UNM | STEM GATEWAY

Internal STEM Needs Assessment at UNM

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Executive Summary

This Needs Assessment targeted students initially interested in pursuing a degree in science, technology, engineering, and mathematics (STEM) at the University of New Mexico, and their support staff and associated faculty to identify success factors, as well as obstacles and recommendations for student success. A Graduate Assistant (GA) for the STEM Gateway Program (funded through a U.S. Department of Education Hispanic Serving Institute TITLE V grant, 2011-2017) interviewed UNM faculty, staff, and students to better understand the strength and support UNM provides to all parties involved, challenges they face in their respective roles, and the obstacles that must be overcome in order to improve the overall teaching and learning experience in the STEM programs at UNM. Specifically, what are the strengths of STEM programs at UNM? What needs to change to improve student learning? What specific actions might lead to better outcomes? What might help students? What might help instructors to teach more effectively? These interviews consider such factors as the classroom learning climate and activities, organization and delivery of course content, support services, and institutional factors.

Findings on what contributes to or detracts from student success fell into several categories: student preparation before entering a STEM program at UNM; student guidance and support; special programs; course design and the classroom learning environment; instructional talent; research and design opportunities; institutional factors within UNM; and broader systemic factors encompassing other institutions and agencies at the local and State level and beyond. Transforming the organizational cultural of UNM calls for a sustained, long-term strategic focus.

Background and Rationale

Near the onset of the STEM Gateway grant, internal research identified low retention rates within STEM fields, particularly among underrepresented and low-income student groups. Throughout the five-year grant period, STEM Gateway had two main components to address this issue:

1. Faculty lead Courses re-designed to reflect the best current knowledge on instructional effectiveness (Bransford et al., 1999; National Research Council, 2005; National Research Council, 2012)
2. Student focused supplementary support, such as specially-trained in-class aides (Peer Learning Facilitators) and on-line resources and workshops, such as Essential Academic Skills Enhancement video workshop series.

Upon entering the no-cost extension year, the STEM Gateway program director identified the need for a follow-up, yet alternative, assessment of the STEM climate at UNM. This needs analysis sought to gain insight into underlying causes of attrition and to gather recommendations from students, staff, and faculty to address those causes and improve retention rates within STEM fields at UNM, particularly among under-represented groups.
The primary target population was students who were undergraduate STEM majors at UNM between Spring 2014 and Spring 2017. These students included current STEM majors, as well as students who switched majors. The GA also interviewed instructors and providers of supplementary services such as counselors, advisors, mentors, and tutors.

Stakeholders

This report provides information and insight to support ongoing efforts to improve STEM education at UNM, retain and ensure the success of students, especially from under-represented populations. The *primary stakeholders* are those who will use this report for decision-making, including the Principal Investigators of the Grant. *Secondary stakeholders* are individuals associated with other STEM-focused support services at UNM (*e.g.*, the STEM Collaborative Center), students, instructors, and support staff who may benefit from these findings. Also included are UNM administrative personnel concerned with overall institutional effectiveness and relevant linkages outside of UNM. *Tertiary stakeholders* include secondary students entering STEM programs as freshman and transfer students from post-secondary institutions such as Central New Mexico Community College (CNM) and Southwest Indian Polytechnic Institute (SIPI).

Methods

The GA scrubbed an Excel database, pulled by the director from UNM's MyReports in January 2017. This file consisted of about 24,000 students who were believed to be STEM majors during at least one semester from Spring 2014 to Spring 2017. Duplicate and incomplete records were deleted reducing the data set to about 20,000 prospective respondents. The GA randomized the list and broke it into segments of approximately 1000 students. He then sent them an email, 1000 at a time (Exhibit 1), over a 6-week period. Response rates were approximately 0.5%. Approximately 4% were not deliverable and about 0.2% responded that they had not taken any STEM courses at UNM. After approximately 10,000 emails were sent, the GA received a

sufficient number of responses. The GA sent a follow-up email (Exhibit 2) and scheduled interviews (Exhibit 3) with willing respondents. There were a total of 44 student respondents: eleven did not complete the interview, five responded to the interview questions by email, and 28 completed a face-to-face interview with the GA. These 28 fell into three areas of approximately equal numbers: Science and math (8), Engineering (9), and Computer Science (11).

The GA created an Excel database of department heads, faculty, and STEM-focused support staff and sent them an invitation for comments and contributions via email (Exhibits 4, 5, and 6). The GA conducted half-hour interviews (Exhibit 3) with 16 faculty and 14 staff. Faculty included Biology, Geology, Physics (7), Math, Computer Science, Chemical & Biological Engineering (3), and Mechanical Engineering (2). Staff included advisors for Biology, Mechanical Engineering, Civil Engineering, Nuclear & Chemical Engineering, Engineering Student Services (2), Communications & Journalism; and Program Specialists for ROTC, Men of Color Initiative (MOCI), Post-Baccalaureate Research and Education Program (PREP), Veterans Resource Center, Student Support Services, and the TRIO/McNair Program. At the start of each interview, the GA requested permission to take notes by hand. Immediately after each interview, the GA organized his notes and sent them to the interviewees in an email attachment for verification and revision.

The GA organized responses according to three categories: *strengths, challenges,* and *recommendations.* This first section included themes identified by all three respondent groups such as the inadequate mathematics preparation of incoming students. Subsequent sections included themes and issues specific to sub groups: students, faculty, staff, and individual STEM fields.

Limitations and Constraints

The GA planned and executed the project, made the contacts, interviewed respondents, analyzed and interpreted the data. The Director and the co-PIs provided oversight, however, results were subject to the assumptions, biases, and interpretations of the GA. In addition, responses were subject to self-selection bias. Although the GA sent his notes of the interview to all respondents, only about half responded to confirm their accuracy and completeness.

Strengths, Challenges & Recommendations of STEM Students, Faculty, and Staff

Strengths

Cultural Diversity. New Mexico is rich in cultural resources. Many students, faculty, and staff are bilingual or multilingual, bicultural or multicultural. These non-academic assets enrich the UNM community. The UNM campus is racially diverse. In addition, UNM is host to students, faculty, ans staff representative of a wide range of cultures from around the world. Non-traditional students bring work experience, military experience, and other life experience to enrich the UNM community. For example, over 1200 veterans have a background in experiential and team-based learning that could serve as a resource for re-thinking and re-designing UNM STEM courses.

Instructional Talent. Many instructors and advisors show a genuine personal interest in their students, in the successful completion of their chosen program, and in continuing success in their careers and in their lives. They make personal sacrifices to help their students. Many instructors are deeply committed to their students' learning in their classes, work to increase their effectiveness as teachers through collaboration with colleagues, exploration of innovative teaching methods, and continuing development of their course material. Engaged instructors bring the latest developments in their field to the classroom to enhance classroom discussions and student learning and are available to their students not only during posted office hours but at other times as well. In addition, UNM provides workshops to help instructors improve their teaching practice.

Innovation in Teaching Methods and Course Design. Many students benefit from alternatives to the traditional lecture such as project-based learning, and "flipped" classrooms where the lecture is provided online before class and students work together in class in hands-on activities, problem solving, and small group discussions. Instructional technologies such as iClickers, a learning management system (UNM Learn), and Assessment and Learning in Knowledge Spaces (a mastery-based online learning platform) when used effectively, enhance learning and learner autonomy and provide immediate feedback. The Math Mall (the National Center for Academic Transformation Emporium Model) is a computer-assisted peer-tutoring program. It includes an entry-level Quantitative Analysis course taught in small classes with individualized instruction and support. First-Year Learning Communities (FLC) combine two courses that meet core requirements. STEM programs offer alternatives to the traditional lecture, including theme-based approaches, active learning, small group discussions, current readings, group problem solving, and student presentations. Parachute courses (Lindell, Coulombe, & Saul, 2016) allow students to transfer mid-semester from an introductory required STEM course they may be failing into an easier course so their GPA is not affected thus allowing them to maintain eligibility for scholarships. The parachute course is designed to prepare them for re-taking the required course.

Student Support. UNM offers a wide range of programs, projects, and online resources to support students, including some aimed at particular student populations such as underrepresented racial and ethnic minorities, women, veterans, students of low SES status, and first generation college students. The Center for Academic Program Support (CAPS) offers supplemental instruction, online tutoring, drop-in tutoring, workshops, and language conversation groups. The

Accessibility Resource Center (ARC) provides a range of services to students with special needs. Student Support Services serves 160 low-income, first generation students with financial assistance, academic advisement, tutoring, mentorship and other services. The Men of Color Initiative (MOCI), El Centro de la Raza, and the Veterans Resource Center provide academic support and career planning, mentoring and coaching, and community engagement for their target populations. ROTC scholarships are five years for STEM students compared to four years for NM State lottery scholarships.

The College Enrichment & Outreach Programs (CEOP) work closely with first year students, primarily first generation students whose families are not in a position to provide financial support or guidance in navigating the university system. CEOP takes a holistic view of the student and provides academic guidance and encouragement to help ensure students feel successful and capable as they develop study skills and awareness of career options. CEOP works to counteract negative messages students may get from the campus environment that raise doubts about their capabilities. CEOP provides peer coaches, assistance with off-campus living, financial guidance, coaching in learning strategies and in developing tools of self-management. CEOP builds trust between students and support staff.

Undergraduate Research Opportunities.
The Ronald E. McNair Scholars Program and the Research Opportunity Program (McNair/ROP) provides faculty-mentored research experience to undergraduates from under-represented groups to prepare them for graduate school. The STEM Talent Expansion Program (STEP) provides mentoring, internships, targeted retention activities, and financial incentives for students in STEM fields.

Collaboration and outreach. Collaboration and outreach extend the UNM community of interest into the larger community and into other institutions. There is collaboration with Albuquerque Public Schools (APS) and CNM to address issues of student preparedness and alignment of curricula. UNM has outreach activities with local public schools and world class research facilities such as the VLA. Guest lectures bring subject matter experts to UNM to share their research and expertise with the greater UNM community. Senior Day introduces high school students to UNM engineering labs and other facilities. The robotics laboratory holds outreach demonstrations in local schools.

Challenges & Recommendations

Cultural Diversity. Underrepresentation of female and minority students and faculty continues to be a major challenge. Women and underrepresented minorities enter STEM programs at a lower rate and drop out at a higher rate than their white male counterparts. The anecdotal evidence found in this assessment indicates that women and others perceive the STEM environment as cold, harsh, and uncaring, or even downright hostile. Some attribute this to Euro-American values of aggressive competition and exploitation, cultural attitudes of superiority and privilege, a lack of empathy, or deficit model thinking. For example, there is frequent reference to "weeding out" of students who do not learn well in the environment and in response to the methods they encounter in the classroom. The "weed" is pulled out by the roots and tossed aside; cultural roots that differ from mainstream Euro-American roots are often viewed as a liability or a deficiency. This may set up a dynamic of unconscious bias and low expectations. The term

"remedial" also implies deficiency (Clarke, 2006). An achievement model might be more empowering of student success. Many faculty need to develop cultural competence and more role models are needed for women and students of color. There is a need to build a supportive community and align institutional values with New Mexico cultural values.

