

A Quarter Century of Minorities in Engineering: Design, Development and Team Teaching of Institutional Core Curricula

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Abstract

We have been teaching Institutional core curricula courses at The University of Texas at El Paso (UTEP) since 1996. The course curricula, sources, and most relevant, the innovations in teaching each course have impacted STEM student success and learning.

The Texas Core Curriculum (TCC) is defined by the Texas Education Code (TEC) Section 61.821 as: ... "the curriculum in liberal arts, humanities, and sciences and political, social, and cultural history that all undergraduate students of an institution of higher education are required to complete before receiving an academic undergraduate degree." Texas Senate Bill (SB) 148, passed by the 75th Texas Legislature in January 1997, repealed previous legislation concerning either lower-division transfer or core curriculum and sought to resolve concerns regarding the transfer of lower-division course credit among Texas public colleges and universities while maintaining the core curriculum as one of the fundamental components of a high-quality undergraduate educational experience. More recent sessions of the Texas Legislature have fine-tuned the existing laws regarding the core curriculum, but the essentials of the statutes have not changed since 1997.

UTEP selected the specific courses that it offers to fulfill that framework of the UCC, taking into account the individual role and mission of our Minority Serving institution. The UCC implementation at our institution requires we gain approval from the certifying body for the university's state. All institutions in the state must evaluate the effectiveness of their UCC at regular intervals.

Our teaching methods and content has evolved such that the institution's component courses and pedagogies of Team Teaching are vital to achieving the desired outcomes. Our model is an "all in" team endeavor; our instructional team meets with all classes, and such is an enterprising dynamic, engaging faculty, staff, and near-peer teachers, working together.

Modeling teamwork is a core attribution of our approach. Research-to-practice becomes practice-to-research as we learn new ways to help our students succeed while growing their preparedness for future success in their degree aspirations. Our sharing focuses on entering students and Juniors. All students in the university take these courses: STEM students learn discourse and liberal arts critical thinking, and non-STEM students learn the value of sciences, (big) data, and scientific analyses.

One of the most important provisions of the UCC is that it allows students who successfully complete core curriculum courses at one institution to transfer (up to) the entire set of completed courses to another public institution of higher education without the need to repeat any core courses. Students who transfer without completing the whole (42-SCH) core curriculum also receive credit for each of the core courses they satisfy. Although the studies included in the CUC may vary by institution, every higher education institution's core curriculum in our state must consist of 6-SCH of Foundational Component Areas. These courses are the focus of our sharing.

A final segment of our work is designing the latest core course, which includes an emphasis on innovation and leadership engineering. Thus, the newest part of our work is developing the latest core course, emphasizing innovation and leadership engineering. The course arises as a natural outgrowth of our work and the changes in society and STEM education necessary to promote lifelong learning.

Context of the Core Curriculum

We have come a long way since the 1970s and 80s, when minority student attrition was viewed through the lens of psychology, when "students failed, not institutions" [1]. During the 1980s, we began rethinking the causes and cures of minority student attrition when there was a realization that student-focused interventions would impact entering students' success [2]. This early work on student retention ushered in what might be called the "age of involvement" [1], [3]. We have learned that belonging and involvement matter and are critical to success during the critical first year of college [4], [5]. Further, as a profession, we have recognized we are in transformation (for example, The Engineer of 2020 [6]), and now, more than ever, "critical

thinking," and "learning how to learn" have become recognized as crucial attributes of teaching engineering fundamentals.

With this rising awareness, UTEP determined twenty-five years ago to implement a first-year core class experience as part of The Model Institutions for Excellence (MIE) program. The UTEP implemented MIE to increase underrepresented minorities in science, technology, engineering, and mathematics (STEM). Funded by the National Science Foundation, this 11-year program challenged UTEP to: (a) Improve the first-year experience of its entering freshmen; (b) Develop good study habits, (c) Enhance instruction across the STEM curricula; (d) Promote career options; and (e) Encourage advancing to graduate school studies. According to MIE Director Dr. Benjamin Flores," the MIE program's success was based on changing the University culture by promoting early contact with faculty, active learning to engage students, a "home" to study and interact with peers, and exposure to research at the undergraduate level. These MIE activities were a driving force in achieving the university's mission of providing a diverse, commuter-student population in a geographically isolated binational location with the two ideals of excellence and access."

