications skills, both oral and written, are developed through an explicit communications plan that includes various communications outcomes and associated assessments in each of the design courses. These include presentation skills, short and long forms of technical reporting, etc. and these assessments are used in grading.

Prior Teaming Approach

For quite some time the early design courses have included some limited elements aimed at improving teaming skills. These have included a presentation of the attributes of effective teams and team members as part of the short in-lab talks given by the instructor in the first design course. This was timed to be just before the teams started the major design project (autonomous robot challenge) that runs through the second half of the course. Follow up was ad-hoc in that individual instructors gave feedback to the teams during this course and then in Design 2 they referred back to the experiences students had with their teams in Design 1. They used that to discuss issues that students might address during the semester to ensure that the teams worked well.

Current Teaming Approach - Phase 1

Recently a more systematic approach was initiated to build a teaming thread through the early design sequence as preparation for and reinforcement by the capstone design experience. The first phase commenced with Freshmen in the Engineering Design 2 course. This course follows up on the first design course in having a sensors and systems theme and again includes a major design project. The students were not just asked to reflect on their first semester teaming

experience, but were now given instruction in teaming skills using material prepared in collaboration with a faculty member in technology management with expertise in teaming and leadership development.

A significant innovation was to introduce the use of a team charter as a means for the team to formalize roles and responsibilities and the "ground rules" of team operation. This was done at the time that the Request for Proposal (RFP) was issued to the teams for their major design project – projects are posed as business opportunities, hence the use of the RFP. Each team was required to develop a team charter and review it with the instructor. The week prior to developing the team charter, the students were given a survey (see Appendix 2 for sample) to complete in which they were asked to assess their own contribution and that of their teammates to the performance of the team up to that point in the semester. This self & peer survey, known as the Team Member Contribution Rating Form, also asked individuals to judge who contributed most and least and asked about satisfaction with personal and team performance. The students were informed that the results of the survey would not have impact on grading, but that the survey would be repeated at the end of the semester and that the results would then be considered by the instructors along with their own personal assessment in awarding an individual participation grade to each student for their major project, which was in all other respects graded as a group effort. While direct feedback from this self and peer survey was not provided to students during this phase of the teaming thread development, the focus it gave was apparent in the various team charter development discussions as concerns were raised by the team members and ways to address them negotiated.

Current Teaming Approach - Phase 2

Based on the experience with the above implementation in Design 2, it was decided for the next academic year that the formal teaming thread should be started with the incoming Freshmen in Design 1 rather than wait until Design 2. While it was decided that the first use of team charters would remain with Design 2, towards the end of Design 1 and well into their major design project, the students were asked to complete the self and peer teamwork assessment survey at the end of the major project and told it would be considered by the instructor, again in combination with the instructor's own assessment, in giving a participation grade for the project. Prior to completing the peer survey, students were asked to complete a separate survey, the Team Experiences Survey (see Appendix 1 for sample), that was intended to learn about the types and extent of their pre-college experiences with regard to teamwork and their attitudes towards teamwork and perceived preparation for collaborative work in college. Students were informed that the survey data would be confidential and not influence grades, rather that it would be used to help in improving team skills learning in the program. The goal of conducting this survey was to determine if prior experience and attitude had any correlation to team performance in the college setting and if this information could help identify individuals for whom personal development planning, for example in time management, might have potential value, and/or in assisting instructors in selecting members of teams.

As noted above, following the introduction of peer assessment in Design 1, Design 2 for this cohort of students was kept the same as in the prior year as the point at which team charters are introduced. The use of the self and peer assessment survey was also used as previously described for this course.