- There is a gap between *espoused values* and *enacted values.* For example, *diversity* is widely proclaimed as an institutional value, however, institutional practice supports *assimilation* into the dominant culture. This gap needs to be explored and addressed. Many professors are perceived as culturally and racially insensitive. Unconscious bias is an embedded feature of our society, including the UNM campus community. Values of competition and exploitation associated with Euro-American cultures, including the academic community of UNM, are not shared by underrepresented cultures. A frank and open discourse on these issues might contribute much to the health and vibrancy of the UNM community.
- In order to bring the culture of UNM more in alignment with the culture of New Mexico, incoming freshmen, either in orientation or in a more formal course, would benefit from an orientation to the cultures of New Mexico.
- The concepts of "weeding out" students, placing them in "remedial" courses, or "competing" for grades are expressions of a deficit or scarcity model of human performance and are not consistent with local values of a supportive family and community. These practices are disproportionately prejudicial to underrepresented populations and are at variance with the espoused values of UNM. There needs to be more emphasis on and support for collaborative learning and alternatives to the 3-credit-hour model and grading on a curve.
- Hire more women and faculty of color in the STEM fields. Underrepresented groups need to see role models and develop coaching and mentoring relationships with people who have overcome the same societal challenges they face.
- Take measures to ensure a level of cultural awareness and competence in recruitment processes.
- Establish small cohorts and supportive learning communities.

Systems Perspective. UNM lives and operates in a larger system of academic tradition, state laws, federal regulations, public schooling, union contracts, grant restrictions, career aspirations, societal expectations, availability of funding, competing goals of a range of stakeholders, and many other factors. Nevertheless, there are things that UNM can do, avenues of change it can explore. The following recommendations were suggested during the course of these interviews:

- Align rewards with goals. If the intention is to improve teaching, then great teaching needs to be rewarded. Teaching faculty need to be hired on the basis of their commitment to student learning, genuine caring for their students, and commitment to continually improve their teaching capabilities. Research faculty need to be encouraged and rewarded for including more first-year undergraduate students in their research, coaching and mentoring them.
- Simplify, define, and continually improve administrative processes. Experience working with faculty doing real research is one of the most potent tools for ensuring student performance, graduation, and career success. The process for hiring students for positions in research labs needs to made easier for faculty. Coordination among administration, faculty, labs, and student support services needs to improve.

- Resources available to help students and to help faculty and advisors help students need to be coordinated and their availability made known to students, faculty, and advisors. There are many excellent programs and projects that are not known to all who could benefit from them or could refer others in need. There is duplication of effort. Integrate student services and academic affairs so that existing support services are more widely understood and students referred to appropriate support.
- Alternatives learning models need to be explored. Arbitrary units of time such as semesters and 4-year programs, and units of content such as credit hours assessed through written exams do not necessarily support how students actually learn. A mastery based approach and alternative assessment through demonstration of skills or portfolios need to be explored more widely as indicators of capabilities and competence.
- Lottery scholarships are insufficient to cover students entering STEM programs with insufficient high school preparation in math and science. This is a large proportion of New Mexico students. The four-year limit needs to be extended for STEM students. The system creates pressures for students to "get through" courses, not necessarily to learn the needed knowledge and skills. There needs to be a stronger focus on developing the competencies of the profession.
- Students often need to spend years at UNM before they take their first course in their chosen field of study. Basic courses are seen as something to "get out of the way" in order to move on to what the student came to UNM to do. Foundational knowledge and skills are taught divorced from the applications that will serve the student in professional practice. Ways to integrate a fragmented curriculum need to be explored. Collaboration among departments needs to extend into the public school system.
- Overhaul the teacher evaluation process in the public schools. Evaluation of teachers based on test scores drives good teachers out of the system and diverts teacher attention away from deeper learning.

Preparedness of incoming students. Students need more preparation for STEM programs at UNM, especially in mathematics. This is particularly true for students coming from New Mexico public schools. They need a better understanding of STEM fields, the kind of work the field entails, the opportunities it affords, and the demands that will be placed on them to successfully complete their chosen program of study. Students need to develop certain dispositions before college enrollment, such as curiosity, perseverance, critical and independent thinking. They need a work ethic that includes a sense of reciprocity, contribution, service, and striving for excellence.

- Expand outreach into middle schools and high schools to introduce these students to the many career paths available in the STEM fields, the capabilities they need to develop, and what they need to do to prepare for the various university programs available to them. Students need a broad understanding of the options in relation to their aspirations before declaring a major.
- Make dual enrollment more widely available and encourage high school students to take advantage of it. This will better prepare them for college level work, help ensure timely completion of their degree program, and save money on tuition.
- High schools need to hold higher expectations and explain applications of math in a way that makes sense to the students.

- High school students don't know what engineers do. High School teachers need to be taught more about engineering and other STEM fields so they can help provide meaningful context for course content.
- Incoming students need to be assigned to a supportive community based on interest, status (such as veteran, disability, etc.), ethnicity, or other criteria that define the community.

Orientation. Student orientation is an opportunity to address many issues surrounding the transition to university life. However, there are different populations of incoming students with different needs. Nontraditional students coming to UNM with work experience, military experience, and other life experiences are not the same as students coming straight from high school. In addition, too much information is presented in too short a time. Student orientation is an opportunity to induct students into a culture. There needs to be more emphasis on the cultural aspects of orientation and less transmission of information that will soon be forgotten. Incoming students, as well as the rest of the UNM community, need to become aware of unconscious bias. Unconscious bias impedes the progress primarily of women and minorities and operates often subtly in daily interactions. In the first two weeks, incoming students should be told: This is how you succeed, these are the expectations, and this is what we are prepared to do to support you. Then monitor the process frequently to be sure those supports are effective and continually improved. Students need to understand what their chosen career is like and the degree requirements, including commitment of time and effort, and the importance of intrinsic motivation.

- Some students need support in making the transition from rural to city life.
- Students need training in such things as a growth mindset, grit, and perseverance.
- Implicit bias tests could be administered during orientation to heighten awareness and sensitivity to issues of sexism and racism. This should be done in a way that invites open, candid, and respectful conversation.
- The campus climate needs to cultivate independence and self-responsibility.
- When students attain a high GPA (3.0+) in their first semester, it boosts their self-esteem and reinforces their confidence. An advisor, a peer coach or mentor is often needed to help students understand the level of effort and time commitment required to achieve this, to encourage them, and to hold them accountable.

Data. There is much data available but these data are not necessarily helpful in evaluating the effectiveness of programs or allocating resources, or in improving processes. Acquiring, organizing, and analyzing institutional data can lead to important insights into how UNM is functioning and what might be done to improve processes, systems, and long-term performance. However, small scale, local data collection at the department, program, class, and individual level might support better and more timely decisions for teachers, advisors and students.

- For example, students in the College Enrichment and Outreach Program (CEOP) calculate their GPA right after midterms. Then they sit down with an advisor and determine what they need to do to ensure they end the semester with at least a 3.0. This first semester success and the boost it gives to the student's self-confidence is critical. Too often, students either don't know they're in trouble or are not motivated to take action until it's too late. A student who feels "behind" is at high risk of dropping out.

- At the macro level, data systems need to be designed to help faculty and advisors help students. This calls for standardization and transparency, as well as confidence in the integrity, relevance, and validity of the data. Ease of use is essential.
- UNM overall does not have the sink or swim attitude toward students commonly found in other universities. But we don't have the structure to tell people how to support students. And we don't have good data. Faculty generally don't know how their students are engaging with the university. Relevant information on the students' lives is not available to help advisors understand where they have problems outside the university. These are often problems that cannot be addressed in a 15-minute session with an advisor. The system is not designed to help faculty and advisors help students.
- Money should come with accountability and assessment. There needs to be more standardization and transparency around data acquisition and use.

Teaching and Learning. Traditional methods of lecture supplemented with PowerPoint slides is the least effective method of teaching. Students learn best in hands-on, experiential, project-based and team-based learning environments, and through collaboration (Bransford et al., 1999). Through mentorship they learn to become independent thinkers. They need to be introduced to real problems in four areas: community, industry, entrepreneurship, and research. Engagement with real world problems enhances learning in the core discipline. However, current resource levels do not permit providing these experiences to all undergraduates.

- Instructor attitude is critical; a cynical, indifferent, or uncaring attitude on the part of the instructor is demotivating to students.
- Students need to be able to see the connection between what they're learning in the classroom and the knowledge and skills needed in their chosen career field. Experience in school needs to be more like real life and real work.
- The teaching skills of adjuncts need to be assessed *before* offering a teaching contract. Training in effective teaching methods is needed.
- Effective teaching needs to be assessed and rewarded. The validity of end-of-semester student evaluations needs to be questioned; they create an incentive to "teach to the evaluation."
- A math course needs to be designed for those who do not get into Calculus I to bring them up to a level where they can take Calculus I.
- Students need to be able to take their basic math and chemistry courses in the summer. Many students will need summer tuition scholarships.
- There is pressure to keep the existing curriculum even when it doesn't meet the skill development needs of the students. Students need statistics at least as much as calculus but statistics is not required. Students need technical writing skills but writing courses are not coordinated with labs when they need to apply their writing skills. Also, technical writing courses were designed more for business students than for STEM students.
- Design is an important skill and we (as an institution) don't teach it very well. We need to give design the same emphasis we give research. Design is widely neglected in academia.
- We have a culture of test taking. Performance on exams takes precedence over deep learning. Students are often blamed for poor performance on exams when systemic factors beyond their control contribute significantly to outcomes. We need to understand best practices for this student population; explore new approaches; change the culture.

- Recitation and lab sections for core courses can greatly enhance learning yet they are not always required as in other universities.
- What happens in the classroom is the most important thing. The way we teach is oriented toward middle income, predominantly white students from college educated families. It is generally less responsive to the needs of underrepresented populations. We especially need to look at how we're teaching math.

Undergraduate Research Opportunities. Early involvement in research greatly enriches the student experience and increases the likelihood of graduation and continuing on to graduate school (Eagan *et al.*, 2013). Although there are many opportunities for undergraduates to get involved in research, these opportunities are limited. There need to be more such opportunities and they need to be made available to students as early as their first year. Mentoring and coaching need to be part of the experience.