An important outcome of this effort was establishing UTEP's core curriculum courses, most notably a "Seminar in Critical Inquiry." The course was first taught in 1996 as a one-credit-hour course, self-selected by students. It was led by an engineering Instructor, coupled with two Peer Facilitators; being successful undergraduates who served as mentors to support the entering students. Concurrently, the university established a cross-campus advisory group, charged with designing and inaugurating a pilot three-credit-hour core course with the same name. The model course was required of all majors at UTEP and was added with instructor-determined themes.

Course Emphases, Goals, and Objectives

College transition and success skills are addressed within each course section. The seminar often acts as an integrator course taught by an instructional team consisting of a faculty member (preferably science or engineering faculty), a librarian, and a peer (upper-division

student) facilitator. The seminar addresses the following five goals: (1) Strengthening students' academic performance and facilitating their transition to college; (2) Enhancing students' essential academic skills; (3) Increasing student-student and student-faculty interaction both in and outside of the classroom; (4) Encouraging students' self-assessment and goal clarification; and (5) Increasing students' involvement with UTEP activities and resources. Data from surveys administered twenty years ago showed most students reported that academic survival skills, sense of comfort, campus participation, and use of essential student services improved due to the seminar [7]. Instructors reported increased instructional innovations and student development strategies; peer leaders indicated increased knowledge about teaching and leadership. The average number of years to STEM undergraduate degrees decreased from 6.6 years (in 1997-98) through to 5.1 (in 2004-05) as the result of the seminar and related efforts, including advising and mathematics curriculum redesign [7].

Thus, the course has impacted generations of UTEP student success and learning, especially for STEM students and non-STEM majors. All UTEP students with less than thirty credit hours are assigned the course. From 2000, students entering {xxxx} with more than thirty credit hours joined an alternative core course, UNIV 2350 "Interdisciplinary Technology, and Society." This course, initiated in 1996 as IT 2350, supports non-STEM majors in learning science and engineering discourse and professional communication skills, such as presentation and teamwork. During the decade beginning in 1999, these two offerings were administered through a University College, established to support the course teaching and offer an Interdisciplinary Studies Bachelor's degree, provided for students whose interests and experiences across traditional disciplines.

The rationale behind the University's Core Curriculum (UCC), which is required of all undergraduate students in public higher education in the state, provides the gateway to success in higher education. UNIV 1301 and UNIV 2350 are offered as the "Component Area Option." As such, it includes a minimum of three Core Objectives, including Critical Thinking Skills, Communication Skills, and one of the remaining Core Objectives of the institution's choice [8].

The Texas Core Curriculum (TCC) is a 42 Semester Credit Hour (SCH) core curriculum for all undergraduate students in Texas public higher education. Since 1987, every student who

received a baccalaureate degree from a Texas public institution of higher education must complete the state's general education core curriculum regardless of the student's academic discipline or principal. The Texas Core Curriculum (XCC) is defined by the Texas Education Code (TEC) Section 61.821 as: "... the curriculum in liberal arts, humanities, and sciences and political, social, and cultural history that all undergraduate students of an institution of higher education are required to complete."

The six core objectives of the Texas Common Core are:

- Critical Thinking Skills (CT) - creative thinking, innovation, inquiry, and analysis, evaluation, and synthesis of information
- Communication Skills (COM) - effective development, interpretation, and expression of ideas through written, oral and visual communication
- Empirical and Quantitative Skills (EQS) - manipulation and analysis of numerical data or observable facts resulting in informed conclusions
- Teamwork (TW) - ability to consider different points of view and to work effectively with others to support a shared purpose or goal
- Social Responsibility (SR) - intercultural competence, knowledge of civic responsibility, and the ability to engage effectively in regional, national, and global communities
- Personal Responsibility (PR) - ability to connect choices, actions, and consequences to ethical decision-making.

One of the most important provisions of the UCC is that it allows students who successfully complete core curriculum courses at one institution to transfer (up to) the entire set of completed courses to another public institution of higher education without the need to repeat any core courses. Students who transfer without completing the whole (42-SCH) core curriculum also receive credit for each of the core courses they satisfy. Although the studies included in the CUC may vary by institution, every higher education institution's core curriculum in our state must consist of 6-SCH of Foundational Component Areas. These courses are the focus of our sharing.