The next phase of the teaming thread is in Design 3. This course is linked to a concurrent core lecture course on Mechanics of Solids, with several experiments and two design projects with this theme. In Design 3 a more elaborate assessment is introduced aimed at self-awareness building, including personality and behavioral items. At this stage students have had two sets of design team experience, including assessment of their performance and an introduction to concepts and tools that can promote teaming skills. They are also at a stage when students as sophomores typically have reached or passed through a transition in perspective, becoming more reflective on their goals, motivations and sense of self[10,11]. So this represents an appropriate point in emotional maturity to have students take the assessment. The self-awareness building is intended to provide the students with a better sense of how they approach problems and interact with others and can enhance their ability to apply the teaming knowledge and tools that they have learned. There is considerable empirical evidence that self-awareness contributes to well-being, personal development and productivity at work (e.g. Boyatzis[14] and Cervone[15]). In particular, Argyris and Schon[16] have stressed that self-awareness (e.g. self-insight and understanding, the capacity to consider our actions from others points of view) are fundamental to individual and organizational learning.

It is also true, that self knowledge alone does not always lead to development (Whetten & Cameron[17]). Students must also be guided in how to process feedback that may engender defensiveness and challenge self-concepts and identity. They also need to be introduced to the principals of personal development planning, goal setting and self-management (Latham & Frayne[18]). Therefore, another key feature of the Design 3 teaming assessments includes requiring students to establish development goals based upon the assessment information they receive. These goals include potential areas for improvement but can also stress ways of optimizing strengths.

The behavior-oriented instrument added in Design 3 is based on the online Team Helper™[12] in which students rate themselves and their teammates on items that have been found to associate with cognitive and behavioral skills important for effective teaming[13]. Students receive an automated developmental feedback report that highlights strengths, areas for development and shows where self perceptions differ from how their behavior is perceived by their team members. This peer assessment methodology will be extended to capstone design, where as in the earlier courses, peer rating of an individual's team contributions will be incorporated into project assessment. The behavioral feedback will not be part of assessment but a valuable tool for development of self awareness and subsequent team and leadership skill development.

Future phase of teaming thread implementation

The components of the teaming thread will be used again in Design 4 with an expectation for students to employ team charters and the peer assessments previously applied as well as personal goal setting in the context of the course. While it is expected that there will be some carry over of team skill reinforcement into Design 5 (core) and Design 6 (disciplinary), the current nature of these courses (without a major project) is not conducive to a significant focus on teaming. It is in the capstone design courses, Design 7 & 8 with a major two-semester project, that the principles and practices learned in Design 1-4 will be reinforced and assessed. Table 1 provides an overview of the teaming thread through the design course sequence.

Table 1 Conceptual overview of the team thread with the key themes and development tools.

Design Course	**Key Team Skills & Concepts**
Freshman Year	
Design 1	Communication Skills Introduction to Principles of Team Process and Effectiveness
Design 2	Defining Team Expectations - Team Charters Personal Accountability - Peer Assessment of Performance
Sophomore Year	
Design 3	Self-Awareness – Interpersonal Style Behavioral Feedback Personal Development – Establishing development goals Self-management
Design 4	Team Skill Integration and Application
Senior Year	
Design 7 & 8 (Capstone) - disciplinary & multidisciplinary teams	Reinforce Teaming Topics and Assessment

Analysis Results from Freshman Surveys

The paper so far has described what has been implemented to date in the freshman and sophomore years to thread teaming into the engineering curriculum through the core sequence of design course each semester and the plans to continue the implementation up to senior capstone design. We have analyzed the results from the surveys conducted in the Freshman year in order to establish if they provide insight to assist the future development of the teaming pedagogy.

Team Experiences Survey results and performance in the first design course
Some results of the analysis of data from the Team Experiences Survey given to Freshmen in Design 1 are shown in Table 2. The results are presented by separating out students who were poor performers in the course overall with a grade of B- or below, approximately 10% of the population. The question posed in doing the analysis was whether students who performed relatively poorly in the course had a significant difference in prior team experience or attitude towards collaborative work compared to the other students.

Table 2 Self Ratings on the Team Experiences & Attitude Survey - compares those students with low overall course grades (≥ B-) with the remainder.