Work and Study Balance. Some students need to work; this may not allow them sufficient time to be successful in their studies. Rather than work minimum wage jobs just for a pay check, we might create opportunities for tutoring high school students or lower level college students in math, chemistry, or physics; create more jobs in research labs and more internships in industry. Students need jobs that reinforce learning and allow more time for studying by paying above minimum wage. Students also need experiences that cultivate a work ethic needed for a successful career.

Student Support. Although UNM offers many programs to support students, these are not necessarily well integrated or aligned with academic program requirements.

- Some faculty see their role as enforcing rigid requirements such as attendance and homework completion regardless of student circumstances. Sometimes flexibility, compassion, and understanding individual circumstances would be more helpful to student success.
- We need to consider what we can do in the first couple of weeks of the first semester with workshops and other means to get across to students what they will need to do to succeed in the program.
- An open door. Students need a place where they can come to ask questions, get help, and hear straight talk … an honest conversation about what they need to do. Then commit to doing it. For example, getting a whiteboard and keeping a 2-week schedule on their wall where they can see it every day.
- Students can be slowed down when a course they need is offered only once a year, especially if they need to retake it.
- Students who struggle for a C in lower level courses then go on to higher level courses are not well prepared. Their struggle continues.

Strengths, Challenges & Recommendations of Specific STEM Fields

Biomedical

Undergraduate Research Opportunities. UNM provides undergraduate research opportunities, mentorships, and internships. Access to real research has been shown to be a significant factor in student success in STEM programs and careers (Eagan et al., 2013). The Undergraduate Pipeline Network summer research experience, the Maximizing Access to Research Careers (MARC) program, and the Initiative for Maximizing Student Development (IMSD) cultivate interest and develop skills for students to pursue graduate studies in the biomedical field. UNM also offers post-baccalaureate research opportunities aimed at groups underrepresented in biomedical research through the Post-Baccalaureate Research and Education Program (PREP) and the FlyBase program. These programs also seek to prepare and encourage students to enter graduate programs.

Alternative Track to Medical School. The BA/MD program recruits high school seniors who will commit to serving as doctors in New Mexico and offers a four-year degree specifically designed to prepare them for UNM School of Medicine. This program serves a dual purpose of increasing engagement of under-represented groups in the biomedical field and providing medical services to rural and underserved populations in New Mexico.

Engineering

Undergraduate Design Opportunities. UNM Engineering provides undergraduate design opportunities such as the International Environmental Design Contest, Formula SAE international engineering design competition, a rocket engineering course, Solar Splash boat design competition, the National Concrete Canoe Competition. Other project-based courses provide opportunities to develop team skills, presentation skills, and management skills. Projects provide real-life experience and a context for learning math, physics, engineering and other essential competencies.

Outreach. Engineering sponsors events for interested high school students like open house and weekend programs. Senior Day brings high school seniors to tour the engineering facilities. A workshop sponsored by Mechanical Engineering teaches grade 5 students at Monte Vista Elementary School the difference between science and engineering.

Computer Science

Anyone who completes a degree in computer science can find a job. Even those who don't complete a CS degree can find a job. In this field, many employers hire for skills, not for the degree. Some students come into the program with work experience and/or programming skills. The program is flexible; there are many options – many paths. There is not a rigid order of courses. Many CS courses are project-based and team-based with hard deadlines – designed to simulate the work environment outside the university.

- Some university math requirements are not needed in the Computer Science program such as calculus. Align the math requirements with the professional needs.
- Since students may be hired without a degree, they may or may not continue working toward their degree. In such cases, time-bound graduation rate criteria, such as 4-year or 6-year graduation rates, are not realistic measures of success in the program.

- Because of the many paths available through the CS program, there is not a rigid order of courses. Consequently, there is not a strong sense of a group progressing through a common program. Other avenues of creating a sense of community need to be explored. This is especially true for women and other underrepresented groups.

Conclusion

Several factors contribute to student success in STEM programs at UNM. Paramount is the learning experience in the classroom. The quality of this experience tends to improve when the instructor moves away from traditional lecture/PowerPoint to more active learning modes, project-based and team-based learning, interactive discussion, individual projects and presentations by students. Re-designed courses have been instrumental in raising the level of engagement on the part of both instructors and students. However, success with innovative approaches in the classroom is dependent on a culture of respect and acceptance of the full diversity of the students as well as the instructor. Students quickly perceive the level of interest and caring the instructor brings to the course and any unconscious (or conscious) cultural bias is soon evident to perceptive students. Creating a welcoming learning environment for all is a significant factor in retaining women and other under-represented groups in STEM programs. A variety of special programs provide invaluable support to under-represented groups yet there is still a need for more mentorships, particularly for women. A strategic focus on UNM's organizational culture is needed; diversity needs to be understood as much more than demographics in order to create an environment where women, people of color, first generation students, and other under-represented groups feel safe and fully integrated into the learning community at UNM. The many opportunities for undergraduates to engage in research and design with peers and faculty mentors is an important factor in student success. However, the number of these opportunities falls short of the need, particularly for first year students. Financial factors are critical; there is a need for more work/study opportunities that pay well and complement the student's course of study. Findings suggest that a holistic approach to academic, cultural, and financial issues, recognizing that there is considerable overlap between them, is likely to contribute more to student success than approaching these issues separately. In addition to the factors that are within the scope of UNM governance, other important factors can only be addressed through outreach efforts and collaboration with other institutions and agencies.

Preparedness of incoming students is a major concern. Graduates of New Mexico high schools are generally not prepared for introductory STEM courses. This is a complex issue that calls for long-term strategic thinking among State and local agencies and institutions, including UNM. In addition to academic preparation, public institutions need to cultivate curiosity and the students natural inclination to learn. Capabilities of inquiry need to be cultivated from an early age. Students need to have a better understanding of what various disciplines entail, the opportunities they afford, the kinds of problems they address, and the level of preparation and effort the discipline demands. They need to understand how their own talents and inclinations match up with a wide range of professional possibilities. As long as New Mexico students are not adequately prepared in high school for university STEM programs, guidelines for State scholarships need to be more flexible to facilitate summer enrollment and to extend the scholarship period beyond the current four-year limit.

Appendix A: Interview Results of Faculty, Staff, and Students

Faculty Interviews: Strengths, Challenges, and Recommendations

Geology

Challenges

- Underrepresentation of female and minority students and faculty is a major challenge in the field of Geology as well as in other STEM fields. Role models are important. Gender and ethnic preconceptions and antiquated cultural attitudes can be an obstacle to feeling accepted within science communities. These dynamics can operate in subtle ways, often below the conscious awareness of the person holding such attitudes and preconceptions. Change is slow.
- Students entering the field are generally unprepared both academically and in understanding what the field entails and the opportunities it affords. They also often lack a basic understanding of what science is or dismiss it as being "too hard". It is not uncommon for students to think that science is already "done" and the textbooks and courses are just rehashing it – they perceive science as memorization of "facts".
- Students often lack curiosity, a basic understanding of inquiry, and the ability to think quantitatively. Many find the courses either too hard or boring; the way the courses are taught is critical.
- Some students come from families that have no understanding of science or experience in higher education; consequently, these students have no one in their family to lean on.
- There is a disconnect between Student Services and Academic Affairs. Many valuable resources are available at UNM but often neither students nor faculty are aware of them, for example: College Enrichment and Outreach Programs (CEOP).

Recommendations

- Recruit more female and minority faculty.
- Outreach to public schools to familiarize students with STEM fields, the preparation required, and the opportunities they offer.
- Cultivate curiosity, inquiry, and quantitative thinking in public schools.
- Support first generation students.
- Integrate student services and academic affairs so that existing support services are more widely understood and students referred to appropriate support.

Chemical & Biological Engineering Undergraduate Committee

Strengths

- Students bring non-academic assets, including life experiences, that can be resources for success in the program.

Challenges

- Students come to the program unprepared for this level of academic rigor. Many are weak in chemistry, math, and physics; lack the necessary time management and study skills; and don't have the work ethic needed to commit the time and effort required.
- Students come into the program without knowing what chemical engineering is; they need to know what an engineer *does.* Some students don't like the classes; they don't see

classes as preparation for a career, they see them *as* the career. Often, their main concern is how they will be graded.

- Typically, the top 5 to 8 students do extremely well; the majority to OK; some are not motivated.
- Math is critical for success in engineering. There is a problem with the way math is taught at UNM. There are huge classes and the way technology is used does not necessarily enhance learning. When there is a call to reduce hours, math often comes up first.
- Deficiencies in math preparation is a big problem in the U. S., especially in New Mexico; foreign students are generally much better prepared in math. Aversion to math is common in U.S. schools.
- Evaluation of teachers based on test scores is counterproductive. For example, Steve Brugge was an excellent eighth grade science teacher with 25 years' experience. His classes were very interactive. He went from near the top of the evaluation scale to near the bottom in one evaluation cycle. He quit after receiving poor ratings. https://www.abqjournal.com/588684/retiring-teacher-reveals-evaluation-for-all-to-see.html

Recommendations

- We need to cultivate intrinsic motivation.
- Students learn from hands-on activity; with mentorship they learn to become independent thinkers. They need to be introduced to real problems in 4 areas: community, industry, entrepreneurship, and research. Engagement with real world problems is needed to enhance learning in the core discipline. Current resource levels do not permit providing these experiences to all undergraduates.
- A math course needs to be designed for those who do not get into Calculus I to bring them up to a level where they can take Calculus I.
- Math scores at UNM predict success in Chemical Engineering and future GPA. High schools need to explain applications of math in a way that makes sense to the students and hold higher expectations.
- Georgia Tech offers basic courses (such as Calculus) to high school students for dual credit. These courses are also broadcast or offered online. Many of these students then attend Georgia Tech. This approach could be tried at UNM.
- Top students in New Mexico generally don't attend UNM. Students must be introduced to engineering at a younger age. High school students don't know what engineers do. High School teachers need to be taught more about engineering and other STEM fields so they can help provide meaningful context for course content. Perhaps online videos should be made available to high school students so they can see what engineering is like. AICHE created a video series of various Chemical Engineering careers about 25 years ago. They are still available.
- Overhaul the teacher evaluation process in the public schools.
- Some students need to work; this may not allow them sufficient time to be successful in their studies. Rather than work minimum wage jobs just for a pay check, we might create opportunities for tutoring high school students or lower level college students in math, chemistry, or physics; or jobs in research labs; or internships in industry. They need to do jobs that reinforce learning and allow more time for studying by paying above minimum

wage. Students also need experiences that cultivate the work ethic needed for a successful career.

Computer Science

Strengths

- Anyone who completes a degree has a job.
- The Computer Science program prepares students for employment before they finish the program and many are hired without degrees.
- Some students come into the program with work experience and/or programming skills.
- Students often bring interest and enthusiasm into the program.
- The program is flexible; there are many options – many paths. There is not a rigid order of courses.
- Many Computer Science courses (such as CS 351) are project-based and team-based with hard deadlines – designed to simulate the work environment outside the university.

