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Integrating Soft Skill Competencies Through Project-based Learning Across the Information Systems Curriculum

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Integrating Soft Skill Competencies Through Project-based Learning Across the Information Systems Curriculum

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Abstract

Contemporary Information Systems graduates will be more marketable in the workplace upon graduation if they have combined competencies in both technical and soft skills: interpersonal communication, teamwork, time management, planning and organizational skills. Team and project-based learning can be used to incorporate soft skill competencies with technical skills. The authors have created instructional modules that take these factors into account. Using these strategies while at the same time applying soft skills into practice, students gain a deeper understanding and appreciation of the importance of such skills.

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1. INTRODUCTION

The fluidity of the information systems (IS) profession is such that certain skills not usually taught in IS programs are becoming more and more crucial. Today's graduates will have a better chance of starting their career soon after graduation if they have competency in the soft skills: interpersonal communication, teamwork, time management, planning and organizational skills.

University programs traditionally lag behind industry. Information Systems professionals are less expected today to be specialists in one field; they are expected to be gurus, practitioners of the art of IT. System integration, fluency in multiple programming languages and protocols, and security assessment are some of the skills expected by today's employers. Caudron (1999) made a strong case that university IS departments need to produce graduates with a wider knowledge base (the hard skills) and proficiency in the people, communication and project work (the soft skills).

The authors have created an instructional module which takes these factors into account. This module was implemented in an upper level undergraduate database management systems class and in a capstone undergraduate course in enterprise networking. The module mirrors as closely as possible the IS workplace environment. Students are placed in teams and given a project with clearly defined goals and parameters. Students learn that their individual success is dependent on their team's collaboration, not simply individual effort. Drawing from a strong pedagogical foundation that combines experiential learning, the design process, cooperative learning strategies, and the dialogic analysis of case method, this instructional module encourages the development of soft skills and offers a much more organic learning experience than the more traditional combination of lecture and lab time.

2. REVIEW OF THE LITERATURE

2.1 IS Curriculum Model

The IS 2009 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems (Topi, et al, 2009) and earlier IS Curriculum Models (Gorgone, et al, 2002) emphasize a well-rounded undergraduate information systems curriculum. While technology must be the main focus of the IS curriculum, these models argue that the understanding of technology alone is not enough to create a well-rounded, employable graduate.

The IS 2002 Model Curriculum stressed four high-level graduate exit characteristics: Business Fundamentals; Technology; Analytical and Critical Thinking; and Interpersonal, Communication and Team Skills.

The updated *IS 2009 Curriculum Guidelines* has divided into three categories the knowledge and skills that Information Systems graduates are expected to have. The category 'Information Systems Specific Knowledge and Skills' includes components that are specific to Information Systems as a discipline. 'Foundational Knowledge and Skills' are shared by many disciplines, including categories such as "leadership and collaboration, communication, and analytical and critical thinking." 'Domain Fundamentals' cover skills and knowledge related "to the domain to which a specific Information Systems program applies computing" including general business (Topi, et al., 2009).

The authors of IS2009 Guidelines assert that "IS professionals exist in a broad variety of domains", for example, "business, health care, government and non-profit organizations." The 'Foundational Knowledge Skills' are not unique to the information systems discipline, however, more emphasis must be placed on developing these skills in the IS curriculum. These skills include leadership and collaboration, communication skills, negotiation skills, and analytical and critical thinking skills, including creativity and ethical analysis.

The report states that IS professionals must have "strong analytical and critical thinking skills to thrive in a competitive global environment." In addition to acquiring excellent technology skills, they must also be problem solvers, critical thinkers, "exhibit strong ethical principles and have good interpersonal communication and team skills." The report further indicates that in addition to achieving individual success, they must also be able to collaborate with others to ensure team success. Management will demand excellent listening, and oral and written communication skills. Outside of traditional soft-skills, IS professionals require "persistence, curiosity, creativity, risk taking, and a tolerance of these abilities in others." (Topi, et al., 2009)

In a survey of IS employers, Cappel (2002) reported that "overall, employers rated non-technical skills even higher than technical skills." He also stated that the "gaps between 'expected' and 'actual' performance tended to be greatest for non-technical skills." The greatest disparity between actual and expected skills was in oral and written communication and problem solving skills. He found that the highest rated desired skills and abilities were: the ability to learn, teamwork, problem solving, written communication and oral communication.

