State of the Art : Drafting Principles of Teaching and Learning for a New Department

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Abstract

This paper presents an ***Evidence-Based Practice*** on the development of principles of teaching and learning for a new department. The formation of a new engineering department, whether it be from scratch, merger, or reorganization, comes with significant challenges. Departments must prioritize the development of future engineering professionals. Effective student development starts with ensuring all faculty demonstrate excellence as teachers and scholars. When hiring new faculty members, it is standard to require them to write a personal teaching philosophy. However, many terminal degree programs do not require graduates to receive formal instruction on teaching and learning. Further, institutions may lack the resources or scheduling flexibility to prepare new faculty for their first semester teaching. Individual educators hold ultimate responsibility for adopting effective techniques to enhance their students' experience and learning. This manuscript outlines the formal process taken by a new department to draft guidance for faculty members in the form of department "Principles of Teaching and Learning." These principles were aspirational for faculty to achieve and were nested in the mission and vision for both the department and the institution. The goal of the guidance was not to provide a rigid model that faculty were forced to follow, but rather to outline characteristics that the department valued. This allowed each faculty member freedom in their approach to educating students but improved the sense of community among the faculty. The authors reviewed the extensive literature available on techniques for teaching and learning and highlighted those essential to the department's identity. Further, faculty members were surveyed on important aspects of teaching in their former programs and departments. Drafts of the principles of teaching and learning were provided to faculty members for review and comments. This paper documents previous research on effective teaching and learning, the difference between teaching and learning models and principles, and the process taken to draft principles for a department that supports the faculty, the institution, and most importantly, the students.

Introduction

Educating undergraduate students is arguably the most important job for higher education faculty. A recent survey conducted by the Council of Graduate Schools found, for 69% of PhD graduates in faculty positions, teaching was either a primary or secondary responsibility [1]. This included both research universities and primarily undergraduate institutions. Of those who indicated teaching was their primary responsibility, only 38% indicated their PhD program prepared them "very well" for their current job. Engineering institutions are also turning to faculty who lack a terminal degree such as adjunct faculty and professors of practice due to the wealth of technical knowledge and industry experience, they can provide for students [2], [3]. Compared to surgeons, plumbers, electricians, lawyers, aviators, and even practicing engineers and K-12 educators, higher education engineering faculty are not required to take extensive coursework or possess significant experience in their primary responsibility: teaching [4], [5], [6]. Engineering faculty often enter academia with little formal preparation for teaching. Research shows that teachers can learn by observing and emulating good teachers or on trial-

and-error approaches that can take years to develop [7], [8], [9]. However, that research assumes that teachers were provided with the opportunity to observe good teachers. Teachers who teach how they were taught may not necessarily be teaching the way their students learn [10].

Most hiring institutions require proof of teaching experience when selecting new faculty members. Of 100 open postings for engineering Assistant Professors at 63 different institutions on AcademicKeys (12NOV25-12JAN26), 97 of the postings required some form of a teaching statement or teaching philosophy [11]. Of the three positions which did not require a teaching statement, two were for Assistant Research Professors and one was for a faculty position at a post-graduate institution. One posting went as far as to state "Describe the core principles that guide your approach to teaching as it relates to the following three areas: student engagement, assessment of student learning and your own continuous improvement." This is a lofty expectation for many graduate students who lack formal preparation for teaching [12].

The National Academy of Engineering stated engineering education needs to better align with what is expected in the workplace and faculty need to possess the skill sets necessary to deliver the desired curriculum [13]. While many believe the simple solution is to require formalized training for doctoral students and new faculty members, this would require systematic acceptance, reform, and resourcing from graduate programs and hiring institutions [10], [14], [15]. Lack of development programs and high-quality teaching practices can negatively influence student learning and retention in engineering majors [16], [17]. Independent programs such as Preparing Future Faculty (PFF), the National Effective Teaching Institute (NETI), and the Excellence in Civil Engineering Education (ExCEEd) provide voluntary evidence-based professional development opportunities for faculty focused on teaching [18], [19], [20]. Structured faculty development programs can significantly improve teaching quality early in a faculty member's career [21], [22], [23]. The growing emphasis on outcomes-based accreditation [24], coupled with changing student demographics and expectations, further underscores the need for robust instructional development initiatives [25], [26].

Departments can begin to improve their undergraduate education by establishing a culture of excellence in teaching [27]. Research has shown that a supportive culture, formal mentoring of new faculty, and incentivizing high quality teaching and participation in faculty development programs can significantly improve student outcomes [21], [28], [29], [30], [31].

This manuscript presents an evidence-based practice to draft principles of teaching and learning for a new Department of Civil and Environmental Engineering at the United States Military Academy at West Point (USMA). The goal of this study was to draft principles of teaching and learning, which emphasized to new and existing faculty members the importance of high-quality engineering education within the department. These principles would help establish a culture of excellence in teaching. This manuscript reviews current literature on effective principles of teaching and learning, existing evidence-based models of teaching and learning, different initiatives that other institutions and societies have taken to promote excellence in engineering education, and the process for drafting principles of teaching and learning for the new department.

Principles of Teaching and Learning

This section reviews literature on evidence-based strategies and methods for effective teaching and learning. For comprehensive books on best practices in engineering education, the authors recommend the following [32], [33], [34], [35].