Challenges

- Some students are not prepared with basic skills (especially math) coming into the program.
- Some university math requirements are not needed in the Computer Science program such as calculus.
- Students can be slowed down when a course they need is offered only once a year, especially if they need to retake it.
- Students who struggle in 100-level courses are allowed to go on to higher level courses even though they are not prepared; and the struggle continues. A grade of "C" may indicate that the student is insufficiently prepared to move on. Insufficient effort combined with insufficient preparation is a major factor in limiting student success.
- There was a program to admit high school students as interns in the DNA wet lab but administration set a standard of guaranteeing their absolute safety – a standard virtually impossible to meet so high school students will no longer be part of the program.
- Many students are hired without degrees and may or may not continue working toward their degree. In such cases, time-bound graduation rate criteria, such as 4-year or 6-year graduation rates, are not realistic measures of success in the program.
- Because of the many paths available through the CS program (a strength), there is not a rigid order of courses. Consequently, there is not a strong sense of a group progressing through a common program

Biology

Strengths

- Freshman Learning Communities
- The BA/MD program
- Simplify the process for getting work/study jobs in the labs

Challenges

- The biggest challenge for students is math. Math is a gateway to STEM and students have trouble seeing why they need to take it.

- Introductory STEM courses often have hundreds of students. The BA/MD program is successful with class size around 50 but we don't have the resources to make these smaller classes available to all.
- Students often don't understand the level of effort required outside of class. They need to understand that they need to practice outside of class, but it's not part of their culture.
- Many students have a financial challenge. The level of work required to meet their income needs detracts from their academics.
- The process for getting work/study jobs in the labs used to be simpler. It is now too demanding of faculty time so fewer work/study positions are offered.
- There is pressure to keep the existing curriculum even when it doesn't meet the skill development needs of the students. Students need statistics at least as much as calculus but statistics is not required. Students need technical writing skills but writing courses are not coordinated with labs when they need to apply their writing skills. Also, tech writing courses were designed more for business students than for STEM students.
- Freshman Learning Communities were successful but now resources are not available for them. In this program, two small classes follow a parallel curriculum such as Psychology and English Writing or Chemistry and Math. There will be only one of these in the fall.
- Another barrier is the transfer process from CNM. Introductory biology courses at CNM do not adequately prepare students for courses at UNM, especially the labs. Biology labs at UNM demand more critical thinking skills. The State common course numbering project is not an effective strategy to address disparities between course content at UNM and CNM.

Recommendations

- It is important that incoming freshmen get an advisor in their major.
- Basic courses need to be offered in the summer. All four courses in the biology sequence are now offered in the summer. Students also need to be able to take their basic math and chemistry courses in the summer. However, many students will need summer tuition scholarships.
- Skills needed for STEM careers need to be integrated into the STEM curriculum. Statistics could be paired with BIOL 203/204. Writing could be paired with the labs.
- Provide resources for more Freshman Learning Communities.
- Evaluate curricula and re-design as needed.
- Align/redesign technical writing and statistics courses to support other courses in the program.
- Ensure alignment between CNM and UNM biology courses.

Mechanical Engineering

Strengths

- The 400-level Race Car Design course (40 students) involves lots of close interaction with students. It is very hands-on. Students design and build a car and compete nationally. They learn team skills, presentation skills, and business management skills. We also recruit a few EE students for the team. This program provides real-life experience and a context for learning other subjects like math.

- Students now become part of the department as freshmen; previously they joined the department only after completing prerequisites. The 2 advisors provide administrative support but it is faculty who advise students about academics.
- We teach a course in Grade 5 at Monte Vista where students learn the difference between science and engineering. They build balloon-powered cars. SAE has courses available on the internet for each grade level.

Challenges

- Lower level courses are taught by adjuncts who may or may not have teaching skills.
- Many students come from poor schools and may have a poor work ethic.
- First generation and second language learners may not have the vocabulary to understand the lecture or the textbook.
- Class performance is bi-modal: students perform in the 90's or the 60's in about equal numbers. Not many C students.
- Hispanic men generally do not come for help even when invited to do so.
- Many students have time demands: working 20 hrs/wk, caring for family members, and other life demands.
- The transition from rural to city life is difficult for some students.
- Design is an important skill and we (as an institution) don't teach it very well. We need to give design the same emphasis we give research. Design is widely neglected in academia.

Recommendations

- Provide a course on teaching the teacher how to teach for incoming adjuncts.
- Give Design the same emphasis we give research.
- The university experience needs to be more oriented toward real work.
- There needs to be more STEM awareness among students long before coming into the program.

Math

Strengths

- Persistence; bravery – speaking up and asking: "I don't remember how to …"
- All Math Department heads in APS meet periodically and sometimes invite UNM.

Challenges

- The transition from high school to college is difficult for many students. In high school, they meet every day and the teacher can re-teach if students don't get it the first time around; this doesn't happen in college. Students who got good grades in high school often have not had to work hard; it is not uncommon for them to fail the first exam. They may not even realize they don't understand the material until after the first exam. The pace is much faster.
- Students who need help often do not seek help – even after the instructor tells them they need help – until it's too late. Students frequently do not get the message that they need to spend at least 2 to 3 hours outside of class for each hour in class.

- At CNM, students have to meet with a coach on the third repeat of a course; at UNM, there is no limit to how many times they can repeat a course. There is a common attitude of "Oh, I'll just take it again".
- Some students are misplaced over their heads in UNM math courses. There needs to be a way to check this.

Recommendations

- Orientation needs to do more to help students understand and accept the level of effort required, to take advantage of the instructor's office hours and to seek help in other ways such as CAPS. They need to be made aware of available resources, know how to access them, and be motivated to take action when they need help.
- Students need to get the message at the start of their university experience: this is different from high school, much more is required, this is how to be successful, and here are the resources you have available to you to help you be successful.
- A supportive community is important. Having an example of a successful student who they can identify with, who has faced the same challenges, is helpful. Relationships will help students get through.
- Create a process that prevents students from being misplaced over their heads in UNM math courses.
- To transition from high school to university, Orientation needs to convey: Here's how you succeed; these are the expectations. Time does not equal effort; a commitment to both is needed. Then follow up and find out how they're doing. Students need to learn strategies for studying.

Physics

Strengths

- Students have strong ties to New Mexico … this can be both an advantage and a disadvantage.
- Many students are bilingual.
- I have more support than most instructors because I teach in the BA/MD program with small class size, active learning, flipped classrooms (we do group work in class and I have a helper). In the BA/MD classes, non-BA/MD students need instructor permission to enroll.

Challenges

- Students are unprepared. They often lack basic math skills. They are slow at the math they already know.
- Vocabulary. Many students have a hard time with the language of the textbook.
- Instructors sometimes lack empathy and have unrealistic expectations of incoming freshmen. They sometimes blame students for being lazy.
- With STEM Gateway, we started a pre-intro to physics course but it was only offered for a year and a half. Available data did not reveal any clear-cut criteria for admitting students into this course. Engineering came up with their own course, but without any involvement or collaboration with Physics.
- Students are under time pressure in a 50-minute class and the time it takes to pass out exams and prepare for the start of the exam adds pressure. Then they're pressured to hand

the exam in before they have had time to finish it. We need a different attitude toward test taking. Teachers tend to blame students. We should not assume that how we learned is a good model for our students.
- At UNM, recitation and lab sections are not required as in other universities.
- Many students believe that now they are in college, they don't have to go to class.

Recommendations
- It would be helpful to know how students do later in the engineering (or other STEM) program.
- Data could be helpful to provide insight into each student's situation and performance.
- Students are hard workers. If we can get them through the basics most of them will be fine … maybe the first year and a half.
- Reduce the pressure of exams … change the attitude toward test taking. We need to understand this student population and explore new approaches … change the culture … establish best practices for this population.
- Have smaller sections.
- Encourage students to go to instructors during office hours.
- It is important for instructors to want the best for their students.
- Offer the level of support provided in the BA/MD program to all students.

Physics Undergraduate Committee

Strengths
- The Physics & Astronomy Department piloted a course to address the problem of under preparation (Physics 140).
- The Engineering Department is offering a preparatory physics course.
- One professor observed no change in success rates or drop-out rates in 30 years of teaching at UNM.

Challenges
- Many students come to the UNM Physics program with weak backgrounds in math and science; New Mexico public schools generally do not prepare students for the academic rigor of a career in physics.
- Students come with unrealistic expectations about the level of effort required for the program.
- Students may have been exposed to basic concepts in math and science, but they did not develop a level of mastery necessary to progress to higher levels. They need more practice.
- If a student is working 20 hrs/wk, there simply isn't time for most students to do what is required to complete a degree in 4 years. Many scholarships offer only 4 years of funding. For many students this is an insurmountable economic barrier.
- Some underprepared students might do well in physics, but they would need an extra year or two to develop the basic knowledge and skills. The current system does not allow for more than a 4-year program for an undergraduate degree.

- There are systemic problems with the distribution of resources. For example, a dedicated TA/tutor might have a big impact on student success, but restrictions on use of grant funds do not allow it.
- Programs may be highly visible and politically appealing, but fail to channel the resources where they can have the most impact, partly due to restrictions imposed by funding sources, partly due to a concern for appearances at the expense of substantive change, partly due to institutional factors at local, State, and national levels.

Recommendations

- Students need a better understanding of the sacrifices required to meet the demands of a program such as Physics and Astronomy and they need to be willing to make those sacrifices.
- Students entering STEM programs at UNM need a better understanding of what careers are possible following completion of their degree program. They need this understanding before they get to UNM and before they declare their major. In addition to persistence, we need to do more to ensure alignment of student expectations and a realistic assessment of student preparedness in relation to requirements for program success. Ideally, this should happen long before the student arrives at UNM. If students do not have the needed preparation, we need to be realistic about the time it will take them to complete the program and fund them accordingly.

Power Engineering

Strengths

- The students come with strong motivation to learn. They appreciate faculty who work hard for them and for me this is the rewarding part of teaching.
- I want all students to understand, not just write down what I say. Sometimes we do problems in class to make sure students are up to speed.
- There are numerous workshops for better teaching within UNM.
- I usually focus on what the students struggle with and make myself more available to the students via emails and office hours.

Challenges

- Sometimes students are disrespectful. Ethnic stereotyping may play a role. My strategy is to be extra nice to the students and dedicate myself to the teaching.