As such, our core course "component option" fulfills that framework of the UCC, taking into account our minority-serving institution's role and mission. The UCC implementation at our institution requires we gain approval from the certifying body for the university's state. All institutions in the state must evaluate the effectiveness of their UCC at regular intervals.

Innovations and Frameworks for Implementing Core Curriculum

As an example of the regular advancement of the courses based on effectiveness evaluation, in 2000, UTEP introduced accompanying entering students program advising in science and engineering, known as CircLES (Circles of Learning for Entering Students). The program was designed to meet the specific curricular and social needs of entering pre-engineering and pre-science students. In the past, these students had no department, program of study, or departmental advisor. The program provided an "academic home" for STEM students who could not matriculate into a program of study [9]. The CircLES program was designed to provide students with an opportunity to:

(a) Establish close relationships with faculty teaching cluster courses; (b) Make new friends who have interests in similar disciplines; (c) Develop study groups and a culture of persistence; (d) Form a connection to and identification with the university; (e) Learn about and use university resources; and (f) Participate in academic and social activities that encourage "best efforts."

In the next innovation, during 2007, the CircLES program was fully integrated into the UTEP Entering Student Program to grow the model to serve all UTEP students. Five goals, including thirteen objectives, weaved together the core university courses. Five of the purposes were required of all sections; all other intents were highly recommended. Additionally, entering engineering students were "clustered" in a group of three or four courses taught by dedicated faculty [9].

As a further example of continuous quality improvement (CQI), in 2006, UTEP fully integrated CircLES into the UTEP Entering Student Program. The course goals were edited but in terms of emphasis and directives for instruction remained virtually the same. During the next decade, the Entering Students Program, led by Dr. Maggie Smith, was separated from University College to provide administrative independence. In 2008, Smith et al. [10] reported the core course's efficacy; students who completed the seminar showed higher retention rates and GPA than their counterparts. Three indicators of seminar success were selected as baseline measures in the longitudinal study of student persistence and program effectiveness: (a) first-time seminar enrollment, (b) retention rates, and (c) cumulative GPA [10]. Since the seminar's inception, the

number of full-time students enrolled in a fall-semester seminar more than doubled, from 777 in Fall 1999 to 1,859 in Fall 2006. The percentage of first-time, full-time, first-year students enrolled in the course increased from 44% in fall 1999 to 81% in fall 2006. During this same period, the seminar's retention rate ranged between 69% and 74%. The one-year retention rates for those who never enrolled in the seminar are considerably lower, between 40% and 61% [10].

In 2008, the course goals for the course were modestly updated, and a course-specific textbook, edited by faculty and staff, was adopted [11]. The text addresses: (a) Academic Skills; (b) Transition Issues; (c) Careers; (d) Finances; and (e) Campus Resources. The text was updated each year through 2016. At that time, accompanying instructional support and resources were added. Online modules were also developed to support course goals, including career and goal setting, information, and financial literacy. Accompanying instructional support and resources were added. Online modules were also developed to support course goals, including career and goal setting, information, and financial literacy. By Fall 2008, 60 sections of UNIV 1301 were offered, with 32 of these STEM degree-seeking students. In 2016, the course was again updated. This time it was reframed to include leadership and professional pursuits: "entering students will build on their talents, skills, and experiences to successfully transition to UTEP. UNIV 1301 will support students' leadership development, academic excellence, and campus and community engagement, paving the way to success in their educational and professional pursuits." The text was updated each year through 2016. At that time, accompanying instructional support and resources were added. Online modules were also developed to support course goals, including career and goal setting, information, and financial literacy.

The core course goals were updated again in 2016 to include: "Students will develop and apply elements of leadership through effective individual participation and meaningful team collaboration to empower them to be agents of change." Thus, as part of the continuing success of the UTEP model developed, UNIV 1301 was reframed to include leadership and professional pursuits: "Entering students will build on their talents, skills, and experiences to transition to UTEP successfully. UNIV 1301 will support students' leadership development, academic excellence, and campus and community engagement, paving the way to success in their

educational and professional pursuits." This emphasis on development, excellence, and engagement is vital in making the course successful [12]. Another key is the engagement and impact of peer facilitation, embedded in the UNIV 1301 course teaching and learning model. Amidst the evolution of innovations in teaching the institution's component courses, Team Teaching makes such a difference in achieving the outcomes. Our model is an "all in" team endeavor; our instructional team meets with all classes, and such is an enterprising dynamic, engaging faculty, staff, and near-peer teachers, working together.