There are a variety of established teaching and learning models in literature. A teaching model is a plan for how an instructor designs and implements curriculum, courses, and individual lessons [36]. Good models are plausible, simple, explicit, comprehensive, limited, useful, testable, and possess aesthetic appeal [37]. As much as it is an informational tool, it can also be used as a promotional tool for effective strategies. It is important to understand that models are consistently evolving as research improves. Models are created to achieve targeted outcomes which may not capture the holistic objectives of a learner [38]. Owen Wilson [39] states "There are no one-size-fits-all models of teaching and all models are not appropriate for all instructional scenarios." An equally important aspect to a teaching model is the learning model or learning styles. Understanding learning styles can help teachers design curriculum to address all students [40]. However, recent literature has disputed the efficacy of learning styles [41]. Instructors should not teach to a single learning style and should vary learning activities as learners may experience the same teaching in different ways [10]. While many of these teaching and learning models are well established and proven, their rigid nature may restrict a faculty member's academic freedom and flexibility in applying teaching strategies to reach all their students. Therefore, the authors focused on principles of effective teaching and learning presented in literature.

Principles represent broadly applicable, research-informed guidelines that describe how learning and motivation generally function across settings, whereas models provide structured representations or frameworks that organize these principles into a coherent system for application [42]. Principles offer flexibility and adaptability, while models emphasize implementation by specifying relationships, sequences, or components [43]. The components of teaching may be more important than the method or model implemented [44].

There are four reoccurring themes in literature that are essential for effective teaching and learning. The first should be the primary goal for all teachers, which is to establish a student-centered learning environment and demonstrate a belief that their students can learn [44], [45], [46]. The learning environment plays a crucial role in the depth of student learning [42], [47], [48], [49]. Several aspects of the environment can have an impact such as the physical learning space and individuals, the psychological state of the students including their prior knowledge and experiences, the social dynamic between all the students and the instructor, and the instructional strategies implemented.

The second is to ensure their students are prepared to enter their careers and continue to learn and grow independently. Students must possess cognition, metacognition and motivation to be classified as a self-regulated learner [50]. In addition to having a strong grasp of fundamental concepts, students must also understand the "why" behind the concepts and have a strong motivation to expand their knowledge further. Active learning can support metacognitive

learning [51], [52], [53]. It is critical that students collect and research information independently, communicate that information to their instructors or peers, evaluate the feasibility of the information in a cooperative learning environment, receive feedback from their instructor, and adjust their strategies as needed [42]. This collaborative and cooperative learning environment created through project or problem-based activities reflects the team-oriented environment of the engineering field, which increases students' motivation for the subject. Felder et al. [28] recommended applying Wlodkowski's five motivational factors for adult learners: expertise, relevance, choice, praxis (action plus reflection), and groupwork [54]. In this sense, Wlodkowski's framework enables the translation of theory into practice without prescribing rigid instructional methods [21], [28], [54]. This framework aligns with cognitive science principles outlined in How People Learn, emphasizing learner-centered environments and active engagement [54], [55], [56].

The third key element is the instructor. A teacher must be prepared, organized, clear and understandable [57]. They must also be stimulating, enthusiastic, approachable, fair and sensitive to the class level and their progress [58]. Lowman [32] defines these as the two dimensions of effective teaching: intellectual excitement and interpersonal rapport. An instructor who possesses both is a complete exemplar. However, achieving this goal takes practice, continuous improvement [58], and in most cases, an institutional culture that values and rewards good teaching.

Lastly, good teachers must provide formative and frequent assessments to track learning based on clear learning objectives [60]. Assessment of student learning must be primarily based on mastery over cognitive knowledge.

The Appendix details initiatives that other institutions and societies have taken to promote excellence in engineering education.

Evidence-Based Practice for New Department

In 2024, USMA began a transformation to optimize and modernize the academic program to meet the changing needs of the U.S. Department of War and Department of the Army. This transformation expanded resources for STEM majors including the construction of a new cyber and engineering academic center, initiating a new Aerospace Engineering major, and placing a larger focus on educating students on resilient and sustainable design. As part of this transformation, there was significant reorganization of the academic departments including splitting the Department of Civil and Mechanical Engineering and the Department of Geography and Environmental Engineering into three departments: the Department of Civil and Environmental Engineering, the Department of Mechanical and Aerospace Engineering, and the Department of Geography and Earth Sciences.

This manuscript focuses on the drafting fundamental principles of teaching and learning to support all faculty in the Department of Civil and Environmental Engineering (D/CEE). For more information about lessons learned through the process of forming the new engineering department refer to Dacunto et al. [61]. USMA is an undergraduate only institution, which places significant emphasis on improving teaching activities to benefit student development [62]. Both

the civil and environmental engineering programs have had strong reputations for high-quality education and strong faculty development programs primarily focused on teaching. Leaders in the new D/CEE wanted to establish a culture where the top priority for all faculty members was to demonstrate excellence in teaching and a passion for educating and mentoring students. To achieve this objective, the authors drafted key guiding principles that reflected the legacy and teaching philosophies of the two programs including all their faculty both past and present.