In another IS employer survey Woratschek & Lenox (2002), also found that "employers rate non-technical skills higher than technical skills." They concluded that the reason for this finding is because "non-technical skills apply to every type of IS professional position." They determined that the most desirable non-technical skill was professional ethics. They found that ten other soft skills were "highly rated." They included: motiva-

tion to work, ability to learn, attention to details, time management, problem solving, maturity, persistence, teamwork, initiative and oral communications. Their results indicated that oral communication, written communication, and problem solving skills had the highest mean difference between 'expected' and 'actual'. They concluded that "soft skills are as important, if not more so than the technical skills in the IS curriculum."

Bailey & Stefaniak (2002) and Bailey & Mitchell (2006-2007) concluded that "unquestionably a well-rounded IT employee must possess a good mix of both technical and non-technical skills." However, they stressed that this conclusion should in no way minimize the importance of the value of technical skills. Their study, a survey of 325 IT professionals, sought to identify specific sets of knowledge, skills and abilities, or KSAs, that are most important to IT organizations. A study conducted in 2000 concluded that employees must reach a "new level of literacy" including "strong academic skills, thinking, reasoning, teamwork skills and proficiency using technology (21st Century Workforce Commission, 2000, in Bailey & Stefaniak, 2002).

Flynn, Valikoski, & Grau (2008) assert that listening skills remain "one of the most neglected aspects of organizational communication." According to other scholars, listening is considered to be "the single most important element in the communication process (Fracaro, 2001 in Flynn, et. al, 2008).

In a 2007 Computerworld survey of 10,000 IT executives, nine non-technical skills that employers were looking for in new IT hires were (Hoffman, 2007):

1. Writing ability
2. An understanding of business-process mapping and tools
3. An aptitude for public speaking
4. An understanding of accounting
5. The ability to work well with a team
6. Initiative (entrepreneurial)
7. An inquisitive mind
8. The ability to get a point across—writing skills
9. Willingness to take risk

Other researchers have concluded that soft skills are an absolute must in order for IS graduates to be competitive in the workforce (Leung, 2008; Elmuti, 2004; Noll & Wilkins, 2002). Todd, McKeen & Gallupe (1995) concluded that a successful IS professional must blend "technical knowledge with a sound understanding of business while commanding effective interpersonal skills." Fisher (2007) reported that employers are finding that "freshly minted" MBAs "lack key interpersonal skills." In another study, 75% of the 1400 financial executives who responded to the survey indicated that "verbal, written and interpersonal skills are more valuable now…then they were five years ago." (Messmer, 2007). Evenson (1999) established that soft, social skills, or "people skills", are as "important as hard, technical skills in achieving professional success." People skills foster effective communication and a positive personal attitude necessary for success in the workplace. Morton ("How Well", 2007) reported that in a survey of 300 administrative professionals, 93% of the respondents believed that "technical skills are easier to teach than soft skills."

Other studies have shown that people with high emotional intelligence, or EQ, scores tend to rise to the top of the organization. Emotional Intelligence has four dimensions: self-awareness, self-management, social skills, and social awareness (Caudron, 1999).

