Developing and Assessing Student's Principled Leadership Skills to Achieve the Vision for Civil Engineers in 2025

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Force Base, Calif. From August 1988 to September 1989, he underwent specialized undergraduate pilot training at Laughlin Air Force Base, Texas and from September 1989 to July 1994, Col. Fehrmann was a KC-10 evaluator/instructor pilot, flight commander, and combat crew training Instructor pilot, 32nd Air Refueling Squadron, 458 Operations Group, Barksdale Air Force Base, La. From July 1994 to July 1996, he was deputy chief of the Mobility Forces Programming Branch and Mobility Force programmer with HQ USAF/XOFM at the Pentagon near Washington, D.C. From July 1996 to June 1997 he was a student at Naval Command and Staff College at Newport, R.I. and from June 1997 to May 1999, chief of the KC-10 Combat Crew Training School's 305th Operations Group. Col. Fehrmann was also assistant director of Operations for the 2nd Air Refueling Squadron at McGuire Air Force Base, N.J. He began as operations officer with the 458th Airlift Squadron, Scott Air Force Base, Ill. in May 1999 and then in July 2000 he became commander. In August 2002 he became chief of the Air Operations Branch with the U.S. Transportation Command there. Col. Fehrmann spent a year starting in June 2003 working as a J3 executive officer with the U.S. Transportation Command there. In June 2004 he started as a student at the Air War College in Maxwell Air Force Base, Ala. and ended in June 2005. From July 2005 to May 2006, Col. Fehrmann became deputy commander of the 22nd Operations Group at McConnell Air Force Base, Kan. He spent a year beginning in June 2006 as vice commander of the 380 Air Expeditionary Wing at Al Dhafra Air Base in the United Arab Emirates. Then from August 2007 to May 2011, Col. Fehrmann worked as professor of Aerospace Studies and Commander with the Air Force ROTC Detachment 765 at The Citadel in Charleston, South Carolina. Col. Fehrmann has a Command Pilot rating and has more than 4,600 flight hours. He has flown the KC-10, KC-135A/R, C-21, T-37, T-38. He is the recipient of many awards and decorations: the Legion of Merit, Defense Meritorious Service Medal, Meritorious Service Medal with three oak leaf clusters, Air Medal, Aerial Achievement Medal with one oak leaf cluster, Air Force Commendation Medal, Joint Meritorious Unit Award, Air Force Outstanding Unit Award with "V" device and four oak leaf clusters, Air Force Organizational Excellence Award with one oak leaf cluster, Combat Readiness Medal with one oak leaf cluster, National Defense Service Medal, Armed Forces Expeditionary Medal, Southwest Asia Service Medal, Global War on Terrorism Expeditionary Medal, Kuwait Liberation Medal from the Kingdom of Saudi Arabia, and the Kuwait Liberation Medal from the Government of Kuwait.

Developing and Assessing Student's Principled Leadership Skills to achieve the Vision for Civil Engineers in 2025

Abstract

Achieving American Society of Civil Engineers (ASCE) Vision for Civil Engineers in 2025 focuses on student skills needed to serve the profession and meet demands of tomorrow's world and outlines five major areas where civil engineering's will lead society in establishing a sustainable world and raise the global quality of life. Civil engineers are envisioned to be master builders, stewards of the environment, innovators, managers of risk, and leaders of public policy. The ASCE Body of Knowledge (BOK) 2 provides a significant foundation for how engineering programs could prepare future civil engineering students to meet these aspirations. Professional outcomes identified in BOK 2 suggest target levels of cognitive development to adequately prepare undergraduate students. Preparing students to rise to the call of Vision 2025 as professionals requires synthesizing these professional outcomes across overarching concepts, such as principled leadership, so students are ready to serve as stewards of the environment and leaders of public policy. At the same time colleges and universities are faced with the challenge of teaching and assessing a core curriculum needed to provide technical competence versus expansion of the curriculum to address professional outcomes to support this higher vision. Additionally, college and universities often face expectations of multiple accrediting agencies and arduous university policies surrounding accreditation. To address these challenges, The Citadel Department of Civil and Environmental Engineering (CEE) is adopting a holistic approach to investigate and analyze principled leadership through individual course goals and student extracurricular activities, resulting in evidenced base assessment that can be mapped to outcomes at various institutional levels.

If engineering educators are to be successful in developing student leaders, faculty need to improve instruction on leadership development, provide opportunities for students to practice leadership skills in the classroom without direct oversight, and facilitate extracurricular leadership experiences with faculty serving in advisory roles. This paper presents and discusses application of outcome-based threads, specific elements of the principled leadership thread, methods used to document extracurricular leadership activities for undergraduate civil engineering students, and anticipated changes from analysis of the principled leadership thread. Results from this process are being used to create an evidence-based means to raise student cognitive performance levels aligned with principled leadership and other related professional development outcomes.