ASCE ExCEEd Program

This study began by reviewing the existing ASCE ExCEEd program. When developing this program, ASCE defined good teaching in the context of the "ExCEEd Model" which is shown in Fig. 1 [63]. This model was developed almost 30 years ago. It includes attributes exhibited by good teachers. The beneficial impacts of these attributes on student learning are well supported by literature. The model defines a good teacher. A teacher should demonstrate all attributes outlined in the model which include structured organization of the entire course and each individual lesson, engaging presentations, infectious enthusiasm, positive rapport with students, frequent assessment of student learning, and appropriate use of technology. The ExCEEd Model dives deeper by providing a model instructional strategy shown in Fig. 2 [64]. This is an eight-step process to support student-learning.

The framework provided by the ExCEEd program is detailed and specific. The 1-week workshop was designed for new faculty members to improve their teaching skills. The program placed their focus on this model, but Estes et al. [63] acknowledged that "teaching is a very personal activity, and no two people do it the same." Therefore, this model may be difficult for all faculty members in a single department to achieve in the same manner. Emphasizing a rigid model may discourage faculty members who do not fit this profile. For example, those with less enthusiastic demeanor or those who teach a more abstract course that does not lend themselves to physical models or demonstrations.

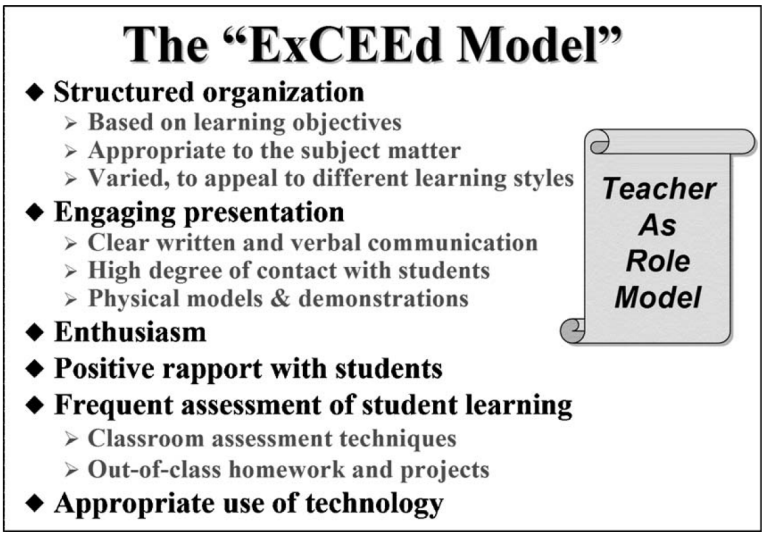

Fig. 1: The ExCEEd Teaching Model. Adapted from [63]

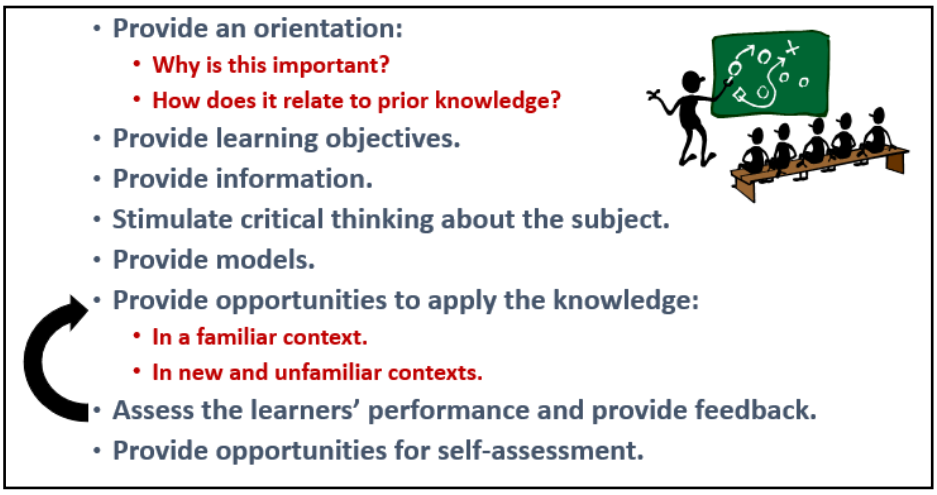

Fig. 2: The ExCEEd Model Instructional Strategy. Adapted from [64]

Previous Department Teaching and Learning Models

The former Department of Civil and Mechanical Engineering developed their own teaching and learning model shown in Fig. 3 [65]. This model was largely based on the ExCEEd model but was even more detailed. The model emphasized the importance of a student-centered learning experience. It focused on attributes of the instructor, students, and learning environment. The fourth bullet required continuous improvement of all three areas through assessment. This model was not meant to be achieved by brand new instructors. The former department recognized the requirement for on-going faculty development to truly achieve all facets of the model. New instructors focused on the fundamentals of teaching and strove to continuously improve as a teacher to meet the additional attributes outlined.