2.2 Pedagogical Foundations

John Dewey (1938) stated that "Education is a social process. Education is growth. Education is, not a preparation for life; education is life itself." Dewey strongly believed that learning should be an active engagement through which students interact within a community that provides them with opportunities for guided, real life experiences. These authentic learning experiences would foster a student's capacity to eventually contribute positively to society (Dewey, 1938; Gordon, 1998; Stein, Isaacs, & Andrews, 2004). Dewey believed that learning activities should consist of real-life tasks and challenges. Project-based learning is rich in such authentic learning experiences while combining design processes critical to IT networking and database design. These projects as described by the literature are complex tasks typically based on challenging problems or

questions (Jones, Rasmussen & Moffitt, 1997). To complete the project, students are involved in design, problem-solving, decision making, or investigative activities (Jones, Rasmussen & Moffitt, 1997; Diehl, et al, 1999; Barnes, et al, 2005). Provided the opportunity to work in relative autonomy over an extended time period, the students' highly motivated efforts culminate in a functional and well crafted product (Jones, Rasmussen & Moffitt, 1997; Bartscher, Gould & Nutter, 1995). Project-based learning (PBL) also incorporates other features such as explicit goals, teacher facilitation and coaching, authentic content, cooperative learning, and authentic assessment (Stein, Isaacs & Andrews, 2004; Gordon, 1998; Moursund, 1999; Diehl, et al, 1999).

Embedded within PBL is the design process. This process takes a slightly different path depending upon the discipline (engineering, IT, graphic arts, publishing), but invariably contains the following basic steps according to Johnsey (1995): 1) design brief (statement and analysis of goals), 2) research investigating possible solutions, 3) specification requirements, 4) problem solving and conceptualizing the design solution, 5) developing appropriate design documentation, 6) development, 7) testing, 8) revision (or tweaking), 9) implementation, 10) reflection. When developing a product or project in PBL, students require facilitation of the design process through the use of templates that outline the process and the documentation required as evidence of research and planning. PBL without these scaffolds can lead to a team skipping or overlooking crucial steps in the process that deprive them of learning, and ultimately lead to confusion during development, or an incomplete, unfinished or inadequate product. Once familiar with the design process, students can develop their own documentation based upon the specification parameters and evaluation criteria explicitly provided beforehand by the instructor.

Such project development naturally assumes that students will work together throughout the process. This form of intentional collaboration is known as cooperative learning (Johnson & Johnson, 1994; Johnson, Johnson & Smith, 2000). In order for group work to be considered a cooperative learning endeavor, the groups need to be structured to work cooperatively. All members of the group need to be held accountable by their group members (and the instructor) to know the material and be able to perform the various tasks involved in the process.

As specified by the research of Johnson & Johnson (1994), the elements of cooperative learning must contain the following: 1) positive interdependence, 2) frequent opportunity for face-to-face interaction, 3) group member perception of individual and personal accountability toward the group goals, 4) consistent use of interpersonal communication skills, and 5) ongoing group processing of progress and functioning for improved effectiveness. Instructors can introduce these cooperative elements to students through a series short exercises and case studies that provide them with opportunities to reorient themselves to a more cooperative mindset.

Prior to the PBL experience, instructors can enhance their students' awareness of needed content knowledge, IT processes and cooperative behaviors through the use of case method. Drawn originally from the fields of medicine and law, case method instruction (CBL) is a learner-centered instructional method that engages students in discussion of specific situations, typically real-world examples. The primary purpose of CBL is to build knowledge and improve analytical thinking skills through discussion. With the instructor acting as a facilitator, the group is encouraged to resolve open-ended questions that have no single correct answer. According to Herreid (1994) the instructor, bearing in mind at all times the learning objectives, structures the presentation and discussion toward the development of students' critical thinking skills, especially analysis. Maximizing student participation, the instructor identifies the case's issues and problems. After reaching consensus on the issues, the students (with some facilitation by the instructor) explore possible solutions along with their consequences. Welty (1989) offers his own approach of a discussion method that utilizes an appropriate introduction, followed by "directive, but not dominating questioning", accompanied with some visual aids to highlight the essential components of the analysis. After a thorough debate, the instructor summarizes the discussion.

It is from this foundational work of Dewey; Johnson & Johnson; and Herreid that the

authors developed a course curriculum for their courses that sought to provide their students with an equitable blend of both the hard and soft skills required of the IS/IT field.