Introduction

The Citadel CEE Department's curriculum and student development program has traditionally placed a premium on preparing graduates to serve with distinction as principled civil engineering leaders through their service to society as technical leaders of design, construction, maintenance and operation of built-environment facilities needed by society to establish safe, healthy, equitable and vibrant communities. As a result CEE Department faculty are developing an integrated student leadership program to prepare civil engineering graduates to embody the highest ideals of moral and ethical engineering leadership. Instructional modules were

implemented that focus on furthering student understanding of the moral and ethical responsibilities of practicing engineers through emphasis on principled leadership. The goal of this initiative is to establish an integrated approach for concept mapping, knowledge construction, and educational scaffolding of principles needed for graduates to embody the highest ideals of principled leadership in engineering practice.

Until recently this program initiative has been limited to courses in the curriculum due to the need to assess all students against adopted CEE Department program outcomes and standards. However, now the CEE Department's student leadership development program is being expanded to include extracurricular activities, which will be recorded, coded, and aggregated to further enhance this crucially important aspect of preparing civil engineering students to meet the high calling of professional practice. Student extracurricular activities are tracked and assessed using Taskstream, a widely used customizable, electronic assessment management and performance based instruction tool that includes web-based e-portfolios and outcomes assessment mapping.

Sequential course outcome maps, or "threads", aligning elements of the curriculum along professional CEE Department program outcomes have been established with the intention of linking course goals and supportive extracurricular activities within an overarching comprehensive strategy for student development. An essential component of establishing this plan was adoption of embedded indicators that are organized along CEE Department program outcomes and mapped across all four years of the undergraduate experience. As part of the department's assessment process, 28 course-specific embedded indicators are aligned with ten leadership oriented CEE Department program outcomes. Each embedded indicator is mapped to appropriate Blooms Taxonomy levels and organized sequentially to provide a progression of student development under these important civil engineering CEE Department program outcomes for professional practice and leadership. Additionally, extracurricular activities are used to support student development in leadership including participation in professional societies, student competitions, service to the profession, community service, supplemental instruction, and service learning. Providing meaningful extracurricular activities, guided by faculty advising and mentoring, challenges students to develop as leaders and is helpful in preparing graduates to embody the highest ideals of principled leadership and prepares students to meet the high calling of engineering practice.

Background

As identified by the American Society of Civil Engineers (ASCE) in Vision 2025, civil engineering students will be entrusted by society to help achieve a sustainable world, and to raise the global quality of life [1,2]. Similarly Walesh describes a path for accomplishing this major reform in education and pre-licensure experience in the engineering profession [3]. Furthermore, longstanding ethical cannons of engineering practice require that civil engineering graduates serve the profession and society as principled leaders [4]. To prepare students to effectively meet the evolving demands of the high calling of the engineering profession, undergraduate programs will need to respond through both academic curriculum enhancement and extracurricular student enrichment. The American Society of Civil Engineers published an expanded set of 24 civil engineering program outcomes in the Civil Engineering Body of Knowledge for the 21st Century

that many undergraduate programs are adopting as evidence of continuous improvement in fulfillment of ABET, Inc. (formerly know as Accreditation Board for Engineering and Technology) Criterion 5 [5,6]. Over one third of the civil engineering program outcomes identified by ASCE correlate with development of student leadership skills.

A review of publications and research on development of leadership skills for undergraduate students helps identify needed improvements [7]. Analysis by Kuh and others has shown self assessed improvement in interpersonal relationship skills, using the Mature Interpersonal Relationship Scale do not consistently illustrate improvement through the college experience [7,8]. Conversely, leadership skill development has been shown to improve through the college experience [7]. Leadership principles covered in the curriculum have proven to make statistically significant improvements in student development and studies have indicated interaction with faculty members has a positive effect [7]. A study by Astin suggests interaction with peers may result in twice the impact than with faculty outside the classroom [9]. If engineering educators are to be successful in developing student leaders, academic programs need to improve instruction on leadership development, provide opportunities for students to practice leadership skills without direct oversight, and facilitate extracurricular leadership experiences with faculty serving in advisory roles.

Assessing student obtainment of fundamental leadership concepts at lower levels of Blooms Taxonomy within the classroom is relatively straightforward. Welch provides some ideas of how this might be accomplished [10,11]. A more difficult challenge becomes tracking and assessing what takes place outside of the classroom through meaningful extracurricular activities. This paper intends to address this important challenge facing academia. Using a subset of ASCE BOK outcomes, student attainment is measured through application of a Bloom's Taxonomy calibrated rubric to provide an effective tool for mapping and improving student readiness in the crucially important aptitude of engineering leadership.