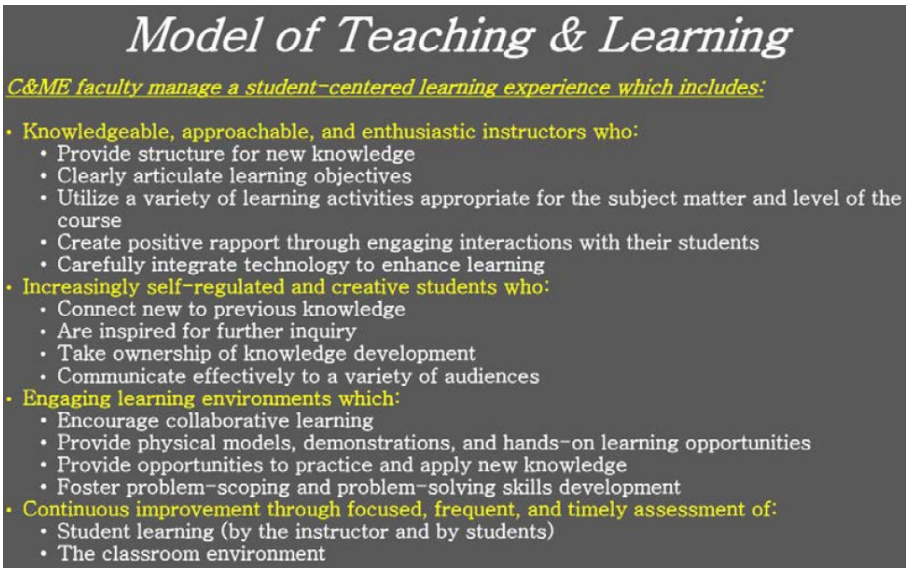

Fig. 3: Former Department of Civil & Mechanical Engineering Model of Teaching & Learning. Adapted from [65].

The former Department of Geography and Environmental Engineering's teaching and learning model, shown in Fig. 4, articulated what constituted excellent teaching. It focused on inspiring students, connecting learning objectives throughout the program, engaging students in a variety of activities, mentoring students, and developing self-directed students. This represented a more holistic view of a faculty member's role in the department including programmatic development and mentoring students outside the classroom.

The Department of Geography & Environmental Engineering educates by…

Inspiring students to learn course material, to be curious, to apply knowledge outside the classroom, and to be lifelong learners.

Connecting learning objectives to courses across the curriculum, to the Army profession, and to real-world problems at multiple scales.

Engaging students in a variety of active learning activities that promote interaction with their instructors and peers.

Mentoring students in the development of their character, their leadership skills, and their professional habits and behaviors.

Empowering students to learn independently, to be creative, and to take intellectual risks.

Fig. 4: Former Department of Geography & Environmental Engineering Model of Teaching & Learning

Proposed D/CEE Principles of Teaching and Learning

When forming the new D/CEE, department leadership asked the authors to develop a model of teaching and learning to reinforce the mission of the new department. The mission of the new department was nested in the academic mission of USMA which was to "educate and inspire leaders of character who think critically, internalize their professional identity, and employ their education to fight and win our Nation's wars. The mission of the new D/CEE was to "educate and inspire Army leaders of character prepared to engineer resilient and sustainable solutions to the Nation's toughest challenges."

The authors started by surveying current faculty members who joined the new department with modified versions of the models of teaching and learning from the previous departments shown in Fig. 5 & 6. The survey was an anonymous MS Forms survey. Of the 21 faculty members who responded to the survey, 13 preferred the more concise model in Fig. 6 (Fig. 7a). Fig. 7b shows themes observed in the faculty survey responses. Each response contained up to two themes. Even two faculty members who preferred the detailed model (Fig. 5) acknowledged it was too long and would benefit from being consolidated. Faculty members who preferred the more detailed model cited the practical application of the model to their classroom experiences. The faculty mentioned the more detailed teaching and learning model provided clear guidance for new faculty members to embrace and achieve excellence. It better supported faculty members in their lesson preparation and more specifically addressed student learning. Four faculty members desired a comprehensive, stand-alone product to inspire faculty members as educators. However, the themes of concise and comprehensive directly contradicted each other. To balance this, a

faculty member recommended including an accompanying document to provide additional examples and explanations. Lastly, one faculty member mentioned that both options (Fig. 5 & 6) were "repackaged" versions of the old models (Fig. 3 & 4). Department leadership provided guidance at the start of the transition that while both programs already had strong reputations, the goal was to create a new, unified department culture. Therefore, the authors returned to the literature to draft a new model to reflect the new department.