Prior experiences (*Rating Scale* - 1:None – 4: A Great Amount)	Poor performers (n=37)	All others N=337	T-Test results
How much experience did you have as a member of groups or teams prior to coming to college (e.g. sports teams, extra-curricular teams/organizations, civic activities, church-religious, military)	2.97 (.83)	3.38 (.68)	t=3.33, df=341, p=.001
Prior to coming to college, how much experience did you have working on school-related team projects, working with two or more people in a group.	2.64 (.76)	3.03 (.76)	t=2.9, df=341, p=.004
How much experience did you have ***leading*** team or group activities prior to coming to college (e.g. sports teams, extra-curricular teams/organizations, civic activities, church-religious, military)	2.49 (.87)	3.11(.80)	t=4.4, df=341, p=.000
Setting aside the technical knowledge and skills you learned, to what extent do you feel your **high school experiences** prior to college prepared you to work collaboratively (e.g. helped you develop team skills).	2.7 (.85)	3.05 (.78)	t= 2.5,df=342, p=.046
Team-related attitudes and behaviors (*Rating Scale* - 1: Strongly Disagree – 5: Strongly Agree)	Poor performers	Better performers	T-Test results
In group situations I like to take the lead	3.11 (1.22)	3.45 (.95)	t=2.00, df=333, p=.046
I usually let people know when I feel they have let me down or not done their share of work.	2.84 (.93)	3.26 (.93)	t=2.61, df=333, p=.009

Table 2 is composed of only those experience survey items for which we found statistically significant differences in response between poor performers (B- or below) and better performers in terms of Design 1 overall course grade . Those survey items are listed in the left column. The second and third columns show the mean (and standard deviation) of the rating responses for the two groups of performers on a scale of 1-4 for the prior experience questions, and 1-5 for the attitude and behavior items - as noted in the legends within the column. See the actual survey in Appendix 1 for all the items. The right column in Table 2 shows the parameters from the independent samples t-test used to check for significance in the differences in mean responses when comparing the low performers to the others. The low performers comprised approximately 10% of the class.

The results show, that in terms of prior experience, poor performers reported that they were less likely to have participated on teams in both extra-curricular or academic settings were less likely to have team leadership experience and felt less prepared to work collaboratively. Taken together these results may suggest that poor performers enter college-level, design-team experiences with low efficacy perceptions regarding their ability to succeed in such settings. While these efficacy perceptions may be confounded with actual abilities (both cognitive and interpersonal skills) the results at least suggest that one important avenue for helping students improve should include realistic efforts to enhance confidence in their capacity to develop as team leaders and members (Bandura[19] and Dweck[20]).

In terms of team skills and abilities, we also found poor performers were less inclined to seek leadership roles when working in groups and were also less inclined to confront others when they were not happy with their efforts (the bottom two items in the table). These findings suggest that at least some students may benefit from earlier introduction to important team skills like conflict management and interpersonal influence.

Not shown is an analysis which compared the Team Experiences Survey ratings of those with high peer ratings (>2.75/3) in the self and peer rating survey with those who had low ratings (<2/3). As with poor performers in the course, lower experience survey ratings are seen from those with low peer ratings compared to those from high-rated students, being markedly lower on the items that addressed self organization, study habits and procrastination.

The results have prompted several other ideas for future consideration. For example, it may help to take prior ratings of experiences into account when assigning students to design teams. In order to elevate efficacy perceptions and expectations, it may also be helpful to have students discuss experiences and preferences prior to working together, such as in the context of developing a working agreement. Attitudes and prior experiences could be a basis for having students establish developmental objectives that they could pursue when working on design teams.

Peer feedback and instructor assessment

Since we plan to use peer feedback as a tool for facilitating self-awareness and skill development planning, we were interested in learning more about the relative accuracy of student perceptions. One basis (though not the only) basis for doing so was to compare student judgments of their peers to instructor assessments. An analysis was therefore conducted to answer the question of whether the peer evaluations of an individual from the Team Member Contribution Rating survey correlated with the instructor evaluations for team participation and with the overall performance in the course. It should be noted that indeed the instructors did examine the peer evaluations when assigning a participation grade, but this was informational to their own assessment. So a correlation would confirm that peer rating is a valid assessment that aligns with that of the instructor.