College-wide Leadership Model

Our academic institution places a substantial emphasis on preparing students in all academic majors to serve as principled leaders. To further enhance this mission, a college-wide leadership development model was adopted in 2010 and is shown in Figure 1. This four-year program provides undergraduates with a highly structured process to learn and practice attributes of principled leadership. The program is built upon core values of honor, duty, and respect. Four pillars of academic, military, physical effectiveness, and moral/ethical development are founded upon the core values and provide a framework for student engagement. Students participate in institutionalized programs and develop skills through academic coursework, leadership seminars, training programs, and experiential leadership in numerous aspects of student life.

Leadership in Civil Engineering

The civil engineering program also places a premium on leadership development. The CEE Department mission includes, "development of principled leaders in the civil and environmental engineering community." Additionally, one of four CEE Department core values is dedicated to preparing civil engineers to serve as principled leaders through an understanding and

commitment to high ethical standards in all aspects of professional practice. Furthermore, CEE Department educational objectives focused on design, sustainable success and broad-based education all contain elements connecting with leadership principles in the engineering profession. These founding ideals of the civil engineering program are depicted in Figure 2. The mission, core values and educational objectives are aligned with 22 CEE Department program outcomes that connect these overarching principles to specific locations in the curriculum and with student enrichment activities.

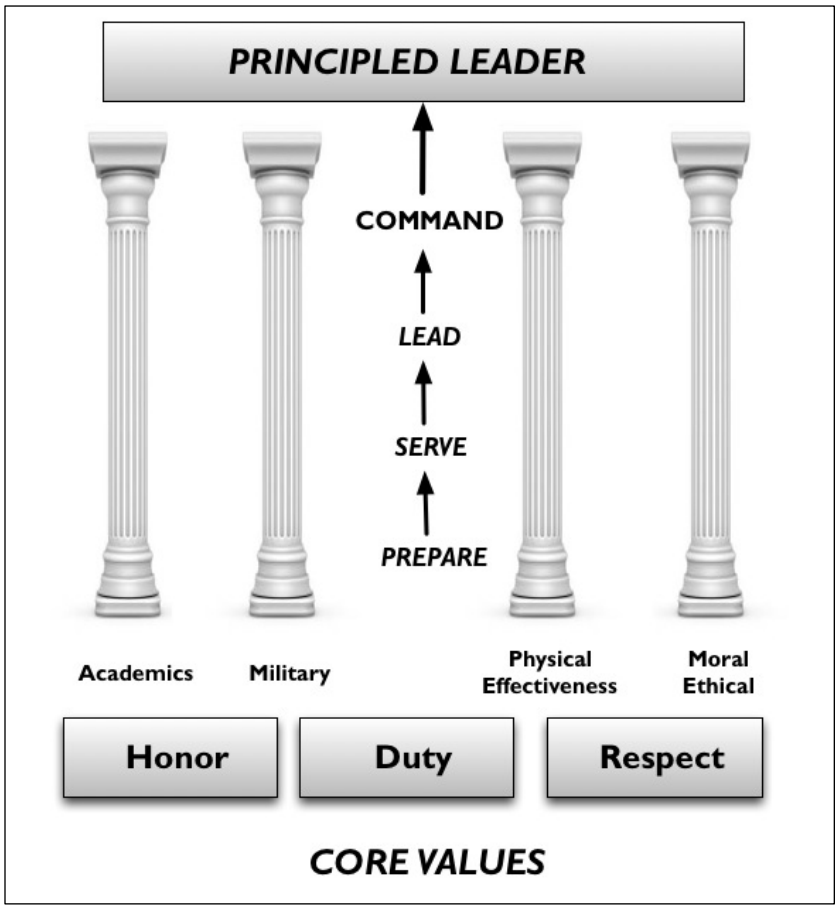

Figure 1 College-wide Student Leadership Development Model

Civil Engineering CEE Department Program Outcomes

The CEE Departments' 22 program outcomes were developed from ABET, Criterion 3, student outcomes A-K [6] and ASCE Body of Knowledge [5]. CEE Department program outcomes provide succinct statements that describe what students are expected to learn through the four-year development period prior to graduation. CEE Department program outcomes identify skills, knowledge and behaviors that students must gain as they progress through the program. Attainment of proficiency for each of the 22 CEE Department program outcomes is measured using embedded indicators with the six levels of Bloom's Taxonomy [12,13] summarized as: 1.) Knowledge, 2.) Comprehension, 3.) Application, 4.) Analysis, 5.) Synthesis and 6.) Evaluation.