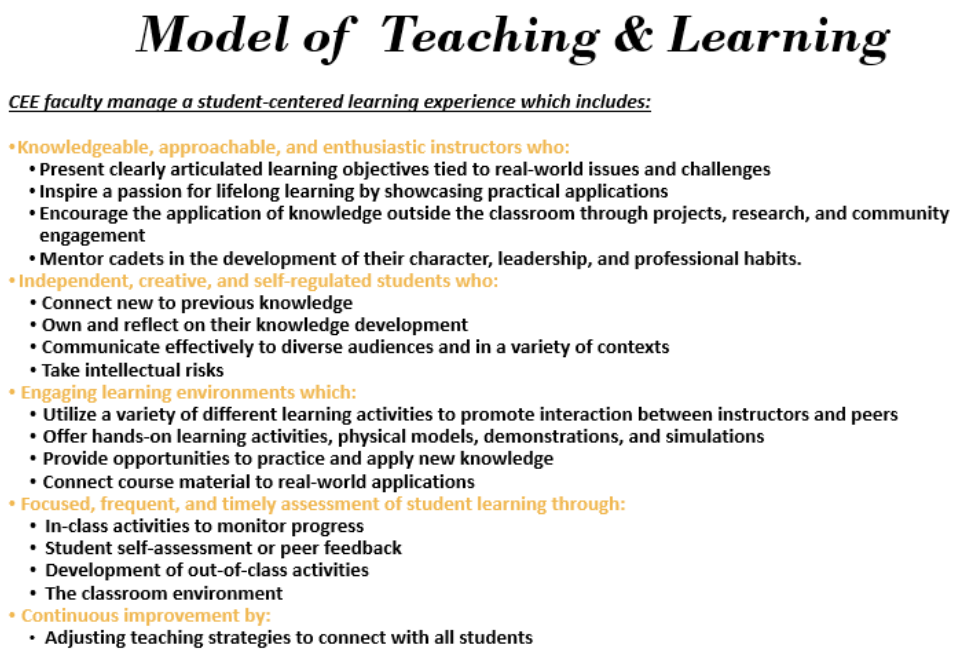

Fig. 5: D/CEE Option 1 – Detailed model

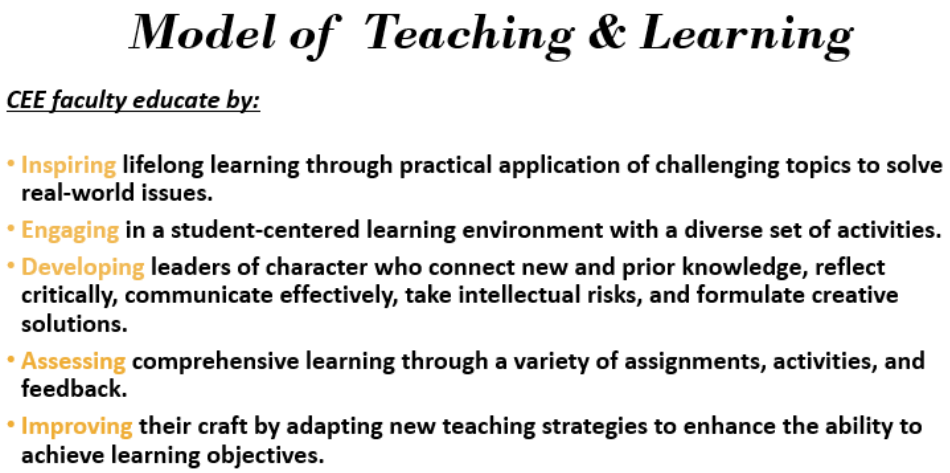

Fig. 6: D/CEE Option 2 – Concise model

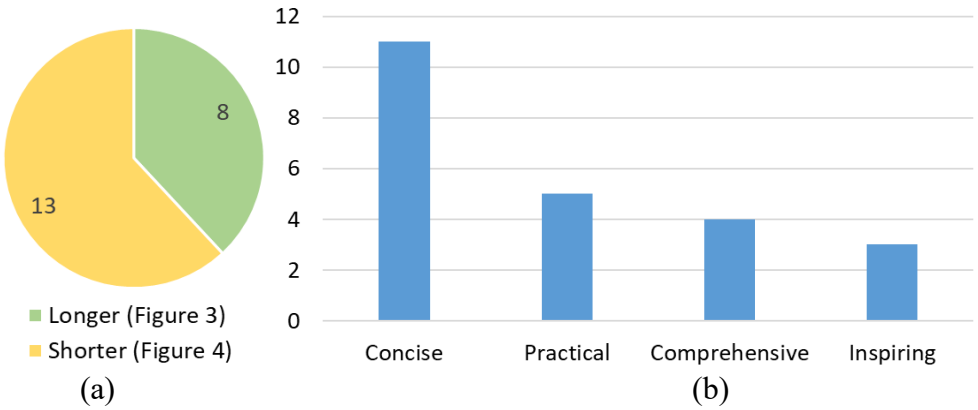

Fig. 7: Faculty survey results – (a) Preference of teaching and learning model format; (b) Emerging themes on preferred attributes of teaching and learning model format.

The goals of the new model were to:

1. Reflect proven methods from existing literature.
2. Combine best aspects of both programs.
3. Provide a concise basis for teaching and learning.
4. Inspire faculty members to pursue excellence.
5. Allow faculty flexibility to apply their own teaching philosophy.

The fifth goal forced the authors to reconsider the idea of providing a model. Although there was nothing problematic with the former departments' teaching and learning models, the authors and department leadership acknowledged that there is no singular model for excellent engineering education and that many of the former faculty members from both departments possessed their own unique teaching style. Instead of providing a prescriptive model that stifled creativity and academic freedom, the authors drafted universally accepted guiding principles of teaching and learning. These principles would serve as an aspirational vision for all faculty members. Each faculty member could interpret how to implement them in their individual classroom. The current principles of teaching and learning for the new D/CEE are shown in Fig. 8.