The results are given in Table 3 for correlations significant at the 0.01 level (2-tailed). In the left column of the table are row legends for the four items (Contribution of Time/Effort, Cooperation with Others, Timely Completion of Tasks and Overall Contribution) on which peer evaluation was made - see the table in the Team Contribution Survey in Appendix 2. Below these are the instructor evaluations for attendance and participation together with the final grade as a percent

out of 100. The first three columns provide the mean and standard deviation (SD) data from the survey and from the instructor for the population (n) for which data was recorded against each item (so there is data for two less students from the instructor than took the survey). The next four columns then provide correlations with each of the peer evaluation items. So for example it is seen that the correlation is high between all peer ratings, the highest (.882) is between Contribution of Time/Effort and Overall Team Contribution. This consistent correlation across the peer ratings is not surprising.

Table 3 Correlations between Peer Contribution Ratings and Instructor Evaluations

				Peer Evaluations				Instructor Evaluations		
	Mean	SD	*n*	Time /Effort	Cooperation	Timeliness	Overall	Attendance	Participation	Final Grade
Time /Effort	2.71	.44	369		.707**	.750**	.882**	.416**	.502**	.316**
Cooperation	2.81	.37	369			.681**	.754**	.455**	.407**	.255**
Timeliness	2.71	.43	369				.801**	.368**	.367**	.273**
Overall	2.74	.42	369					.436**	.490**	.286**
Attendance	29.32	2.21	367						.573**	.552**
Participation	27.62	3.52	367							.668**
Final Grade	88.70	10.41	367							

** Correlation is significant at the .01 level (2-tailed)

The last three columns show the correlation of the instructor evaluations and final grade with the peer rating items and also with each other. So we see a .668 correlation of final grade with the instructor grade for class participation, again not too surprising. Of interest is there is quite reasonable correlation of instructor ratings of participation with the peer ratings and also with final grade. The significance of these results is that most previous studies have focused on using peer feedback to provide students with information about their team behavior. These results confirm the validity in the current setting of feedback as an assessment and development tool in teaming. Our results build on these findings by suggesting that peer feedback can be an accurate source of developmental information with regard to overall performance.

Conclusions and Future Work

A teaming thread has been established in the early core design courses of the engineering curriculum. It is intended to build team skills through application of tools and concepts associated with best practices. It also uses self and peer assessment to provide a path to development of the cognitive and behavioral aspects associated with effective teamwork. Analysis of the results of assessment instruments applied to date in the Freshman year give some insight into the significance of pre-college team experiences and attitudes as they relate to college level collaborative project participation. They also validate the notion that peer assessments can be valuable in support of overall teaming performance development in project-centered design courses.

The following are some considerations in further development of the thread and associated assessments:

- Understand more about how individual differences impact performance on design team (e.g. learning style, personality, emotional intelligence)
- Consider the impact of goal setting interventions (e.g. have students specify developmental goals regarding teamwork and study practices)
- Track longitudinal development of students teams skills throughout design experiences
- Look at impact of peer feedback on student behavior and performance