Table 1 summarizes the 22 CEE Department program outcomes adopted for the Civil Engineering program and identifies the ten outcomes that are being used to assess leadership development. Course embedded indicators on tests, assignments, and projects are used systematically to evaluate each of the 22 CEE Department program outcomes. Multiple means of assessing each CEE Department program outcome are deployed and include embedded indicators, results from Fundamentals of Engineering examination topics, curriculum measures, and indirect survey measures. This approach allows creation and evaluation of sequenced curriculum threads along major discipline tracts (structural, environmental, transportation, land development) and central learning subjects, such as leadership, within the academic program.

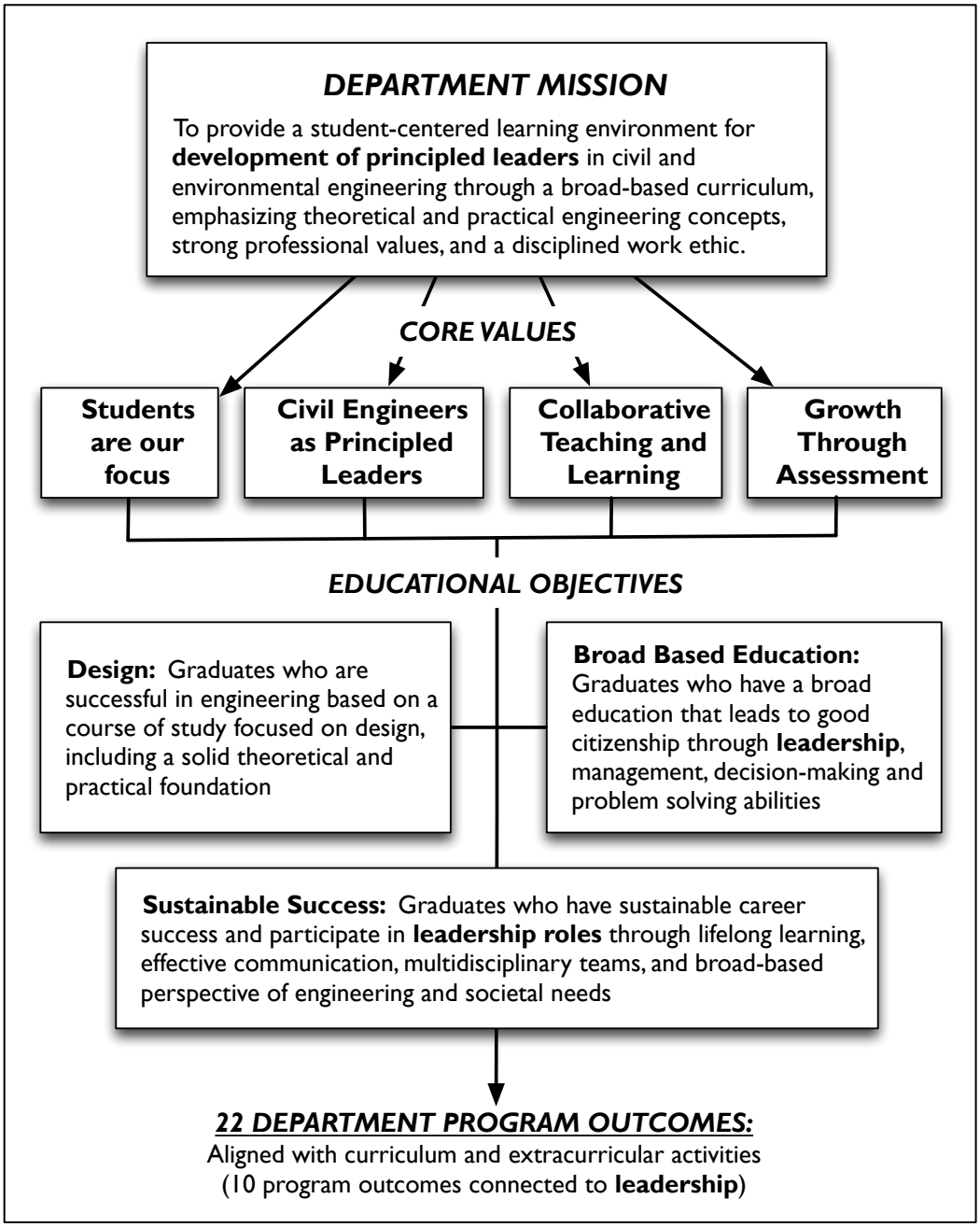

Figure 2 CEE Department Mission, Core Values and Educational Objectives

Table 1 Summary of Civil Engineering CEE Department Program Outcomes

Dept. Program Outcome	Description of Dept. Program Outcome with Leadership Linkage
1. Mathematics 2. Science 3. Solid & Fluid Mechanics 4. Experiments 5. Problems Solving a) Techniques b) Tools	
Design **6. a) Environmental** **7. b) Structural** **8. c) Land Development** **9. d) Transportation**	**Design systems, components, and processes within realistic constraints such as regulatory, economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.**
10. Contemporary Issues	
11. Project Management	Explain what a project is and key elements of **project management**.
Engineering Problems 12. a) Environmental 13. b) Structural 14. c) Land Development 15. d) Transportation 16. Communication a) Graphical b) Verbal b) Written	
17. a) Public Policy	Discuss and explain key concepts involved in **Public Policy and Public Administration**.
18. b) Business	
19. Leadership	Explain the **role of a leader and leadership principles and attitudes**.
20. Interdisciplinary Teams	Function effectively as a **member of an interdisciplinary team**.
21. Self Directed Learning	Demonstrate the ability for **self-directed learning**.
22. Ethical Responsibility	Apply standard of **professional and ethical responsibility** to determine an appropriate course of action.

Results from embedded indicators and other measures are evaluated to ensure overall desired performance standards are met and to develop targeted solutions when problems are identified. Solutions often include modification to instructional material, improvements to increase student understanding and scaffolding of knowledge construction. Curriculum-based solutions often extend across multiple courses and can be used to address learning objective scaffolding, along with thread continuity issues, to help students' progress in their skill level growth along the Bloom's Taxonomy scale.

Civil Engineering Curriculum Leadership Thread

An evidence-based system, using Taskstream administered by the CEE Department Head, was adopted by the CEE Department to populate and maintain a systematic record of course goals and embedded indicators to facilitate curriculum assessment through thread analysis of important instructional and student development topics. The primary source for analysis data is taken from direct measures including course embedded indicators and Fundamentals of Engineering (FE) examination subject areas. Indirect measures include self-reported survey results aligned with CEE Department program outcomes. As shown in Tables 2 and 3, evaluation extends across all four years of instruction, including engineering design, effective communication, life-long learning, multidisciplinary teamwork and principled leadership. Focusing on a student leadership development thread within the engineering curriculum, and emphasizing ethical cannons of professional practice for leadership in addressing society and community needs, a framework for student leadership development was implemented across each year of educational growth.