Modeling teamwork is a core attribution of our approach. Research-to-practice becomes practice-to-research as we learn new ways to help our students succeed while growing their preparedness for future success in their degree aspirations. Our sharing focuses on entering students and Juniors. All students in the university take these courses: STEM students learn discourse and liberal arts critical thinking, and non-STEM students learn the value of sciences, (big) data, and scientific analyses. A final segment of our work is designing the latest core course, which includes an emphasis on innovation and leadership engineering. The system arises as a natural outgrowth of our work and the changes in society and STEM education necessary to promote lifelong learning.

We understand that the transition from high school to university is difficult for our Hispanic, low-income, and first-generation college students. Our students tell us that the way they have lived their life for the past 18 years completely changes upon entry to UTEP. This could be one reason why the dropout rate of first-year college students in the US is a staggering 33% [13]? Before they even become a sophomore, 25% of students drop out. For community colleges, 43% of students enrolled dropped out before obtaining a degree. These percentages, unfortunately, increase for minorities: 38% of Caucasians drop out of college, 37 of Asians, 62% of African Americans do not complete their intended degree. Relative to our student demographic, some 55% of Hispanics enroll in college but do not complete their degree. According to a study conducted by Public Agenda, the number one reason for leaving college is money. Many students find it too challenging to balance work and study at the same time. Thus, 54% said they dropped out because they could balance work and school [13].

Many colleges now have transition programs in place to try to lower the dropout rate. We would like to share our experience with this UTEP program and the minor changes we made that we think can tremendously improve the perspective of the UNIV1301 class at UTEP.

Course Research and Development

At its early stages, UTEP's Entering Student Program's primary goal was to provide students with a supportive atmosphere that guides them onto academic success. This program consists of a three-credit-hour core curriculum course designed to develop a sense of community among students and connect students to resources and services at UTEP. Back in 1999, instructors used theme-driven lectures expecting students to use content in the future. The program was modified in 2017 to focus on advancing student self-development and encouraging self-assessment and goal clarification, and math preparedness.

The ESP is now driven by an instructional team: instructor, peer leader, librarian, and advisor. They all work together for the same purpose; to strengthen students' academic and social performance and facilitate their transition to university. The instructional team connects students with all services that entering students need to become successful: enrollment services, academic advising center, tutoring, and learning center. The Peer Leaders' responsibility is to share the learned tools and secrets as an experienced student to succeed in college and help first-year students transition smoothly. The Librarians are also an essential connection for students, as they teach students to use all the research data and help UTEP has for them. Advisors guide them through the process to complete their degree plan and make recommendations to balance semester course loads. While the instructional team seems to be complete in growing academic life, we consider it lacks professional tools. In response, we have taught sections of this course during the past two years, which implement what we consider as positive changes.

We made the most drastic change to give less importance (and thus time) to technical STEM themes in class. We noticed that most of the instructors of UNIV1301, for engineers, focus more on the math skills, and the class ends up being another engineering class to teach math applications of engineering. The math review and unit conversion topics were included in

our calendar, focused on evaluating their core math skills. This decision was made to help us understand students' math preparedness, knowing they will have so many more classes to learn and develop math proficiency. Rather than math topics, we focus on giving them professional and educational tips that make them realize that college is not just the continuity of their education but the beginning of their professional life.

Our sense of this matter is that sometimes instructors try to simplify their lives by just following course formats, which they repeat each semester, and forget about the importance of connecting and close communication with their students. For this reason, we decided that engaging experienced students in our teaching team was vital. Having engaged and student-centered teaching team members is central to the design and implementation of this class. Students who are near-peer simply know what first-year students are living at that moment and what precisely they need, and coupled with students who are graduating, it makes for a high-impact team. Through teamwork with experienced students — now authors of this contribution — we have designed and taught the latest version of UNIV 1301, the UTEP core course, and we now share our efforts from Fall 2020.