References

1. "Engineering Education: Designing an Adaptive System", *Board on Engineering Education, National Research Council,* (1995) (ISBN 0309052785).
2. "The Engineer of 2020: Visions of Engineering in the New Century", National *Academy of Engineering,* (2004) (ISBN 0309091624).
3. Besterfield-Scare, M., Shuman, L., Wolfe, H., Clark, R. and Yildirim, P., "Development of a Work Sampling Methodology for Behavioral Observations: Application to Teamwork", J. *Engineering Education*, Vol. 96, No. 4, (2007), pp. 347-357.
4. Plumb, C. and Sobek,D., "Measuring Student Ability to Work on Multidisciplinary Teams: Building and Testing a Rubric", *American Society for Engineering Education Annual Conference Proceedings*, Honolulu, Hawaii, June 2007, Paper AC 2007-803.
5. McGourty, J., Dominick, P., and Reilly, R., "Incorporating Student Peer Review and Feedback into the Assessment Process", ASEE & IEEE, Frontiers in Engineering Education, Tempe, AZ,, November, 1998.
6. Dominick, P., Reilly, R., and McGourty, J., "The Effects of Peer Feedback on Team Member Behavior", *Group and Organizational Management*, Vol. 22, (1977), pp. 508-520.
7. Schmidt, L., Schmidt, J., Colbeck, C., Biglio, D., Smith, P., and Harper, L., "Engineering Students and Training in Teamwork: How Effective?", *American Society for Engineering Education Annual Conference Proceedings*, Nashville, TN, June 2003, Session 1430.
8. Edmondson, C. and Summers, D., "Integrating Teamwork Across the Curriculum", *American Society for Engineering Education Annual Conference Proceedings*, Honolulu, Hawaii, June 2007, Paper AC 2007-348.
9. Sheppard, K and Gallois, B., "The Design Spine: Revision of the Engineering Curriculum to Include a Design Experience each Semester", *American Society for Engineering Education Annual Conference Proceedings*, Charlotte, North Carolina, June 1999, Session 3225.
10. Schaller, M, "Wandering and wondering: Traversing the uneven terrain of the second college year", *About Campus*, July-August 2005, pp 17-24.
11. Baxter Magolda, M., *Knowing and Reasoning in College*, (1992), John Wiley & Sons, Inc..
12. Reilly, R.R., *Team Helper Peer Feedback Survey*, (2003), New York: Learning Bridge: New York.
13. Loc. Cit. ref. 5.
14. Boyatzis, R. E., *The Competent Manager: A Model for Effective Performance*, (1982), New York, John Wiley & Sons.
15. Cervone, D., "Social cognitive mechanisms and personality coherence: Self-knowledge, situational beliefs and cross-situational coherence in perceived efficacy", *Psychological Science*, (1997), 8, pp. 43-50.
16. Argyris, C. & Schon, D., *Organizational Learning: A Theory of Action Perspective,* (1978), Addison-Wesley.
17. Whetten, D.A. & Cameron, K.S., *Developing Management Skills, 7th edition*, (2007), Upper Saddle River, NJ. Pearson Prentice Hall. p. 58.

18. Latham, G.P., & Frayne, C.A., "Self-management training for increasing job attendance: A follow-up and a replication", *Journal* of *Applied Psychology*, (1989) Vol 74(3), Jun. pp. 411-416.

19. Bandura, A.. *Social Foundations of Thought and Action: A Social Cognitive Theory*, (1986), Englewood Cliffs, NJ: Prentice-Hall.

20. Dweck, C. S., "Motivational processes affecting learning", *American Psychologist,* (1986), *41*(10), pp. 1040-1048.

Appendix 1

Team Experiences Survey

The purpose of this survey is to learn more about your experiences and interests with regard to teamwork and collaboration. Please take a few minutes to candidly answer the questions below. Your responses will remain completely confidential and have no impact or relationship to your grades in this course. We will be using the information you provide to help us improve the ways in which we design and deliver team learning experiences.

Your name: _____ Section: _____ Date: _____

Part 1 (circle the box that best applies)

How much experience did you have as a member of groups or teams prior to coming to college (e.g. sports teams, extra-curricular teams/organizations, civic activities, church-religious, military)

None – I was rarely/ if ever involved in team-based activities.	A small amount – I was occasionally part of a team or group but my involvement was sporadic and not that important to me.	Some – I was consistently part of a team or group and generally valued the experience.	A great deal – Team-based activities were a significant part of my life and routine.

Prior to coming to college, how much experience did you have working on school-related team projects, working with two or more people in a group.