As shown in Tables 2 and 3, a sequenced course thread for leadership development links 17 courses and 28 course objectives within the civil engineering curriculum to provide students with a means to develop their skills as preparation for success in professional practice. This thread extends across all four years of the undergraduate curriculum and includes half of the 34 required courses taught within the CEE Department. Development of principled leaders through the curriculum culminates in an engineering capstone class were students work on multidisciplinary teams to achieve common goals. During capstone courses students either serve as group or discipline leader, or routinely evaluate their leaders as part of the learning process.

Courses within the civil engineering curriculum that prepare students and develop their leadership skills are identified in Table 2 and are further described in an accompanying matrix provided in Table 3 that summarizes mapping of 28 course objectives to levels of Bloom's Taxonomy. As recommended by ASCE BOK 2, many of the course objectives are mapped to Bloom's Taxonomy levels 1.) Knowledge, 2.) Comprehension, and 3.) Application. These tables provide a collective illustration of curriculum mapping for student leadership development within civil engineering courses. This approach provides a useful means to visualize how well course goals are distributed over four years of the curriculum and connected with other crucially important topics within the curriculum such as design, and four discipline tracts in environmental, structures, land development, and transportation.

Table 2 Summary of Civil Engineering Courses linked with Leadership Development

Civil Engineering Course	Academic Year
Introduction to Civil Engineering, CIVL 103	**Freshman**
Surveying, CIVL 205 Computer Application for Civil and Environmental Engineering, CIVL 210 Surveying I Laboratory, CIVL 235	**Sophomore**
Highway Engineering, CIVL 302 Transportation Engineering, CIVL 305 Engineering Economy, CIVL 314 Professional Sustainability, CIVL 317 Hydrology and Hydraulics, CIVL 321	**Junior**
Reinforced Concrete Design, CIVL 404 Steel Design, CIVL 406 Water and Wastewater Systems, CIVL 408 Engineering Management, CIVL 411 (1) Subdivision Planning and Design, CIVL 421 (1) Comprehensive Project in Environmental Engineering, CIVL 422 (1) Comprehensive Project in Structural Engineering, CIVL 423 (1) Comprehensive Project in Civil Engineering, CIVL 425 (1)	**Senior**
Notes: 1.) These courses related to leadership development, however, are not yet mapped to the student leadership development thread. These mapping efforts are currently in progress.	

Extracurricular Leadership Development Activities

Civil engineering students are encouraged by CEE Department faculty to engage themselves in a host of extracurricular enrichment activities. Students are publically acknowledged and recognized through awards for their activities, however no formal credit provided. Through the use of Taskstream e-portfolios, activities will be included as part of their academic record. Currently activities are reported retrospectively during a survey conducted in their senior capstone course. Once Taskstream e-portfolios are fully functional to address this issue, the goal will be to have students update this data once a year.