Recommendations

- To help students learn, explore ideas for effective teaching: use iClickers; maybe iPads or laptops. We can do a lot more with the tools we already have. Read multiple textbooks and carefully select problems to enhance student understanding. This takes time; faculty need to find the time. Some faculty are excellent at this, but it took them many years to get there.
- To encourage students to persist in STEM majors and careers: Does the 3 credit hour model really work? TAs run the lab and grade the homework. They could do more with the 20 hrs/wk they're paid for. They may need closer supervision by faculty; they need to put in the time and effort to enhance the learning process. Incentives may be needed so that excellent teaching is a greater factor in tenure and promotion decisions.

- Have a couple of lecturers who focus on Freshmen and Sophomore classes.
- Create enhancement classes for students who may lack needed skill sets in Math, Physics, and Chemistry. These courses can be offered by the lecturers as well.

Staff Interviews: Strengths, Challenges, and Recommendations

Mechanical Engineering

Strengths

- Engineering courses are fun for them.
- Students learn Design early in the program (Design I & II).
- Students study together. The high achievers help those who struggle. There's no formal program, they just do it.

Challenges

- Students struggle with math, especially Calculus I and Calculus II. They also struggle with physics and chemistry.
- The student lottery. The old lottery requirement was 12 credit hours, now it's 15 credit hours with a minimum GPA of 2.5. With the new rules, if a student repeats a course, then he has to take 18 hours the following semester.
- A high student-to-advisor ratio limits the level of service available to students.
- The ME program is 3 years so students should finish their prerequisites in 2 semesters, otherwise their lottery money will run out.
- Many students need better math preparation in high school.

Recommendations

- Get students sooner into Calculus I and II. For this they need better preparation in high school.
- Encourage students to take the initiative to get help. When they ask for help, it builds confidence.
- Encourage students to take advantage of Engineering Student Services tutoring, CAPS, and the STEP Mentoring Program.

PREP & FlyBase Program – Lab experience to students bound for PhD programs in Biomedical Sciences (2-year fulltime employment)

Strengths

- Many participants also take courses.
- All 13 program participants were accepted into PhD programs this past year.
- Retention in this program is very high. The few who leave do so for personal reasons.
- Participants are successful in the lab. They gain lab experience and they grow in professionalism and self-confidence.
- Sincere interest in pursuing a PhD in Biology is the primary screening criterion for applicants. Our success rate is about 80% based on acceptance into a PhD program.

Challenges

- Participants need to learn life skills such as self-confidence, writing cv's and personal statements for PhD program applications, networking, professional etiquette, and money management.
- Communicating with students can be a challenge. I share my personal stories of success and failure and this helps establish rapport. I also refer them to other resources as needed.

- Students don't have much time to settle into their project before they have to apply for graduate school.

Recommendations

- Good listening skills and patience are needed. Students are going through a stressful transition.
- For participants to get the most out of the PREP experience, it should be 2 years.

ROTC

Strengths

- ROTC gives students up to 5 years for a technical degree.
- Students are successful when they take advantage of research and other opportunities to get more fully engaged. Some faculty are really good at making opportunities available to students, but students often don't take advantage of these opportunities.
- The STEM Collaborative (STEM Summer) is open to anyone. There are empty seats on the buses to outreach events such as visits to the VLA. First generation students are not aware of the importance of these experiences for their career development.

Challenges

- Many students are placed in low level math courses so they don't become engaged right away and sometimes they run out of time on their scholarships. At Arts & Sciences, I saw many students who started in Engineering; many could still not handle the demands of their new major. Some students ran out of time on their financial aid and did not complete their program.
- Students struggle with Math and Physics. They are not properly prepared in high school.
- The advisement case load is too high.

Recommendations

- More collaboration between staff and faculty (also with students). Some faculty don't value what the staff might bring to a conversation on student success.
- Collaboration between high school teachers and university instructors is needed, especially in the area of curriculum. There were times when collaboration was going well and a key person transferred to another area, effectively ending the collaboration. Collaboration needs to be sustainable.
- Show students the light at the end of the tunnel. They can easily get wrapped up in "paying their dues" grinding through introductory courses and lose sight of the longer term goal of graduating; some give up too early.
- Students often don't see the application of the basic course material. They need to be made more aware of the more engaging coursework ahead.

College Enrichment & Outreach Programs

Strengths

- Each student is assigned a peer coach at the beginning of the first semester. We choose peer coaches based on the challenges the student is facing and their major. Most peer coaches are juniors or seniors, a few sophomores.

- We build trust; we want students to come to us when they need help or have questions.
- We help new students with issues of living off campus, ensure FAFSA completion, manage loan debts, and develop study skills. We encourage them to lean on their peer coaches.
- First semester is critical. We have them calculate their GPA at mid-term, then help them develop a strategy to ensure they maintain a GPA that meets their scholarship requirements; this might involve CAPS and other tutoring services. We closely track student progress 1st through 3rd semesters.

Challenges

- We take a holistic perspective on the needs of the students. They generally have no financial support from home and no experience within the family of navigating university bureaucracy.
- We work very closely with first year students. In the second year, we make sure they check in periodically. If they are pursuing or plan to pursue postgraduate education, we keep closer track of them. These programs include IMSD, McNair, North Campus Office of Diversity programs for medical students (this is like a boot camp for MCAT preparation and navigating administrative processes).
- Lack of information about how UNM functions for STEM students. Our students may have an OK GPA but low ACT scores so they are placed in lower level math courses (Math 102, 103, 104) and low level English. But STEM programs have a prescribed course sequence and the students get behind. This sends a message to the students that they are not as good or not as smart as other students and can lead to a personal sense of failure. This creates an emotional drain. Even though we encourage them, they get a negative message from the STEM program.
- Some students may need to work 2 or 3 jobs.
- Many of our students don't have good study skills; they need to learn how to study. They struggle with lab reports. Performance in the first two months is a good indicator of the likelihood of their persistence through the program. We talk a lot one-on-one during the first semester. We may even get a little intrusive to find out how they're doing so we know how to help them.
- Students do not have a broad awareness of career options. We encourage them to explore career possibilities asking them to do their own research and report back to us. We follow up.
- Cultural pride has been an obstacle. The UNM culture, especially in the STEM fields, is very different from what many of our students are used to. We help them bridge the gap.

Recommendations

- Students need to understand the importance of slow and steady progress. Many need to take summer classes. They need to understand it's OK to take more than 4 years to complete their degrees. Many get frustrated and change majors.
- More peer coaches would be helpful. Students need a strong basic core in their discipline.
- Dual enrollment. Many high schools do not prepare their students for university success; the high schools sometimes don't have the resources.
- Students need to attain a high GPA (3.0+) in their first semester. This boosts their self-esteem and tells them they can do this. To help them achieve this, we look at their

schedules before they arrive at UNM and flag courses that may be a problem for them. We consult with them individually and advise against stacking tough classes or make sure they understand the level of effort and time commitment that will be required.

- We need to understand the cultural issues. Faculty need cultural competence. This needs to be addressed by HR in orientation. The institutional values of UNM are not aligned with the strong family values of New Mexican culture. Orientation promotes cultural values that are at odds with New Mexico family values, for example, orientation (and now university policy) promotes a high-cost living style in the dorms. This can affect the sense of self-worth of students whose families cannot afford this life style and create embarrassment and a sense of "I don't belong here".
- Faculty need to be more sensitive to the need for many low income students to work.

Biology

Challenges

- Math preparation. Students must pass Math 121 before they can take their first Biology (or Chemistry) course.
- Keeping up with demand for advisement and answering emails.
- Students frequently don't pay attention to pre-requisites and co-requisites in the online registration system. This wastes time of advisers when they come for help.
- Many students come into Biology without a clear idea of the breadth of the field.

Recommendations

- A student-to-advisor ratio of about 300:1
- Have an introductory biology course with no prerequisites so that students can become familiar with the field.
- Encourage students to take advantage of the services that are offered such as CAPS and instructors' office hours.
- Encourage students to attend Masters and PhD defenses and frequently scheduled afternoon talks. They need to get to know what biology is about.

TRIO - McNair Program

Strengths

- Once they're in the program (juniors), they've already overcome many obstacles so we have a high success rate. Once they're in mentorship, they do very well. This is especially beneficial for STEM students.

Challenges

- Students struggle with getting professors to understand their situation. For example, one student was a single mother and her professor did not sympathize with her situation. When she was matched with another single mother as a mentor, her class performance improved dramatically.
- Financial struggles are common.
- Students have trouble putting in the time needed to be successful in their program.
- Students struggle with finding a sense of belonging, especially minorities and women.
- Many students don't feel conformable reaching out to peers and professors. Some of them drop out; this is more true for STEM students.

- New students face a harsh, cold, uncaring environment. Prerequisites are taught in large classes by TAs. It can be impersonal and intimidating.
- Many instructors are disengaged from the learning process. The incentive structure does not support teaching or caring about students. Tenure is granted based primarily on research.
- Faculty are critical. A primary stress for students is where the teacher is incoherent and whose expectations are unclear. A good professor makes all the difference.
- STEM students typically say that the teacher did not help them learn. This is not the case for social science and humanities.
- Faculty need to teach more introductory courses. TAs are untrained. Professors are untrained in teaching; they need to be taught how to teach. We need professors who are willing to put the effort into teaching; this is especially lacking in STEM courses.

Recommendation

- More money; expanded services.
- Work with the collaborative STEM Center setting up peer mentoring.
- First year research experience through the college enrichment program. This is a staff coordinated program in which they bring in faculty to teach how to do research. Those who did well in this program were already high achievers. First generation students struggle more.
- Create a warmer, more caring environment.
- Make sure TAs are competent to teach.
- Create incentives to support effective teaching and caring about students.
- Make teaching a greater factor in granting tenure.
- Ensure that faculty are competent and caring, including TAs and adjuncts.
- Establish small cohorts and supportive learning communities.

Civil Engineering

Strengths

- Parachute courses help many students who struggle with basic science and math courses.
- A design course for pre-majors exposes students to engineering in their freshman year.
- Students who know what they want to do are generally successful; these students make an effort to become familiar with the field. Those who choose the field and don't have it chosen for them by others tend to be more successful.
- Students have the tools they need. The Department is working on ways to know when students are doing poorly while there is still time to correct the situation.
- We have Senior Day when high school students tour labs and other facilities.
- We have a representative at high school recruitment events who makes presentations in various STEM fields.
- There is a high level of interest and excitement in the department. We have an awesome faculty. There are competitions like the concrete canoe. The curriculum is very project-based.
- Students can work in labs at the pre-major level but these opportunities can only accommodate about 20 students.

Challenges

- For pre-majors, Chemistry, Physics, and Math are major hurdles. Tutoring is available but students need to take the initiative to go. Some students need cajoling to hold themselves accountable and seek help when they need it.
- Many students struggle most with math and physics. Some students struggle with chemistry. These are "weeding-out" courses.
- Students get an overview in Orientation; they need to realize that they will need to put in the time to be successful.
- Advisors need more time for more in-depth conversations with students.
- Students sometimes have a sense of entitlement and expect to be led by the hand.