Civil & Environmental Engineering Faculty are knowledgeable and enthusiastic educators who:

Provide **structure for new knowledge**

Inspire **lifelong learning**

Engage **in student-centered learning**

Develop **leaders of character**

Assess **comprehensive learning**

Improve **their teaching strategies**

Fig. 8: D/CEE Principles of Teaching and Learning

The principles begin by stating that all D/CEE faculty members are expected to be knowledgeable and passionate about teaching [57]. Enthusiasm supports both a teacher's ability to create intellectual excitement for the subject and develop interpersonal rapport with their students [32]. Enthusiasm has long been thought to increase learning of students as well by engaging and holding their attention [66]. However, enthusiasm alone is not sufficient. Educators must be subject matter experts capable of applying effective teaching techniques [67].

All teachers must provide a clear structure for their courses and lessons grounded on achievable learning objectives [44], [68]. Teachers must acknowledge their student's prior knowledge and experience will impact where their learning process starts and that this will vary for individual students [42]. The goal for all teachers is that their students will become self-regulated learners [50]. To accomplish this, a student must be motivated to learn. A teacher can cultivate a student's motivation by providing real-world connections to their prior knowledge and future endeavors. A student-centered learning environment promotes a student's problem solving and critical thinking ability [34]. Engineering educators do not just develop technical engineers, but also professionals and should serve as role models for students. Students must understand the ethical implications of their decisions on society, environment, and profession [69]. At USMA, graduates serve as officers in the U.S. Army. One of our primary responsibilities as faculty members is character development, which is nested in our guiding principles of teaching and learning [70]. Faculty members should provide focused, frequent, and timely assessments for both the learner and the teacher to track mastery of course material [44], [45], [68]. Lastly, faculty members should continuously seek to improve their craft as educators by researching new teaching strategies, observing fellow faculty members, and evaluating feedback from students [59].

As mentioned above, D/CEE faculty are highly encouraged to manage a student-centered learning experience. To support faculty in this effort, the authors outlined desired outcomes:

- Be knowledgeable, approachable, and enthusiastic instructors.
- Apply state-of-the-art principles of teaching and learning.
- Clearly present lesson material aligned with learning objectives.
- Connect course material to the discipline curricula, core-curriculum, profession, and real-world applications.
- Utilize a variety of learning activities and tools appropriate for the subject matter and course level, such as hands-on exercises, physical models, demonstrations, simulations, and/or other carefully integrated technology to enhance learning.
- Provide opportunities to practice and apply new knowledge.
- Foster problem-scoping and problem-solving skills development.
- Encourage collaborative learning.
- Provide focused, frequent, and timely assessment of student learning, the classroom environment, instructional strategies, and learning activities.
- Create positive rapport through engaging interactions with students.
- Inspire intellectual curiosity, creativity, and a passion for lifelong learning.
- Mentor students in development of their character, leadership, and professional habits.

- Continuously improve their teaching skills by receiving and accepting feedback and observing other instructors.
- Conduct research and scholarly projects that enhance their teaching.

For individual courses, faculty members should focus on aiding students in on-time, successful completion of all course learning outcomes by demonstrating achievement of supporting lesson objectives. Within the entire curriculum, faculty are responsible for ensuring they provide each student the opportunity to meet all expectations of the institution and the ABET Criteria for Accrediting Engineering Programs student outcomes prior to graduation [62], [71].

Faculty Observations and Feedback

As continuous improvement of a faculty member's teaching strategies is one of the core principles of effective teaching and learning, the department leadership wanted to establish a culture, which encouraged peer feedback. Receiving peer feedback from instructors who are formally trained is one of the most effective ways to improve teaching and learning practices [72]. The department leadership expected all faculty to observe at least two classes by different faculty each semester. After the observation, they provided feedback to their fellow instructors on curriculum, classroom experiences, and student activities. The authors developed the feedback assessment worksheet shown in Fig. 9, which outlines the department's principles of teaching and learning. Observers do not necessarily need to evaluate each outcome every lesson. This peer review process is an opportunity for faculty to provide tips on teaching but also gain inspiration for methods to incorporate in their own courses. This unique process for observing peers teaching and providing feedback may be adopted by other departments.

Discussion and Conclusions

This manuscript presents the development of underlying principles of teaching and learning for faculty members in an undergraduate civil and environmental engineering department. The paper includes a comprehensive literature review, models used by former departments and the process of drafting the principles. The purpose of outlining these principles of teaching and learning was to emphasize the priority of the department to demonstrate excellence in engineering education. The anticipated outcome was attracting students to the new department through a reputation of great teachers and producing students who are self-regulated learners. Compared to the previous models, the D/CEE principles of teaching and learning are concise and flexible for faculty members to integrate into their individual teaching philosophies. They emphasize the importance of high-quality teaching to encourage faculty members to seek professional development opportunities and continue to improve their craft. The principles keep students at the forefront, by highlighting the importance of creating a student-centered learning environment and developing their student's character in addition to their technical knowledge. The D/CEE principles of teaching and learning are a stand-alone product that reflect the culture of the new department and are nested in the mission of USMA.