Student extracurricular opportunities include participation in professional societies, student competition teams, community service projects, service learning initiatives, academic tutoring, peer mentoring, supplemental instruction, internships and work experience. Student leadership

Table 3 Levels of Cognitive Achievement[1] for Course Objectives Focusing on Leadership Development[2]

Course No.	Course Goals	Leader ship	Ethics	Envir. Design	Struct. Design	Land Dev.	Trans. Design	Team work	Self-dir. Learning	Public Policy	Project Man.
CIVL 317	7 - attitudes supportive of PE practice	2									
CIVL 317	8 - leadership principles	2									
CIVL 103	2 - ethical cannons, licensure		1								
CIVL 205	4 - surveying ethical responsibilities		1								
CIVL 210	3 - software ethics		3								
CIVL 235	5 - use of professional standards		3								
CIVL 408	3 - standards for drinking water			4							
CIVL 408	5 - sanitary sewer system design			5							
CIVL 408	7 - waste water treatment system			4							
CIVL 404	7 - foundation code design standards				5						
CIVL 406	3 - tension code design standards				5						
CIVL 406	5 - beam code design standards				5						
CIVL 302	3 - site traffic operations analysis					4					
CIVL 321	4 - stormwater and detention design					3					
CIVL 408	5 - sanitary sewer system design					5					
CIVL 302	2 - excavation and embankment						3				
CIVL 302	6 - stormwater and culvert design						3				
CIVL 302	7 - highway design project plans						4				
CIVL 103	5 - projects and team dynamics							1			
CIVL 317	1 - multidisciplinary teams							2			
CIVL 103	3 - life long learning								1		
CIVL 210	1 - self directed learning								3		
CIVL 317	6 - life long learning skills								2		
CIVL 305	2 - government and transportation									2	
CIVL 314	5 - b/c ethical considerations									3	
CIVL 317	5 - public policy concepts									2	
CIVL 302	4 - highway construction contracts										3
CIVL 317	3 - project management										2

Notes: 1. Levels of Bloom's Taxonomy 1.) Knowledge; 2.) Comprehension; 3.) Application; 4.) Analysis; 5.) Synthesis; 6.) Evaluation
2. Senior Capstone course are currently being adjusted and are not included in this matrix.

experiences and skills developed through these structured activities harmonically complement principles and practices covered in the civil engineering curriculum and college-wide leadership development model. Through campus-wide adoption of student e-portfolios in 2010 and stipulation of required elements pertaining to academic skills, career development and leadership, tracking of these crucially important student activities is becoming institutionalized. Aggregation of this data for assessment will be important for guiding and advising students to take full advantage of leadership opportunities, and for applying collective knowledge of metrics towards recruitment and student envisioning of a strategic plan.

Consistently reporting, tracking, monitoring and assessing these types of student extracurricular activities is inherently problematic. A rubric has been adopted that correlates typical student activities with six of the ten CEE Department program outcomes used in the curriculum to prepare students for principled leadership. The rubric is shown in Table 4 and centers on higher levels of Bloom's Taxonomy, 3.) Application 4.) Analysis and 5.) Synthesis, identified in matrix descriptions as either development or performance levels. Students self–report, apply rubric standards and record extracurricular leadership oriented activities. Ultimately students will formally enter this data into their e-portfolios during their senior year. Four leadership-oriented CEE Department program outcomes related to design were deemed not applicable for meaningful evaluation through student self-assessment of extracurricular activities. Table 5 shows how the rubric is to be applied for typical student activities occurring within engineering and other on-campus organizations.

Table 4 Rubric for Evaluation of Extracurricular Leadership Development

CEE Department Program Outcomes	Blooms Taxonomy Extracurricular – Development Level I	Blooms Taxonomy Extracurricular – Performance Level II
Project Management	**Develop** solutions to project management problems	F**ormulate** documents to be incorporated into the project plan
Public Policy and Public Administration	**Apply** public policy and public administration concepts and processes	
Leadership	**Apply** leadership principles to direct the efforts of a small homogeneous group	**Organize** and direct the efforts of a group
Interdisciplinary Teamwork	**Function** effectively as a member of a team of student/ faculty of only civil engineers	**Function** effectively as a member of a team consisting of students/faculty who are not strictly engineers
Self-Directed Learning	**Demonstrate** the ability for self-directed learning	**Identify** additional knowledge, skills, and attitudes appropriate for professional practice
Professional and Ethical Responsibility	**Apply** standards of professional and ethical responsibility to determine an appropriate course of action.	**Analyze** a situation involving multiple conflicting professional and ethical interests to determine an appropriate course of action

Professional organizations include America Society of Civil Engineers, Society of Women Engineers, Tau Beta Pi, Society of American Military Engineers, and Institute of Transportation Engineers. Other on-campus opportunities include student organizations, group activities, club organizations, teams, sports, training, service, and leadership. Through these activities, students are given opportunities to develop leadership and teamwork skills within the context of the civil engineering profession. These organizations are available to all students. CEE Department faculty serve as advisors to these groups and receive credit in the faculty tenure and promotion process for working with students outside of class.