Recommendations

- High school students need to know more about choices of majors and careers.
- Improve math and science preparation in high school.
- Create more opportunities for students to work in labs at the pre-major level.

Veterans Resource Center

Strengths

- We monitor grades and contact students when grades are below a C; we reach out through email and set up a meeting to discuss tutoring, ARC, CAPS, SHAC, etc., whatever the student might need. This is an informal discussion to find the best way to support the student.
- Student veterans are resilient and persistent. Vets are willing to put in the work that a STEM program demands.
- STEM career persistence tends to be high among veterans. There are 1200 known vets (using VA benefits) at UNM; there are others who choose not to reveal their status. We ensure that all their classes apply toward a degree.
- We're starting peer-to-peer mentoring for veterans. We try to match the mentor to the student's degree program. We would like to bring in alumni. A veteran's success counselor is leading this effort.
- Green Zone training is a 3-hour course on veterans' issues awareness.

Challenges

- Combat engineering is a lot different from the engineering programs at UNM. The skillset is different. Students struggle with the math.
- Student veterans tend not to ask for accommodations; they want to succeed on their own. I encourage students to get tutoring, but they often don't seek help until they're failing. Then I walk them through it.
- Two things are needed for success in the military: A Team (a cohort model is needed at UNM), and a Skillset (crawl-walk-run training model). Courses at UNM need to be more experiential and less academic.
- Students need to learn how to study, take notes, write papers. We talked with Student Affairs about a Bridge Program; a grant proposal is being written.

Recommendations

- Adopt a cohort model.
- Make courses more experiential.
- Students need to know how the course material relates to real world applications, especially in math.

Men of Color Initiative

Challenges

- Students of color do not see many instructors who look like them.
- Some instructors are not sensitive to the cultural experience of their students of color and may embarrass them in class.
- Instructors' perceptions of students are an obstacle. Many professors are culturally and racially insensitive. The institution is fundamentally Eurocentric and embodies values that are not necessarily shared by those of other than European origin, such as competition and various forms of exploitation.
- Students of color are often underprepared. There's a cultural dynamic where students are afraid to ask for help, especially men. Men frequently equate asking for help with being soft; they would rather sit there and suffer.

Recommendations

- Hire more faculty of color.

Chemical Engineering / Nuclear Engineering

Strengths

- UNM is good at taking students through math courses from Math 101 through pre-calculus when their high school experience did not prepare them well.

Challenges

- A common concern is when exam questions are not aligned with homework assignments.
- Students sometimes feel that CAPS tutoring doesn't help.
- Students struggle with calculus and physics more than with chemistry, especially calculus.
- Some students tend to shift accountability away from themselves to the teacher; they need to learn to take responsibility.

Recommendations

- Ensure better alignment between homework and exams.

Engineering

Strengths

- We sponsor events for interested high school students like open house and weekend programs.
- Students are successful when they ask a lot of questions. When they come for help. When they pursue opportunities like a research position in a lab.
- Students are successful when

    - learning is cooperative, active, and hands-on
    - they understand the context of their learning and how it helps their community
    - they feel safe to ask questions
- Project-based learning

Challenges

- Time management.
- Freshmen (and some sophomores and transfer students) often don't understand how much effort is required to succeed in the engineering programs.
- They may come from a family of "helicopter" parents who don't cultivate independence and self-responsibility in their children.
- They teach differently in high school with more hands-on and less working through problems. Students often don't learn the theory.
- Getting students to listen … to ask for help ... to take their studies seriously … to understand the implications of being in a difficult program.
- Some students with good grades in high school and high ACT scores have not had to make much of an effort. They are not prepared for the commitment of time and effort required.
- Some students look for shortcuts like alternating class attendance with one or more other students.
- Professors sometimes hold inaccurate assumptions about students, such as
    - Students know how to manage their time
    - Students do their homework
    - Students' basic needs for food, shelter, and health care are being met
    - Students know how to write, study, do math
    - Students know how to ask for help when they need it
    - Students know how to take responsibility for their own education
    - Students aren't scared to talk to the professor or come to office hours
- Sexism in engineering comes more from peers than from professors.

Recommendations

- Provide more Design experience in their first year.
- Provide more project-based learning.
- Ensure each student has a mentor.
- Provide training in growth mindset, grit, and perseverance.
- Provide opportunities for relaxed, informal interactions with professor and/or TAs.
- Conduct spatial reasoning screening and develop a workshop in spatial reasoning for those who need it.
- Sensitivity training for sexism in peers/implicit bias tests.
- Keep track of students and reach out if they are missing class.
- Mini grants if students are lacking funds for small but necessary things.
- Some faculty see their role as enforcing rigid requirements such as attendance and homework completion regardless of student circumstances. Sometimes flexibility, compassion, and understanding individual circumstances would be more helpful to student success.

- We need to consider what we can do in the first couple of weeks of the first semester with workshops and other means to get across to students what they will need to do to succeed in the program.
- An open door. Students need a place where they can come to ask questions, get help, and hear straight talk … an honest conversation about what they need to do. Then commit to doing it. For example, getting a whiteboard and keeping a 2-week schedule on their wall where they can see it every day.

Administration

Strengths

- There are many efforts and programs to support students with a wide range of services.

Challenges

- 7 years of stop/switch/stay data on students who enroll in UNM with STEM aspirations show that students make this decision in their first 2 years. Students who stop have a GPA around 2.0; they have not been successful academically. An Annual Benchmarking Report based on 7-year longitudinal data reports that retention is improving but UNM is still behind similar institutions. Students from underrepresented populations, first generation, or low income, drop in higher numbers.
- We typically don't engage students in what they came here to do until their junior year. Until then, they are occupied with prerequisites and often remedial math courses.
- Poverty is a big part of the problem for many students.
- What happens in the classroom is the most important thing.
- Students struggle with math. A basic algebra course may have students from over two dozen different majors so the instructor cannot teach to the degree interests of the students.
- UNM overall does not have the sink or swim attitude toward students commonly found in other universities. But we don't have the structure to tell people how to support students. And we don't have good data. Faculty generally don't know how their students are engaging with the university. Relevant information on the students' lives is not available to help advisors understand where they have problems outside the university. These are often problems that cannot be addressed in a 15-minute session with an advisor. The system is not designed to help faculty and advisors help students.
- Students need to be a part of a supportive community within the larger system where these kinds of conversations can take place. These communities exist on campus but often students, faculty, and staff are not aware of them.

Recommendations

- The way we teach is oriented toward middle income, predominantly white students from college educated families. The way we teach is generally not as responsive to the needs of underrepresented populations. We especially need to look at how we're teaching math.
- The Math Mall (the Emporium Model) is a computer-assisted peer tutoring program developed through the Provost's office. Quantitative Analysis is an entry-level course developed as part of this effort. It is taught in smaller classes with more individualized instruction and more support for students. ALEKS is also part of this initiative; ALEKS is computer-assisted, mastery based individualized instruction.

- The First Year Steering Committee continues to look at advisement, new student orientation, the Math Mall, and other efforts to address retention. In their first semester, 6% of students take calculus, 40% take intermediate or college algebra, and 5% take Quantitative Analysis.
- Assign incoming students to a supportive community based on interest, status (such as veteran, disability, etc.), ethnicity, or some other criteria that define the community.
- Money should come with accountability and assessment. Establish more standardization and transparency around data acquisition and use.

Student Interviews: Strengths, Challenges, and Recommendations

Student Interview Summary - Math and Science

Strengths

- Online resources such as Wolfram Alpha and Kaplan.
- When instructors are really engaged in their field they also tend to be engaged with their students.
- Working in a lab doing real research was the best preparation for STEM success.
- Special programs
    - The Undergraduate Pipeline Network and the
    - MARC program
    - Biomedical Research Education Program
    - BioTech Program at CNM
- Guest lectures.
- Use of clickers in the classroom.
- Online homework with immediate feedback.
- One-hour weekly recitations with a TA.
- Group problem solving throughout the physics curriculum; credit/no-credit in group problem solving recitations.
- Availability of instructors outside of class: having an open door policy in addition to posted office hours.
- Professor's enthusiasm
- Professor's honesty with students.
- The collegiate environment: time together outside of class; a feeling of community.
- Knowing people you can go to for help.
- Internships, including internships with major labs such as CERN and Brookhaven.
- Using physical models such as color-coded models of molecules.
- Courses that make it clear how the material relates to the real world or current topics.
- Some professors experiment with innovative methods such as dancing molecules.
- Opportunities for service and community building
    - Peer tutoring
    - Science Fair judge
    - Docent for ABQ Natural History Museum
    - Mentor programs for middle and high school students
    - Ghost Ranch programs
    - Volunteer for Student Special Events (Open Mic Nights, Music on the Plaza, Art Exhibits, Fiestas, etc.)
    - ENCUENTRO: tutor for immigrant students in science and math.
    - Tutor junior level students to prepare them for the physics GRE.

Challenges

- Under-representation of female and minority students in STEM.
- For some professors, teaching is an unwelcome chore and this is evident and demotivating for their students. Some instructors are indifferent or too busy for students.
- Attrition rates in math and science classes are high.

- Incoming students need better math preparation. Even APS courses do not prepare students adequately.
- Students who work and/or have families cannot make it to office hours or to CAPS.
- CAPS is not always helpful.
- Turnover among advisors can disrupt student progress.
- Growing up in New Mexico with an appreciation for diversity and not seeing it much in physics; this needs to change.
- The STEM culture at UNM does not empower women.
- Transferring to UNM involves a lot of bureaucracy and jumping through hoops.
- Instructors with strong foreign accents can be difficult for some students to understand.
- Shortage of qualified TAs.
- Misalignment of courses with pre-requisites and co-requisites.
- Misinformation about program requirements
- Students need to know what they're getting into: STEM is hard. High school does not prepare you.
- COMPASS tests, AP courses in high school, and ACT scores do not always give a good indication of where a student should be placed.
- In Chemistry 121, half the people dropped.
- Orientation information is soon forgotten; there is too much of it.
- Sometimes required courses, a pre-requisite, or a co-requisite fills up before a student who needs it can register. This can derail a student on a 4-year track, especially when the course is only offered once a year. This can happen when there is a hold on the student's account.
- Frustration with technology.
- In some classes, assigned homework problems, exams, and course goals are not aligned.
- A societal attitude of resignation toward math: it's OK to be poor at math.