2.3 Soft Skills in the Classroom

Given the importance of soft skills in combination with technical skills for information systems students, it is imperative that educators incorporate them into their curriculum. According to many scholars, there are several ways that this can be done. Cappel (2002), suggests that in order to to help students develop these critical skills, faculty can assign "individual and group classroom writings, group projects and presentations, internships, and involvement in student and professional organization [*sic*]." Bailey & Stefaniak (2002) recommend incorporating "comprehensive, holistic, and long-term team exercises and projects" that could include solving customer problems.

Noll & Wilkins (2002) assert that soft skills should be integrated into the curriculum by including "writing, working in a team environment, delivering presentations, managing projects, and developing interpersonal relationships." Tuleja & Greenhalgh (2008) agree that students need a balance of both quantitative and qualitative skills, e.g. speaking, writing, leadership, teamwork and communication. They report that the recent trend has been to emphasize both leadership and communication skills and that students need to work toward communication competence. Faculty could use "integrated learning" where the instructor spends time "coaching" them on how to organize a presentation and effectively present it. In information systems, the faculty member could review systems analysis techniques, such as how to effectively interview an enduser. Such integration of content and skill is the aim of "communication across the curriculum" or CXC (Tuleja & Greenhalgh, 2008).

According to Elmuti (2004), "learning becomes most powerful when it connects interesting ideas to lived experiences." Managers need technical, human and conceptual skills including exposure to international and cross-cultural experiences. The acquisition of skills "can be accomplished through coaching, mentoring and fine-grained skills." Some tacit dimensions of knowledge can be "communicated through experimental teaching, case discussions, or on-the-job training." (Doh, 2002, pp. 59-60).

Navarro (2008) advocates for teaching soft skills through experiential learning. This process can include planning, setting goals, and thinking to actual experimentation, observation and a careful review of the results." He reports that in most business school programs, experiential learning can include "team-building exercises, live projects, simulations, guest speakers and internships." The same techniques can be effectively incorporated into the information systems curriculum.

Authentic learning demands that students actively solve problems while working together. Authentic learning experiences are "those that are personally relevant from the learner's perspective" (Stein, et al, 2004). According to Gordon (1998), authentic learning: simultaneously involves one's knowledge, skills, and attitudes; is driven by essential knowledge that is meaningful to students; activities are connected; students publicly exhibit their learning where there are real-life standards of quality; this type of learning generally does not generate scores on a test. Authentic learning can be utilized in the IS curriculum in a variety of ways: through project-based learning, team-based learning, internships, etc. In-class exercises can include, for example, groups of students working together to resolve SQL coding exercises, or working together to come up with basic end user interview questions during the analysis phase of a project. Authentic learning can also include service learning as part of the curriculum. For example, students might be assigned a semester-long project to build a web site or database application for a local non-profit organization. Authentic learning experiences foster a student's capacity to eventually contribute positively to society (Dewey, 1938; Gordon, 1998; Stein, Isaacs, & Andrews, 2004).

Collaborative and cooperative learning promotes "higher achievement than will competitive or individualistic learning" (Johnson, Johnson, & Smith, 1998). Cooperative learning is at the heart of problem-based learning and emphasizes "natural learning" as compared to highly structured training. Infor-

mation systems faculty often use problem-based learning in their curriculum. Project-based learning (PBL) can be coupled with problem-based learning through the use of semester-long projects.

3. METHODOLOGY

3.1 Course Design and Implementation

Using team and project-based learning, while having tremendous benefit, has the potential of leading to confusion, conflict, and dissatisfaction with final grades. Ensuring that students understand the task at hand, that grading provisions are well defined, and that team members are graded not only on their final project outcome, but on their individual participation are key in effective team and PBL implementations (Dutson, et al, 1997; Harrisburger, et al, 1976; Magleby & Todd, 2005; Kaufman, Felder & Fuller, 2000; Maskell, 1999; Bruce, Harden & Reese, 2004).