None – Almost all of my academic work was done independently	A small amount – I can think of just a few times when I had to complete a team assignment	Some – I probably had at least one or two team projects every year of high school	A great deal – Almost every class had some kind of opportunity to work collaboratively

How much experience did you have ***leading*** team or group activities prior to coming to college (e.g. sports teams, extra-curricular teams/organizations, civic activities, church-religious, military)

None	A small amount	Some	A great deal

Setting aside the technical knowledge and skills you learned, to what extent do you feel your **high school experiences** prior to college prepared you to work collaboratively (e.g. helped you develop team skills).

None	A small amount	Some	A great deal

Part 2: Please rank the items listed below

In what settings have you learned the most about teaming and collaboration. **Rank** the following from most to least (with 1 representing most and 6 representing least)

Settings	**Your Rank**
Academic settings (e.g. classroom, class projects)	
Work settings	
Informal social settings (e.g. friends)	
Extra-curricular school-related activities (e.g. athletics, clubs, etc.)	
Home life, family	
Extra-curricular civic, community related activities (e.g. scouting, community service, church /religious, ethnic organizations)	

Part 3: Please indicate the extent to which you agree with each of the following statements

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
I am confident in my abilities to work well on team projects in college	1	2	3	4	5
I enjoy working on team projects	1	2	3	4	5
When it comes to school work, I prefer to work individually as opposed to working on a team	1	2	3	4	5
Team-based work was common in my high school	1	2	3	4	5
In my high school teamwork and collaboration were highly valued	1	2	3	4	5
I have a good understanding of the kinds of things people on teams need to do in order collaborate effectively.	1	2	3	4	5
When I disagree with others, I am comfortable speaking up, even if I don't know them well.	1	2	3	4	5
In group situations I like to take the lead	1	2	3	4	5
Others would say that I am easy to get along with	1	2	3	4	5
I usually let people know when I feel they have let me down or not done their share of work.	1	2	3	4	5
I usually create plans and schedules to help me get organized for the work I need to do.	1	2	3	4	5
I don't often procrastinate.	1	2	3	4	5
My successes thus far have largely been the result of my own hard work	1	2	3	4	5
I have good study habits	1	2	3	4	5

Part 4: List two things that you think are most important for teams to be successful:

_____

_____

Thank you for completing this survey!

Appendix 2

TEAM MEMBER CONTRIBUTION RATING FORM

Use the form below to provide your assessment of the contributions *you and each of your fellow team members* made to your design project. This information may be used by your instructor to make adjustments to individual final course grades. **The information you provide will remain confidential. No individual ratings will be identified or discussed.**

First, write your own name on the top line of the chart below. Then write the names of each of your team members in the spaces below. Next, rate each team member by circling a number corresponding to the following rating scale:

3 = Meets or exceeds expectations: Is fully deserving of the team grade
2 = Marginal: Questionable as to whether performance warrants an equal grade
1 = Below expectations: Should be graded lower than the rest of the team

Team Member	Contribution of Time, Effort, and Technical Expertise			Cooperation w/ Other Team Members (In and Out of Class)			Timely Completion of Individual Assignments			Overall Contribution to the Team		
(Use top line for your name)	1	2	3	1	2	3	1	2	3	1	2	3
	1	2	3	1	2	3	1	2	3	1	2	3
	1	2	3	1	2	3	1	2	3	1	2	3
	1	2	3	1	2	3	1	2	3	1	2	3

PLEASE ANSWER THE FOLLOWING:

- Indicate the **one person** on the team who you think contributed **the most** to the project:

  _____
  And Why? (Include yourself)

- Indicate the **one person** on the team who you think contributed **the least** to the project:

  _____
  And Why? (Include yourself)

- Some of **my** key contributions to the project were:

- Overall, I was happy with the composition and performance of my team (Circle One).

  1 Strongly Disagree 2 3 Somewhat Agree 4 5 Strongly Agree

- Overall, I was satisfied with the efforts that my team members and I made to collaborate and work together.

  1 2 3 4 5

Please include any thoughts you have for making future team projects more successful and rewarding.