Recommendations

- Hire more role models of women and minorities
- Increase cultural awareness
- Put teachers in classrooms who love their field and love teaching.
- Use real-world examples to illustrate course content.
- Shorten lectures and have students collaborate in solving problems at the end of class.
- Include more demonstrations and learning "toys" in the classroom.
- More hands-on learning.
- Train inexperienced teachers to be more knowledgeable of the learning process and more attuned to student learning needs.
- Ensure CAPS tutors give their full attention to their student.
- More peer mentorship.
- Give students lecture material before the lecture
- Expand the Undergraduate Pipeline Network and the MARC program and make participation requirements more flexible.
- Advisors need to collaborate with people in the labs and Department heads to place more undergrads.
- Advisors need to be aware of emerging opportunities through recent grant awards.

- Attract more students to guest lectures given by people working in industry, government, and academia.
- Distribute UNM STEM Collaborative Center announcements more widely.
- Create a more supportive environment. It is currently too competitive, especially pre-med.
- Greatly reduce the use of the PowerPoint/lecture format.
- Make more of an effort to attract women to STEM programs:
    - Hire more female professors in engineering and establish a mentoring program for women.
    - Develop a more partnership-oriented, strengths-based program – a program more oriented toward solving problems in the community using a network of resources.
    - Simplify the process of transferring into UNM STEM programs.
    - Provide more support for women and non-traditional students.
    - Answer the following questions on the website:
        - What does your professional network look like?
        - How do you connect students to it?
        - How does UNM impact women in STEM jobs?
- Recognize Nutrition as a STEM career
- Older students mentor younger students.
- Design a better process to assess students' math level; students need to know where their deficiencies are. This could be done online.
- Montessori methods encourage independent thinking. This is good preparation for mastering content independently. Deadlines, rules, and instructors present a bigger challenge than the content.
- Learn the material before the class and then have it reinforced in class (flipped classroom).
- To improve STEM at UNM, require an introductory course on what you need to know to be good at independent learning, or a special program for those interested in STEM so students know it's hard, but they can do it. Then show them how.
- Rethink and redesign Orientation. There is too much information and it is soon forgotten.
- Create a concept map for math to see how clusters of concepts connect.
- UNM needs a process/policy on placing holds on accounts that is more flexible and does not obstruct the student's progress.
- Ensure students will be able to take required courses and prerequisites when needed. Perhaps by giving them preference over students who do not need the course, or by providing an online option.
- The process of dropping a class needs to be more flexible. A student cannot drop a course when there is a hold on the account. The transcript will then show an "F" for all time. This may lead to the student dropping out altogether.
- Ensure that assigned homework problems, exams, and course goals are aligned so that homework prepares the student for the exam and both lead to mastery of the content.
- Repair and upgrade the astronomy observatory.

Student Interview Summary - Computer Science

Strengths

- Student chapters of professional organizations such as
    - Society for Industrial and Applied Math (SIAM)
    - Bioinformatics Club
    - Women in Science and Engineering (WISE)
    - Society of Women Engineers
    - Toastmasters
- An internship in chemical biology provided inspiration and direction, a good mentor, and showed me what a non-medical research career in science looked like. I had a supportive community of colleagues and faculty and research opportunities. All this led me to my current field: bioinformatics.
- Collaborative group work – being held accountable to peers at frequent intervals.
- Field trips to see what's going on in academic and industrial applications of what's being taught.
- Labs and project-based courses.
- As a volunteer in Alpha Chi Omega (philanthropy domestic violence awareness), I surrounded myself with talented women who valued high grades, and who reflected on how we all spent our time.
- When instructors
    - Lead by example.
    - Provide an entire problem set, walk the class through them, then base assignments on these class exercises.
    - Show source codes and go through it line by line.
    - Use a graph to illustrate step-by-step procedures.
    - Are personable, interactive in class, available outside of class, and attentive to student needs.
    - Give a wrap-up at the end of each class.
    - Give an overview of the course in a larger context and show students how to think like a programmer.
    - Are caring, kind, and know their subject.
- Work-study is a big retention mechanism.
- An upper level programming course was difficult, but opened my vision and made me interested.
- Online resources help: video lectures, PPTs with notes, transcripts of lectures.
- In Calculus class, we went outside to throw balls and measure trajectories. This active approach to learning was very effective.
- The Formula SAE course.

Challenges

- I majored in CS for 3 years then transferred to Computational Math; I did not have much in common with my classmates. A teacher of an upper level math course became my mentor. I find CS people less well rounded, too much into video games. I find math people more personable.

- Introduction to Physics I and II crammed a lot of content into the courses. It seemed like a "weeding out" class. I did not like the way it was taught with no emphasis on understanding and too much memorization.
- One upper level CS course was incredibly hard. The teacher was disorganized and had not done the assignments before assigning them. We had to work in groups; the group dynamics were challenging.
- There is a discouraging vibe in the program – not welcoming to females. [from a male student]
- The program lacks diversity.
- Answers to homework are easy to find online, so it's easy to check them without fully understanding them.
- I'm not learning in the classroom although I have perfect attendance.
- Too much testing based on rote memory.
- STEM students are underrepresented in student government.
- STEM freshman often don't reach out for help even when help is offered. Or they can't acknowledge that they need help.
- Women are often unwilling to ask for help or seek mentorship, nor do they necessarily know how to.
- There is a need for more outreach to women, minorities, and non-traditional students.
- Some students experience the culture as hostile, particularly toward women and minorities.
- It is hard for some students to meet with professors during posted office hours and there are too many students asking for help at the same time.
- Some students perceive the department as understaffed.
- Bureaucratic delays in admissions.
- ACT scores older than 5 years are not recognized; students must take the COMPASS Test.
- The most engaging experiences like internships and work-study are reserved for juniors and seniors, even though the applicant may have years of work experience.
- Student enrollment is less than 20% female. There is no awareness of biases in judgement. I've been asked if I'm in the right place; I have a feeling that I don't fit. There are groups I can connect with but I should be able to connect more widely. TAs (from a south Asian country) talk to my lab partner but not to me. They ignored me unless I asserted myself.
- Students need to be taught about heuristic judgements and implicit bias; they aren't aware they have biases. The culture is tough.
- Some teachers do not clearly present the lecture topic; they only read from slides.
- In this upper division math course, there was no review of homework. Then Graders started reviewing homework but did not provide feedback. The professor is good but is not available. The course is fast-paced and hard to keep up with. Without feedback, everything comes crashing down. A CAPS tutor is helping but sometimes the tutor doesn't know.
- There is tremendous variation between sections of the same course in the number and difficulty of homework problems and there is no feedback on the homework from the TA graders. The pace is too fast. Half the class has dropped. There is too much content.

- My experience at UNM has been disappointing. My academic advisor did not respond to my email and phone call. The advisor is not familiar with the CS field.
- I dropped CS major after 3 semesters. One upper level course was poorly taught; the professor discouraged questions and was unhelpful. It seemed as if he tried to make it hard. TAs did not know what was going on. "I felt like I was set up to fail."
- Several CS courses were not explained well and did not follow the syllabus. There was too much reading. I felt like I was pushed through curriculum without learning it. The instructor seemed not conversant with the curriculum as if it were borrowed from another instructor.
- When students get behind, it can be extremely difficult to get caught up.
- CS instructors did not seem to care about student success (unlike math professors who did); there was no encouragement.
- There was a disconnect in going from lower level to higher level courses.
- Students need more personalized help; there was no out-of-class help.
- It is a sink or swim culture, but with no swimming lessons.
- There is an elitist culture and a sense of being unnecessarily hard.
- Uncaring, unengaged instructors. Some TAs in the recitation class do not know the material; they may spend the whole class on one problem with one student.
- I didn't like group work in the science labs; I prefer to do the work on my own. I dropped out after 2 weeks. I don't like being called on in class.

Recommendations

- Teachers need to expect students to take initiative for their own learning.
- I felt empowered when I had to present my own work in CS classes and in Calculus II.
- Ensure instructors are invested in their students' learning, hold high expectations, and plan adequately.
- Establish clubs like programming clubs or science clubs – something playful outside of class.
- The way programming languages are taught is not for beginners. The teacher needs to make more of an effort to explain what's going on behind the scenes and illustrate it on the board.
- Give weekly assignments graded and with feedback and discuss them in class.
- At mid semester, the instructor needs to ensure students know how to apply the learning. Start the course by explaining the basics, then build on the basics. The instructor needs to make sure assignments lead to student competence.
- Hold class discussions and hold workshops on what is happening around the world in the subject.
- Provide internships to first year students so they get real-life work experience.
- Provide more research opportunities and allow students a level of autonomy to ask their own research questions.
- Inform students about volunteer programs and encourage them to participate.
- Provide more opportunities for international students.
- More collaborative group work and being held accountable to peers.
- More classes with meaningful field trips to see applications in academia and industry.

- More mentoring resources are needed. Like a web portal that just throws up volunteer spots.
- More bioinformatics on campus will make research on North Campus more productive.
- Students need to learn strategies for getting internships, research positions, advanced classes and seminars. For example, read the papers of the professors you want to learn from; read their profiles on Research Gate and the UNM website (or their profile from wherever they're based), send an email and ask for time to discuss one of their papers; offer to apprentice for free to learn.
- Find a mentor early in the program.
- Develop personal relationships: find out what the life of a person in your career of interest is like at the beginning and at mid-career. Also, get to know all your professors and ask for recommendations on what to do next for your career.
- Confront sexual harassment more openly and honestly.
- Ensure that the syllabus is well developed at the beginning of the course, including lab instructions and instructions for major projects. Then follow the syllabus.
- More hands-on.
- Ensure that TAs are qualified and prepared to help with specific assignments.
- Make students more aware of resources available to them.
- Students need more guidance, information, and knowledge of career possibilities in their field.
- Guest lectures and other academic enrichment activities need to be more widely advertised on campus.
- Dissertation topics need to be more widely known.
- The climate in math class is stressful and militant.
- There needs to be less lecture and more use of visualizations and models to help make the subject real. Students need to see practical applications.
- There need to be more online options.
- A "flipped" classroom model would be more effective.
- Students need a support network.
- Provide better guidance in course selection.
- Redesign introductory courses to give a good picture of the field.
- For lower level courses, give smaller problems to be completed weekly rather than long problems that take months. Break up the bigger projects.
- Write the code on the board and show how it works.
- Show that the basic routine or technique can do something interesting.
- Provide more opportunities to develop friendships in group activity; there is very little social support.
- Standardize the different sections. Assign the same homework and provide timely feedback. Provide less content and slow it down. This will reduce the drop rate.
- Put less emphasis on technical language and programming and more on thought processes.
- Projects (group and individual) and labs are good, but have more than one TA in labs of 20 to 30.
- Students need more personalized help; there was no out-of-class help.
- The culture needs to become more supportive and less elitist.

- Incorporate more physical activity, active learning, and classroom discussion.
- Provide real world applications and step-by-step instructions in how to apply the learning.
- Require instructors and TAs to get Toastmasters training.