For this purpose of this study, the authors describe two undergraduate IS/IT classes where student teams and PBL have been implemented; database management systems and networking/data communications.

Projects and case method readings were presented with clearly defined goals and outcomes in the networking course. For example, in a project involving learning about implementing a Windows 2003 Server network, the roles the various servers would take were clearly defined in the work package provided to the students. In a case study on implementing a network for an international travel agency, requirements for the LANs, WAN and network services were clearly outlined. Providing students with enough information to ensure their work will meet the desired outcomes and learning activities while not providing too much information is critical. In projects, not only were key technical requirements provided, but documentation such as planning timelines, network diagrams and operational checklists were specified for successful completion.

The work packages also clearly denoted the compensation (or grades) to be received by the teams for successful completion of their assigned tasks. Individual work was evaluated through the use of work logs and end-of-project peer evaluation to ensure students received grades appropriate to their effort on their projects.

The soft skills that are incorporated into the DBMS course included written and oral communication, collaboration, team skills, presentation skills and analytical and critical thinking skills using project-based learning. Clearly defined goals and outcomes were communicated to the class at the beginning of the term. A database application was to be implemented at a customer site of the student's choice by semester's end. Four deliverables were to be written and submitted for a grade during the semester. The student's writing skills and technical knowledge were evaluated. Students were to find a project and database subject, interview the end users and stay in touch with them during system development. During the semester, the students would utilize case-based learning as they developed knowledge of the DBMS tool, database normalization and SQL programming skills. At the end of the semester, each team was to present their application to the class for peer and professor evaluation.

3.2 Survey

A survey based on a 2005 study done by Gentili, et al, was administered to the students to gauge their reaction to and perspectives of team-based projects and case studies. A five-point scale was used to gather information on how participation increased their non-technical skills such as interpersonal and communications, public speaking, team work and time management. The second section of the survey used a five-point scale with 23 questions surveying key aspects of teamwork and project management skills. These included project package delivery, team communications, team leadership and management, conflict and resolution, project timelines and planning, and perceived learning. The final survey section presented questions allowing students to provide input on team-based classes, the amount of learning in respect to the course goals, and how the course differed in structure from other courses they had taken. Results from the survey were tabulated and analyzed using descriptive statistics.

4. RESULTS

4.1 Descriptive Statistics

The statistical analyses are based on a sample of 66 IS/IT students enrolled at three universities. Two of the schools were small private universities and the third was a large public university. Each student surveyed was enrolled in a project based IS or IT course. The survey was first distributed at the midpoint of the semester. The same survey was then distributed to the students at the end of the semester. Of the surveys collected 40(61%) were from males and 26(39%) were from females. Responses were from 15 freshmen, 8 sophomores, 17 juniors, and 26 seniors.

4.2 Analysis

Hypothesis 1: There is a difference between the first and second parts of the semester on emphasis on soft skills and personal growth in the class.

A two paired-sample T test was performed to determine if there was a difference between the first part of the semester and second part with regard to class emphasis on soft skills. The class emphasis comparison was based on two variables, class-emp1 and class-emp2 which were created by averaging all class emphasis question scores on the two surveys respectively.

The results of the T-test as shown in Table 1 indicate that the class emphasis comparison was significant. This shows that the instructor did emphasize soft skills more during the second half of the semester.

Table 1. Class Emphasis and Personal Growth

	Mean Difference	t	Df	p-value
Class Emphasis	-0.232	-5.772	61	0.000
Personal Growth	-0.06	-2.936	59	0.005

Hypothesis 2: By incorporating team-based projects, the students acquire personal growth and improvement on their soft skills.

A second T-test was performed to see that the students actually used more of the soft skills during the second part of the semester. The results are shown in Table 1. The personal growth mean difference is -0.06 and is also significant with t = -2.93 and p=0.005, indicating that students used more soft skills after the first survey than before the first survey.

Hypothesis 3: Students growth on soft skills did increase when greater emphasis is placed on the soft skills.