Fig. 9: D/CEE Principles of Teaching and Learning Feedback

The authors conducted this process primarily through input and perspectives of current faculty. The D/CEE completed its first semester as a new department in the Fall of 2025. The department was short four faculty members during the semester including two environmental engineering faculty and two civil engineering faculty. The two programs also had the largest number of majors and sections of courses combined in the last five years. As a result, the teaching requirements for all faculty members increased. While the current study did not directly assess feedback from students or faculty, all authors were faculty members in the department, all but one in non-administrative roles. The authors believed the drafted principles of teaching and learning helped ensure faculty members prioritized their teaching requirements and provided their students with excellent educational experiences. Individual faculty members prioritized teaching over service and scholarship opportunities. Faculty members volunteered to support other faculty members and courses during extended faculty leaves or interruptions to the typical academic schedule. This demonstrated a recognition from faculty in the D/CEE that educating students was their primary role.

Although the D/CEE at USMA is only in its first year, the authors and department leadership plan to assess the impact of the principles of teaching and learning on the department culture and student experience. The authors will survey not only faculty members, but also students. The principles of teaching and learning placed a strong emphasis on creating a student-centered

learning environment and therefore, future assessment must evaluate student feedback. Lastly, the authors plan to continuously refine the principles of teaching and learning to align with current practices, the priorities of USMA, and the students.

To emphasize the importance of undergraduate engineering education to new and existing faculty members at your institution, the authors recommend drafting key principles of teaching and learning that all faculty can aspire to and demonstrate in and out of the classroom. This is a low-stakes, low-overhead initiative that may have significant impact on the quality of higher education at your institution. In lieu of faculty development opportunities or external workshops that may be time and cost prohibitive, establishing a culture of excellence in engineering education can increase the reputation of your program and faculty. The literature and experiences outlined in this manuscript can serve as a guide for drafting principles that align with the goals and priorities of your institution, department leadership, faculty, and students supported by evidence-based pedagogical research. This may help improve department culture and the educational environment.

Acknowledgements

The authors would like to acknowledge all past and present faculty members of the Department of Civil & Environmental Engineering at the United States Military Academy for their contributions and feedback during this transition. The authors would also like to thank their colleagues from the Department of Mechanical and Aerospace Engineering and the Department of Geography and Earth Sciences. The views expressed in this work are those of the authors and do not necessarily reflect the official policy or position of the United States Military Academy, Department of the Army, or U.S. Government.

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Appendix – Examples of Institutional and Society Resources for Faculty and Graduate Students about Teaching and Learning

Colleges and Universities must increase the value of high-quality undergraduate engineering education. This can be accomplished by acknowledging and recognizing good teaching, reviewing teaching practices, providing structured mentoring and observations throughout a faculty member's career, revising the process for evaluation, promotion and tenure with respect to teaching, supporting non-tenure track and adjunct faculty, and incentivizing professional development opportunities [27].

Research has shown the benefit of teaching development programs on graduate students teaching knowledge, skills, and attributes, their self-efficacy, and their ability to secure a teaching job [73], [74]. Organizations such as the Association of Colleges and University Educators [75]. Association of American Colleges and Universities [76], and National Effective Teaching Institute [20] have created teaching certificates, faculty development programs, and workshops to support training of graduate students and new faculty in teaching practices. The Preparing Future Faculty (PFF) program was developed to address the concern about undergraduate education recognizing that preparing faculty to teach was paramount. Multiple colleges and universities have incorporated portions of PFF into their graduate curriculum [19], [77], [78].

Although non-discipline specific initiatives require fewer specialized facilitators and can leverage centralized teaching and learning centers [79], discipline-specific programs including those tailored to engineering and facilitated by individuals with both pedagogical and technical expertise have numerous advantages over generic campus-wide workshops [28]. For example, engineering-focused programs can incorporate examples and demonstrations directly related to engineering courses, making the content more relevant and actionable for participants [80], [81], [82], [83]. The facilitators can also address challenges unique to engineering education, such as teaching design which involves ambiguity, creativity, and teamwork [84]. Furthermore, these programs foster credibility among faculty because facilitators understand both the subject matter and effective teaching strategies, reducing skepticism that often arises when workshops are led by individuals from non-engineering backgrounds [85]. Finally, discipline-specific initiatives can build stronger peer networks within departments and across institutions, encouraging collaboration and sustained improvement in teaching practices [86]. The American Society of Civil Engineers (ASCE) developed the ExCEEd Teaching Workshop to promote excellence in education within the field [63]. ExCEEd graduates have created a community of practice which promote effective teaching practices [18].

There are a variety of examples of teaching courses and training programs developed at graduate institutions to support doctoral students [87], [88], [89], but there is limited research on support for current faculty members. The TABLE below includes examples of institutional centers for teaching and learning that provide resources and voluntary professional development opportunities for graduate students and faculty. Carnegie Mellon University has a webpage that posts their seven principles for effective teaching [90]. Yale University includes extensive documentation on the principles of teaching and learning in the context of both course design and individual lesson planning [91]. They provide their faculty members with a vast number of

resources to allow them flexibility in selecting a framework based on personal teaching philosophy, discipline, or learner demographics. Washington University in St. Louis provides new faculty members with a checklist of important items to consider for their first class [92]. Both Yale and WashU encourage their faculty members to reflect on their teaching practices, assess their effectiveness, and improve their strategies.