Combined Mapping of Overall Program for Leadership Development

Using linkages and mapping previously described, Table 6 provides a comprehensive overview of student leadership development for civil engineering students reflecting both curriculum instruction and extracurricular activities. A total of 16 course goals evaluated using embedded indicators are dedicated to CEE Department program outcomes that support leadership development, excluding an addition 12 that are aligned with engineering design. As shown in Table 6, course goals covered in the curriculum are generally aligned with lower levels of Bloom's Taxonomy, Level 3 or lower. With addition of representative mapping of extracurricular activities that support student leadership development, and corresponding CEE Department program outcomes, higher levels of Bloom's can be achieved, ranging from Level 3 to 5. In accordance with ASCE BOK 2 criteria [4], these higher levels of student attainment are needed to prepare undergraduate students to serve as principled leaders and to fulfill ASCE's Vision 2025 [1] for the civil engineering profession. To attempt to achieve higher Boom's levels solely within the curriculum would likely require removal of foundational knowledge necessary for students to learn the technical and analytical skills need to become a civil engineer.

Initial Student Results From Leadership Development Evaluation

As described in Table 6, mapping and exposure to leadership oriented extracurricular activities in the CEE Department program was determined through self-reporting, use of rubric criteria, and information listed in Table 4 and 5. A representative sample of seven seniors and recent graduates were asked to code their extracurricular activities during their four years as undergraduate students. This sample size is comprised of 51 undergraduate civil engineering seniors containing both traditional and non-traditional students. Information submitted by students was reviewed by faculty for consistent application of coding/rubric criteria and tabulated to provide a representative depiction of student extracurricular activities that support leadership development. Averages of individual activities across the six leadership oriented CEE Department program outcomes are provided in Table 6 and these values revealed students are gaining experience in their development as principled leaders through a host of meaningful extracurricular activities. Students identified multiple experiences (ranging from an avg. of 1.3 to 8.0) at Bloom's Level 3 and 4 for all leadership oriented outcomes. Mapping and assessment of these activities is helpful in providing a more complete depiction of leadership development during a civil engineering student's years spent in undergraduate education. Administrative steps are being taken to institutionalize the reporting, tracking, monitoring, and assessment of extracurricular leadership development activities for all civil engineering students. Obviously more emphasis will be placed on helping student engage in these important leadership

Table 5 Matrix of Extracurricular Leadership Development Activities and Coding

Civil Engineering Extracurricular Activity	Leadership	Professional & Ethical Resp.	Teamwork	Self-Directed Learning	Public Policy & Public Adm.	Project Mang.
Student Chapter Officer	II	II	II	II	I	II
Student Chapter Event Coordinator	II	I	I	I		I
Student Chapter Event volunteer		I	I			I
FE Review Coordinator	II	I	II	I	I	I
Professional Activities Event (PAE) Coordinator	II	I	II	I	I	I
Professional Activities Event (PAE) participant				I		
ASCE Eastern Branch Liaison	I		I	I		
ASCE Eastern Branch meeting participant				I		
Community Service Coordinator	II	I	I	I	I	II
Community Service Project Leader	II	I	I	I	I	II
Community Service volunteer		I	I	I		
Chapter Publicity Coordinator			I	I		
ASCE/SAME Liaison	I		I	I		
SAME meeting participant				I		
ASCE Chapter Photographer			I	I		
GUIDE Mentoring Coordinator	II	II	I	II		II
GUIDE Mentoring volunteer	I	I	I			
GUIDE Mentoring participant			I	I		
Student Advisory Council Coordinator	II	II	I	I	I	II
Student Advisory Council member	I	I	I		I	
ASCE Carolinas Conference Team Captain	II	I	I	I		I
ASCE Carolinas Conference Team member		I	I	I		
Supplemental Instructor	I		II	II		I
Participant in student-peer academic mentoring	I		I	II		
ASCE Concrete Canoe Team Captain	II	I	I	II	I	II
ASCE Concrete Canoe Team member		I	I	I		
ASCE Steel Bridge Team Captain	II	I	I	II	I	II
ASCE Steel Bridge Team member		I	I	I		
NSPE Ethics Presentation participant				I		
Himelright Lecture participant				I		
ASCE/SWE/SAME Chapter member			I	I		
Campus, Regimental Staff Position	II	II	II	II	I	II
Campus, Battalion Staff Position	II	II	II	II	I	II
Campus, Company Staff Position	II	II	II	I	I	II
Campus, Platoon Staff Position	II	II	II	I		I
Campus, Squad Staff Position	II	II	II	I		I
Notes: Level I = Development, Level II = Performance						