To determine if the class emphasis on soft skills is associated with students' application of these soft skills, a bivariate Pearson correlation was performed on teamwork, information gathering, problem definition, idea generation, evaluation and decision making, implementation, and communication between class emphasis and personal growth for the first and second survey. Each skill score was created by averaging all question scores under each skill. As shown in Appendix A, all correlations are positive and moderate and significant at 0.01 level, indicating that the more the instructor emphasized those skills in class, the more students applied those skills.

To compare personal growth on teamwork, information gathering, and evaluation and decision making between the first and second survey, three paired-sample T tests were carried out with adjusted Type I error being 0.05/3=0.017. The results shown in Table 2 indicated that all three comparisons were significant at 0.017 level, implying that students' growth on these skills after the first survey was greater than before the first survey.

Table 2. Priori Planned Personal Growth Comparisons

	Mean Diff.	t	df	P
Teamwork	-.06774	-2.528	61	.014
Info. Gathering	-.07813	-2.839	63	.006
Eval. & Dec. Making	-.1042	-2.813	63	.007

5. CONCLUSION

The authors suggest that a combination of experiential learning, the design process, cooperative learning strategies, and the dialogic analysis of case method for IT stu-

dents should be pursued. Our results suggest that instructor emphasis on these skills had a direct affect on student's application of soft skills.

Students acquire a "real-world" team experience, with all of the associated difficulties and benefits, to a much higher degree than is typically possible within the confines of the university classroom. Furthermore, using these strategies while at the same time applying these soft skills into practice on a daily basis, students gain a deeper understanding and appreciation of the importance of such skills.

These results are particularly important as IT programs prepare graduates for present-day workplaces. If students do not value project based learning opportunities, it is also possible that they are not adequately prepared—especially in team orientations—to successfully negotiate with others in their professional positions. Further research should explore both the types of team skills that are valued by employers, and the teaching strategies or group work activities that can help develop them in students.

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APPENDIX A. PEARSON CORRELATION BETWEEN CLASS EMPHASIS AND PERSONAL GROWTH

	The first survey			The second survey		
	r	*p*-value	*N*	*R*	*p*-value	*N*
Teamwork	0.554	0.000	62	0.430	0.000	66
Information Gathering	0.452	0.000	64	0.571	0.000	66
Problem Definition	0.549	0.000	64	0.566	0.000	66
Idea Generation	0.393	0.002	60	0.355	0.004	65
Evaluation and Decision Making	0.490	0.000	64	0.471	0.000	66
Implementation	0.454	0.000	63	0.466	0.000	65
Communication	0.615	0.000	63	0.590	0.000	66

APPENDIX B. TEAM DESIGN SKILLS GROWTH SURVEY

Instructions: This survey is intended to measure personal growth within each of the elements of the project based learning process. The survey is to be taken twice during an introductory project based course, once at mid-term and the other at the end of the term. All responses should be given relative to what has been learned during each half of the term. Thus, the second survey should reflect only what has been accomplished during the second half of the project based course. A score of 5 indicates a strong class emphasis and/or personal growth.

Demographics

What is your age?

18-24
25-30
31-40
41-50
50-60
60+

Please provide your gender:

Female
Male

If you are a student, please note your class standing:

Freshman
Sophomore
Junior
Senior
Graduate

Extroverts can generally be described as outgoing and enthusiastic. Introverts can be generally described as self-contained and reserved. How would you classify yourself?