2020 Course Iteration and Emphasis

We made a necessary adjustment to the course to design each quiz, each assignment, and every presentation and workshop with a unique purpose; "Making our students better people and professionals." Here are the topics we covered in class and their purpose:

- **UTEP Resources**

Purpose: Give brief information of every STEM department available at UTEP such as: Academic Advising Center, Registration, Miner Learning Center, Office of International Programs and Study Abroad, Honors Program, Library, Math Resource Center for Students, Technology Assistance, University Writing Center, University Career Center, Office as Scholarships, Counseling and Psychological Services and Student Health and Wellness Center. We basically let our freshman students know that the university has all the answers to their questions and concerns and should use these available resources.

- **Introduction to Job Fair and Career Expo - Mandatory**

Purpose: Explain to students what the Job Fair and Career Expo are. We make a mandatory assignment to attend these events. Sometimes students don't follow these events because they are scared of new experiences. We decided to push our students to overcome their fear of interviews and attend professional events for the first time.

- **Topic: Introduction to *EduGuide* and *YesSHECan* Programs**

Purpose: These unique platforms and programs help us to support and guide our students. EduGuide is a platform that provides a path to where the students want to go by using simple steps of content and weekly challenges of reflection. YesSHECan is a program dedicated to encouraging more women to be part of STEM, and they have connections to professionals dedicated to skillful workshops.

- **Topic: YesSHECan Workshops**

Purpose: We invite the YesSHECan program to our class 7 times to introduce six unique workshops. The topics were: Resume Building, Self Discovery, Confidence Building, Communication Skills, Financial Literacy, and finally, Motivation and Time Management. The students were enthusiastic about these workshops, and they were always very grateful to our presenters. As you may appreciate, we include topics that will make students better humans, better professionals, and not just another university student trying to get good grades.

- **Topic: Study Skills Workshop**

Purpose: For this topic, we focus on the desire and dedication of learning importance in college. We talk about active listening, reading comprehension, note-taking, time management for studying hours, and testing taking. In college, everything changes, and also, the methods and time of studying change; we open their eyes.

- **Topic: Mine Tracker Introduction and UTEP Scholarships Information**

Purpose: We teach students how to use MineTracker and highlight the importance of the college experience to be part of organizations and attend UTEP events. Also, we strongly encourage them to apply for many scholarships. We believe once they apply for one, they will not stop seeking new scholarship opportunities. They just needed that little push to encourage new experiences.

- **Topic: Career Center Services Presentation and CAPS**

Purpose: Staff from these professional centers came to our class and introduced all their services and their importance. Job mine, Internships, Peer Career Advisors, Mocking Interviews, and finally help with Resumes. For CAPS, the counseling center's stress workshops and the importance of balancing outside school life for mental health.

- **Topic: Research Projects 1 and 2**

Purpose: As with all of our lectures, each of our projects has a unique purpose. The first project we asked for was a critical thinking hands-on building and an individual research paper. This project allows students to experiment with trial and error, learn from their mistakes, and understand the potential gaps between theory and practice. Our second project was a team presentation. The purpose was to learn to work in teams and overcome any obstacle. Working in teams is a challenging task, and they learn a lot about who they are from the roles they take as a group member. Teamwork promotes strong working relationships and communication skills, and these are important for our student leaders because a leader that can't work in a team is a failure.

- **Topic: Use of GPA, Calculation, and Importance of GPA Workshop**

Purpose: We didn't want to just focus on calculating GPA; we sought to emphasize how easy it is to drop and how hard it is to recover from a bad grade. It is not the most critical factor in Resumes, but it can help you attract their attention between hundreds and hundreds of Resumes.

- **Topic: Engineering Fields of Study**

Purpose: Our objective was to discover their genuine passion for engineering and the major they selected with this topic. Sometimes, students choose their major because they like the title, but they don't know what it's like in the professional field. We want them to be in love with their major and be sure of what they want for their future.

- **Topic: UTEP Edge Experiences (Advisor Presentation)**

Purpose: They have the opportunity to get to know their advisor, build a relationship with them, and learn about the edge experiences such as student leadership and study abroad.