Table 6 Aggregation of Curriculum and Extracurricular Leadership Development Activities

		Leadership	Prof. & Ethical Resp.	Teamwork	Self-Directed Learning	Public Policy & Admin.	Project Management
CE Curriculum (Course Goals) [1]							
Bloom's Level	1. Knowledge		2	1	1		
	2. Comprehension	2		1	1	2	1
	3. Application		2		1	1	1
	Total	**2**	**4**	**2**	**3**	**3**	**2**
Extracurricular Activities [2,3]							
Bloom's Level	3. Application	64(1.3)	173(3.4)	290(5.7)	409(8.0)	86(1.7)	70(1.4)
	4. Analysis	128(2.5)	93(1.8)	121(2.4)	69(1.3)		67(1.3)

Notes:
1.) Leadership related outcomes for civil engineering students are covered through 16 course goals as part of the required curriculum. Each is assessed through use of embedded indicators and compared to department standards for assessment.
2.) Extracurricular activities were determined from an overall average of a representative sample of seven students, who self-reported their activities using information listed in Tables 4 and 5.
3.) Sample size is comprised of 51 undergraduate civil engineering seniors containing both traditional and non-traditional students. Total number of activities and average number of activities per students in parentheses are denoted as 000(0.0)

development activities. An expanded list will also likely help capture additional relevant activities of non-traditional students, such as work experience and professional responsibilities.

Summary

Mapping of curriculum and extracurricular leadership activities along ten CEE Department program outcomes supporting student leadership development, created an informative depiction of experiences civil engineering undergraduate amass in their aspiration to become principled leaders. Through an evaluation of undergraduate student leadership development, the following summary points and insights are provided:

- The CEE Department is committed to student leadership development through emphasis in the mission, core values, and educational objectives that serve to hold graduates accountable for demonstrating growth towards principled leadership.

- The CEE Department is committed to providing students with foundational knowledge and skills needed to develop as principled leaders, through a curriculum-based leadership thread, covering ten CEE Department program outcomes and including 28 course goals.
- Leadership mapping of the curriculum confirms knowledge construction and learning expectations are consistent with Levels 1 to 3 of Bloom's Taxonomy.
- Mapping of extracurricular leadership activities demonstrated experiences allow students to develop and perform at (higher) Levels 3 to 4 of Bloom's Taxonomy, which map to six CEE Department program outcomes supporting leadership development.
- Structure self-assessment of extracurricular leadership activities provides a useful method to begin quantifying how student development is affected by these experiences.
- The leadership thread analysis facilitates a synthesis CEE Department program outcomes supporting student leadership development in accordance with ASCE's Vision 2025.
- If student leadership development is merely attained through meeting ABET standards within the course curriculum, this approach only attains Level 2 to 3 of Bloom's Taxonomy and falls short of developing principled leaders needed to achieve a sustainable world and raise the global quality of life, as advocated in ASCE's Vision 2025. To attempt to achieve higher Boom's levels solely within the curriculum would likely require removal of foundational knowledge necessary for undergraduate students to learn the technical and analytical skills need to become a civil engineer.
- An academic program that includes meaningful extracurricular activities, guided by faculty advising and mentoring, challenges students to develop as leaders and is helpful in preparing graduates to embody the highest ideals of principled leadership and to meet the high calling of engineering practice.

Future Steps

The CEE Department has been using embedded indicators and other measures to assess student performance for important CEE Department programs outcomes across academic threads for a number of years. However, the use, mapping and linkage of student extracurricular activities was recently adopted and administered. Obviously a number of improvements are needed for this assessment tool and development model to provide the level of results envisioned. Some of the initial future steps for further enhancement and improvement include:

- Continue to improve linkages in concept mapping, knowledge construction and educational scaffolding throughout the student leadership development thread by evaluation of data and assessment of evidence-based results.
- Develop more robust assessment methods for extracurricular leadership activities beyond student self-reporting.
- Institutionalize documentation process of student leadership development activities through expanded functionality of online leadership e-portfolios.
- Expand collection of extracurricular leadership self-assessment data for use in identifying activity threshold guidelines for various levels of student leadership development.

- Establish systematic time periods within the curriculum when faculty will interact with students regarding their leadership development through extracurricular activities.
- Use collected data to determine if extracurricular activates are effective in development of a student's principled leadership skills.

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