Very introverted
Introverted
Somewhat introverted
Neutral
Somewhat extroverted
Extroverted
Strongly extroverted

Class Emphasis			Personal Growth during this Half of the Term	
Major emphasis	5		I experienced a tremendous growth and added many new skills	5
Significant emphasis	4		I experienced a significant growth and added several skills	4
Some emphasis	3		I grew some and gained a few new skills	3
Minor emphasis	2		I used previous skills and had little growth	2
Did not discuss	1		I did not use this skill within this class	1

TEAMWORK	Class Emphasis	Personal Growth
Individuals participate effectively in groups or teams	1 2 3 4 5	1 2 3 4 5
Individuals understand their own and other member's styles of thinking and how they affect teamwork	1 2 3 4 5	1 2 3 4 5
Individuals understand the different roles included in effective teamwork and responsibilities of each role	1 2 3 4 5	1 2 3 4 5
Individuals use effective group communication skills: listening, speaking, visual communication	1 2 3 4 5	1 2 3 4 5
Individuals cooperate to support effective teamwork	1 2 3 4 5	1 2 3 4 5

INFORMATION GATHERING	Class Emphasis	Personal Growth
Individuals gather information, use various sources and techniques, analyze validity and appropriateness	1 2 3 4 5	1 2 3 4 5
Individuals use important visual and oral techniques (questioning, observing) for information gathering	1 2 3 4 5	1 2 3 4 5
Individuals use library resources effectively in accessing relevant information	1 2 3 4 5	1 2 3 4 5

PROBLEM DEFINITION	Class Emphasis	Personal Growth
Individuals define problems, which includes specific goal statement, criteria and constraints	1 2 3 4 5	1 2 3 4 5
Individuals understand the open-ended nature of problems	1 2 3 4 5	1 2 3 4 5
Individuals develop specific goal statements after gathering information about a problem (need)	1 2 3 4 5	1 2 3 4 5
Individuals recognize the importance of problem definition for development of an appropriate design	1 2 3 4 5	1 2 3 4 5
Individuals develop problem definitions with specific criteria and constraints	1 2 3 4 5	1 2 3 4 5

IDEA GENERATION	Class Emphasis	Personal Growth
Teams and individuals utilize effective techniques for idea generation	1 2 3 4 5	1 2 3 4 5
Teams and individuals identify and utilize environments that support idea generation	1 2 3 4 5	1 2 3 4 5
Teams brainstorm effectively	1 2 3 4 5	1 2 3 4 5
Individuals apply effective techniques in their own idea generation	1 2 3 4 5	1 2 3 4 5
Teams use techniques that synthesize ideas to increase overall idea generation	1 2 3 4 5	1 2 3 4 5

EVALUATION AND DECISION MAKING	Class Emphasis	Personal Growth
Teams and individuals utilize critical evaluation and decision making skills and techniques, including testing	1 2 3 4 5	1 2 3 4 5
Teams follow an iterative approach that employs evaluation repeatedly in their design process	1 2 3 4 5	1 2 3 4 5
Teams and individuals apply simple matrix techniques for evaluating proposed solutions	1 2 3 4 5	1 2 3 4 5

IMPLEMENTATION	Class Emphasis	Personal Growth
Teams implement the design to a state of usefulness to prospective clientele	1 2 3 4 5	1 2 3 4 5
Teams manage time and other resources as required to complete their project	1 2 3 4 5	1 2 3 4 5
Team members follow instructions provided by others in implementation	1 2 3 4 5	1 2 3 4 5

COMMUNICATION	Class Emphasis	Personal Growth
Individuals communicate with team members at all stages of development and implementation of design solutions	1 2 3 4 5	1 2 3 4 5
Individuals practice effective listening skills for receiving information accurately	1 2 3 4 5	1 2 3 4 5
Individuals exhibit appropriate nonverbal mannerisms (e.g., eye contact) in interpersonal communication	1 2 3 4 5	1 2 3 4 5
Individuals give and receive constructive criticism and suggestions	1 2 3 4 5	1 2 3 4 5
Individuals record group activities and outcomes, ideas, date, etc. in personal design journals	1 2 3 4 5	1 2 3 4 5
Individuals produce technical papers and memos in acceptable style and format	1 2 3 4 5	1 2 3 4 5
Teams present design information in group oral presentations	1 2 3 4 5	1 2 3 4 5
Individuals communicate geometric relationships using drawings and sketches	1 2 3 4 5	1 2 3 4 5