TABLE: Examples of Institutional Centers for Teaching and Learning

Institution	Proponent	Programs	Online Resources
University of California, Berkeley	Graduate Student Instructor Teaching & Resource Center	• Conference on Teaching • Professional Standards and Ethics Course • Pedagogy Course	https://gsi.berkeley.edu/programs-services/conference/
University of Minnesota	Center for Education Innovation	• Preparing Future Faculty Program • Three courses	https://cei.umn.edu/programs/preparing-future-faculty-program
Emory University	Teaching Assistant Training & Teaching Opportunity (TATTO)	• Pedagogy Course • Department Teaching Course • Teaching Assistantship (Mentoring) • Teaching Associateship (Co-teaching)	https://gs.emory.edu/professional-development/teaching/
University of Washington	Center for Instructional Development and Research	• 100 workshops/year • Consultations • Instructional observations • Teaching portfolio • Data analysis	https://www.washington.edu/reports/account/appendixq.html
City University of New York	Center for Teaching and Learning	• Sharing resources and best practices • Advocating for teaching and learning resources • Disseminating standards for faculty development • Mentoring programs • Research and Scholarship • Endorsing assessment models	https://www.cuny.edu/academics/faculty-affairs/cuny-centers-for-teaching-and-learning/
United States Military Academy	Center for Faculty Excellence	• Master Teacher Program • Faculty Development Workshops • Teaching Improvement Presentations	https://www.westpoint.edu/about/office-of-the-dean/center-for-faculty-excellence
University of New Hampshire	College Teaching	• Graduate Certificate Program for faculty, post-docs, and grad students	https://catalog.unh.edu/graduate/programs-study/college-teaching/college-teaching-graduate-certificate/

Institution	Proponent	Programs	Online Resources
Auburn University	Biggio Center – Teaching and Learning Services	• Teaching Feedback • Course Consultations • Faculty Learning Communities • Preparing Future Faculty Program • Engaged Teaching Course	https://biggio.auburn.edu/programs/teaching-learning-services
Worcester Polytechnic Institute	Morgan Teaching & Learning Center	• Faculty On-Ramp to Teaching • Seminars • Consultations • Learning Communities • New Faculty Orientation & Mentoring	https://www.wpi.edu/academics/faculty/morgan-teaching-learning-center
University of Michigan	Center for Research on Learning & Teaching	• Grad Student Instructor Orientation • Teaching materials and resources • Consultations & Mentoring • Preparing Future Faculty • Graduate Teacher Certificate • Development of Teaching Philosophies	https://crlt.umich.edu/programs-services/graduate-students-post-docs
Duke University	Professional Development Programs	• Instructional Fellowship Program • Certificate in College Teaching • Workshops & Mentoring • Preparing Future Faculty • Teacher Assistant Training	https://gradschool.duke.edu/professional-development/professional-development-programs/
University of Illinois, Chicago	Center for the Advancement of Teaching Excellence	• Workshops & Short Course • Consultations & Peer Observations • Teaching Resources & Guides • Community of Practice • College Instruction Certificate	https://teaching.uic.edu/programs/cate-catalog/
University of Chicago	Center for Teaching and Learning	• Discussions, Roundtables, and Panels • Seminars & Workshops on Teaching Portfolios • Fundamentals of Teaching Series • College Teaching Certificate Program • Fellowships, groups, and symposia	https://teaching.uchicago.edu/programs
Columbia University	Center for Teaching and Learning	• Teaching resources and guides • Mentoring • Workshops and professional development programs	https://ctl.columbia.edu/graduate-instructors/programs-for-graduate-students/workshops-for-graduate-students/

Institution	Proponent	Programs	Online Resources
Rice University	Center for Teaching Excellence	• Workshop series • Graduate Certificate in Teaching and Learning	https://cte.rice.edu/programs/graduate
University of Missouri, Kansas City	School of Graduate Studies	• Preparing Future Faculty	https://sgs.umkc.edu/academics/preparing-future-faculty.html
Massachusetts Institute of Technology	Teaching + Learning Lab	• Consultations and observations • Faculty cohorts & Grad fellowships • Teaching workshops, certificate, & resources	https://tll.mit.edu/
University of New Mexico	Center for Teaching and Learning	• Graduate Teaching Certificate • Consultations and Observations • Teaching Conference • Framework & resources for teaching and learning	https://ctl.unm.edu/index.html
University of Florida	Center for Teaching Excellence	• Teaching Certificates • Workshops • Learning Communities • Preparing Future Faculty • Conferences	https://teach.ufl.edu/grow-your-teaching/
University of Pennsylvania	Center for Excellence in Teaching, Learning, and Innovation	• Teaching Certificate • Seminars & workshops • Consultations & Observations • Intro to Teaching summer program • Course Design Institute • Cohort-based learning	https://cetli.upenn.edu/programs/
Washington University in St. Louis	Center for Teaching and Learning	• Tips for Faculty • Conference • Consultations & Observations • Teaching resources and workshops	https://ctl.wustl.edu/
Council of Graduate Schools	Preparing Future Faculty	• Resources • Mentoring • Observations & Feedback	https://preparing-faculty.org/