- **Topic: Leadership and Success Principles**

Purpose: Building the leaders of the future, we cover topics such as working together to achieve more, lead by example, focus on change, and understand the value of listening, and always ask questions. We also stress the importance of communicating and engaging with your peers. These

topics are the ones with more relevance for first-year students. We need to change their worker mentality and encourage them to entrepreneurs and leaders.

- **Topic: Course and Degree Planning Workshop**

Purpose: To help students plan out their complete degree plan semester by semester with their advisor's help. This was definitely a challenging assignment for first-year students, but it is a great activity to help them start thinking about their future as college students. Having things planned, stated, and in order helps students have a path to follow. With this workshop, we teach them how to find and understand their degree plan and the importance of registering on time.

- **Topic: Strengths Finder Workshop**

Purpose: Students value this UTEP Edge experience. We help students identify and develop natural talents and abilities. Knowing yourself better maximizes professional opportunities, which we want for our students.

- **Topic: Final Analysis**

Purpose: We decided to make our final exam a final analysis. Our focus therein was not to grade them but have them grade us. We do this to better understand the students' expectations as incoming freshmen and evaluate our methods to improve each semester with their suggestions. In this final analysis, we asked them about their experience with the workshops, with EduGuide, with the YesSHECan program, presentations, projects, and what they think we should change or add to the class.

The mandatory textbook "Borders: Crossing Into Your Future" [11] addresses academic skills, transitional issues, careers, finances, and campus resources. However, we believe this big step of moving onto college cannot be learned through a book. They have to live the new experiences and learn from them. It is thorough experiential learning that helps students best assimilate into college.

Based on our experience, we made the following suggestions for the upcoming year's course teaching:

(1) More emphasis on critical hands-on activities in the class. Feedback about the hands-on projects was all very positive. Student comments and feedback include: (with the note that names here and hereafter have been changed to protect confidentiality) "*A topic that we would add in*

this course could be something that develops more our engineering skills (something like the first project but with more tasks and challenges)" (Vivian).

(2) Not to focus on math except for application topics for engineering UNIV1301 classes. Here are some of the thoughts our students have about this change we made for the course of just focusing on relevant issues for their professional life:

"UNIV 1301 is about asking questions, thinking critically, being insightful, and making good decisions. At least those were the main themes I caught onto this class" (Gustavo).

(3) Offer a more one-on-one relationship between student-student and student-instructor. Although we decided to make our lectures synchronous, students don't feel the same connection with us even with our cameras on. It is imperative to make students feel they belong to this new community, UTEP, and we think asynchronous classes can't offer this. We would like to encourage this core course teaching program's instructors to provide synchronous courses and connect more with each student.

"If anything, I would have wanted to do at least one more group assignment because I enjoyed meeting and working with my other classmates in project 2" (Delila).

"Changes to my class would be a lot more interactions. Having time to socialize and do more interactions with students and teachers would be awesome" (Jaime).

(4) Add more important professional topics covering: Skills workshop for presentations, workshops in public speaking, and more on mental health. We got from our extraordinary "Final Analysis" these three ideas," We ask our students what is essential for the program. It is their desired tool of how they can be better students and better professionals. Quotes from our students that make this evident are:

"The only change that I think would be beneficial for the course would be to include a lesson about presenting ... I think that having an introduction or a basic understanding on how to conduct professional presentation would be extremely beneficial" (Mauricio).

"A topic that I would add or touch deeper would be mental health and stigmas about it" (Nora).

"The only thing that I would suggest is to add a couple of presentations about suicide and depression since many people feel overwhelmed when they start college" (Raphael).

Final Comments

The entering student experience at UTEP has undoubtedly come a long way in the last 30 plus years due to an institutional willingness to find better methods to help students complete their university studies through to graduation. Leadership and a core of committed entering students' instructors changed the paradigm to value student backgrounds, cultural and linguistic diversity, which helped many students earn a degree. Students appreciate the breadth and depth of course learning opportunities, particularly when they feel valued and feel they belong. Moreover, the teaching team is enthused at providing and continuously improving this program each semester to deliver impactful learning experiences that support retention and degree attainment, looking beyond first-year success. Our most important suggestions for the next iteration are to focus more on professional skills and make sure instructors meet students' requirements to succeed in their academic and professional lives.

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