Student Interview Summary - Engineering

Strengths

- Internships with major corporations such as Phillips Semiconductor and Honeywell.
- When instructors
    - Are entertaining and have a sense of humor; levity helps memory.
    - Have enthusiasm for the subject.
    - Give students conceptual ideas and engage them in thinking through ideas.
    - Have consistent office hours and are available outside of office hours.
    - Answer students' questions, give good feedback, post solutions to tests, and promptly return tests with feedback.
    - Clarify how the content can be applied; let students know *why* they need to learn it.
    - Select and answer questions students submitted the night before lecture.
    - Tell students what's going on in the field – finding out the real-world scope of the subfield.
    - Are interactive, working through a problem with the class and asking questions that engage the students in solving the problem.
    - Allow students time to think as they work through problems.
    - Provide readings to do before the class and include them in the syllabus.
    - Are well prepared
- Student chapters of professional organizations, such as
    - Association for Computing Machinery
    - Home Builders Association
    - Association of General Contractors (AGC)
    - IEEE
- Online courses
- Project-based courses
- STEP Program. The student meets with a mentor for 6 classes then finds an internship.
- Circuits II has the best instructor I ever had. We met twice a week and had a quiz every week. The quizzes built up to an exam. Each quiz covered one topic and the exam was the culmination of all the topics covered in the quizzes. The course was math intensive but he kept the mood light. Tragically, he was let go due to a policy of not hiring those who earned their PhD at UNM for tenure track positions.
- Solar Splash
- Outreach demos with the robotics lab, especially for girls.
- CNM as an alternative for taking basic courses; classes are smaller and more practically oriented and instructors are focused on teaching, not research. They connect better with the students.
- Opportunities for student interns to work at labs.
- Career fairs and networking socials.

- Project design teams such as the drone competition.
- NSF meetings; preparing for jobs; job fairs
- Opportunities to be a science fair judge for MESA and VEX
- Engineering study groups with tutors, especially for first-year students.

Challenges

- Some professors seem to want to weed you out. In one class, half the class dropped by mid semester. I took it again in the fall with another professor who was there to help us. He told us what he expected.
- The math department has a reputation for being a weed-out department. The weed-out professors surprise you on the tests; they throw curve balls.
- Higher level calculus and senior level EE courses were most difficult. The material is tough and professors are mostly the weed-out type. Tests need to be more straightforward.
- APS does not prepare students for college level work nor for college culture. There are no weed-out instructors in high school.
- It is important to stay on top and not get behind.
- Most graduate students lack necessary teaching skills.
- Tutoring services only help you so far; they can't help with higher level courses.
- Classes sometimes seem designed to fail the students. This is not an effective way to teach a course. You don't know how to prepare for the exam.
- Engineering education culture seems to support ineffective approaches to teaching.
- EE courses are theoretical and have no hands-on activity in the basic courses.
- Professors often give tests where everybody fails; then they grade it on a curve. It's as if they expect students to fail the test. This is common in electronics courses.
- Coordination and communication between Engineering and Anderson School of Management is terrible. There was no buy-in from ASM, no support; they didn't seem to care. This view is widely shared in the Engineering school.
- Some instructors assume prior knowledge many students don't have; they need to learn how to teach. You're given a recipe or directive and told to figure it out with no feedback.
- Sometimes instructors take the approach: Here's a recipe, you're on your own; you either get it or you don't.
- Students who take preparatory courses may run out of scholarship money before they receive a degree.
- When instructors
    - Don't allow time for students to process information. Students are generally not comfortable stopping an instructor for clarification in a large auditorium.
    - Skip parts of the syllabus
    - Teach like robots
    - Talk over slides creating confusion about where students need to focus their attention.
    - Scribble quickly on the blackboard and don't allow students an opportunity for clarification and questions.
    - Walk in the classroom, boot up the computer, then read slide after slide.

    - Choose an expensive textbook with too much content at too high a level.
    - Give you material specifically for the exam but then it does not appear on the exam.
- You can come out of the program with a degree without ever having touched a resistor. There needs to be more hands-on. We need more tools like 3D printers.
- Staffing levels are a problem especially in Power Systems. For several semesters there was no one to teach Power Systems courses. These students had to switch programs or extend the length of their program by at least a year.
- The engineering departments are very segmented. They need to be more interdisciplinary. For example, the ME and the EE groups on the Solar Splash "Team" operate as two separate teams.
- The male/female imbalance is ridiculous. I know only 3 females in the graduate programs and they are all foreign.
- The most important thing is a professor who cares, especially in introduction to engineering courses.
- There is a common illusion of invincibility or being terrible at something. People drop out of engineering, not because they don't want to do it, but because they fail a course.

Recommendations

- Ensure grad students are qualified and trained to teach effectively.
- Make sure engineering advisors have experience in STEM.
- Make sure students understand that if they want to party, they should not go into engineering. They need to understand they will have to spend weekends getting caught up and studying.
- Change the culture. There is a weed-out mindset at UNM; only the strong survive.
- Change engineering education culture to be more supportive and to use more effective teaching methods.
- Hire more women. In my experience, women tend to be better teachers. They have more empathy and are better organized for student learning.
- Use visual methods. Show a picture or a video (not a video from MIT but one from popular science and engineering). Break down the material into conceptually digestible components.
- Ensure that the test reflects what was taught in the class.
- Provide more hands-on activity in the basic EE courses.
- Structure homework to support learning the material.
- Courses could be made more effective by having more lab-type options rather than group projects in late sophomore early junior year in which some teams have low buy-in among members.
- Strengthen the connection between the Association of General Contractors and Architecture, Construction & Engineering Charter High School (ACE).
- Engage middle school and high school students in events and design competitions such as the concrete canoe.
- Stop using the synchronous online format. It is not effective.
- In courses where teaching is weak, have a more capable teacher audit the course and provide coaching to the instructor.

- Consistently provide useful, timely feedback on tests and homework.
- Coordinate labs and lecture; schedule labs for *after* the lecture.
- Make BSEE a 5-year program; 18 credit hours per semester is too much.
- Instructors need to tell students about applications and use. Students need to know why they need to learn the material.
- Many students have no professional experience; they need to learn time management, how to study, how to navigate the administrative bureaucracy, etc.
- Provide first year students with senior mentors.
- Students need to develop strategies to compensate for deficiencies in teaching.
- Make known to the students the resources available to help them.
- Add a course to prepare for Introduction to Stochastic Processes.
- EE curriculum is too theory intensive; there are only 2 courses with labs. This leaves a big gap if students don't seek out projects. There needs to be more hands-on.
- Library hours need to be extended.
- EE students need access to a 3D printer.
- Recruit more female students.
- Better integration between courses and engineering departments.
- Engineering courses would benefit from having a TA or an undergraduate assistant.
- Instructors need to integrate math, theory, and practice; don't start with theory.

Emailed Student Responses

Strengths

- There are some truly great instructors.
- Challenging courses
- Engaged professors
- BA/MD chemistry classes
- Instructor availability (office hours)
- Opportunities to work in a research lab
- Professors as mentors
- IMSD program (real laboratory research experience)
- Animal behavior course combined textbook with current scientific literature and class discussion and field work

Challenges

- Administrative processes slow and inefficient
- Inadequate Campus security
- Poorly taught courses
- Advisement and administration out of touch with students and program requirements
- Alienating campus environment
- Unmet student expectations
- Instructors who lecture with slides and don't engage students
- Undergraduate program did not prepare me for a PhD program

Recommendations

- Better instruction and more hands-on biology labs
- Assistance with job placement
- Increase access to internships
- Recruit and graduate more Hispanic and Native American students in STEM fields
- Re-design biology labs to be more applications based
- Teach specific laboratory hands-on skills
- More facilitated discussion and connecting course content with ongoing research and real-life experiences
- Provide opportunities for student to interact with professionals in their career field
- More undergraduate laboratory research opportunities
- More hands-on learning

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Exhibit 1. Email to Students

Dear <<FIRST_NAME>>,

Please share your experience with us. Whether you are currently enrolled in a STEM (Science Technology, Engineering, and Math) course, changed majors, or graduated, you can help improve the STEM culture at UNM.

You're receiving this email because at some point along your enrollment at UNM, you've chosen a STEM major. I'm in charge of seeing what UNM can do to help you, and students like you, more easily complete your STEM degrees. ***It would only take you 30 minutes.***

I would like to listen to your views, concerns, and suggestions about your journey within STEM at UNM. For example, did you feel prepared coming to UNM? How did your STEM instructors, advisors, peers, and classes prepare you for higher level courses? How did your STEM instructors, advisors, peers, and classes prepare you for a career in STEM? If you changed majors, what influenced your decision? How well were your expectations met, or not met, in your STEM courses? What improvements can be made to help students succeed in earning a STEM degree at UNM?

Can we get together over the next few weeks for a brief conversation? Email me with 3 times that work for you and I'll get back to you with a meeting place.

Thank you in advance,

Rob Giebitz
Graduate Assistant, STEM Gateway Program
http://stemgateway.unm.edu

The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).

Exhibit 2. Email to Student Respondents

Dear <<FIRST_NAME>>,

Thank you for responding to my email and for your desire to share your thoughts on the climate of STEM education at UNM.
The aim of this project is to identify success factors and obstacles in science, technology, engineering, and math courses at UNM from faculty, staff, and student perspectives.
Specifically, what strengths does UNM currently exhibit? What can change to improve student learning? What specific actions might lead to better outcomes?
We are looking for your open and honest opinions, thus your identity will not be associated with your answers.
To move forward, please let me know when you are available to chat.
Thank you,

Rob Giebitz
Graduate Assistant, STEM Gateway Program
http://stemgateway.unm.edu

The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).

Exhibit 3. Interview Questions

Guiding Questions for Students

1. What is your current year and major? Have you changed majors along the way? If so, what factored into this decision?
2. Which STEM courses did you find most difficult? What made them difficult? What could be done to make learning easier?
3. What factors in the STEM program helped you feel empowered as a learner? Disempowered?
4. What teaching methods did you find most effective? Least effective?
5. How would you describe your level of engagement in the program? How did it vary among courses and instructors? Why?
6. What were the qualities of instructors that helped you stay engaged? Disengaged?
7. Do you feel prepared for a STEM career? (Or if you are at the start of your UNM experience, do you feel that it will prepare you for a career in STEM?) Why or Why not? What can be done to improve your readiness?
8. How involved in extracurricular activities are you? Are they STEM related? If not, what has prevented you from engaging in STEM related activities out of the classroom?
9. Is there anything else you'd like me to know or experiences you'd like to share related to the STEM climate at UNM?

Guiding Questions for Instructors

1. What courses do you teach and how long have you been teaching?
2. What do you see as the challenges to student success in STEM courses at UNM? Do you have any thoughts on what can be done to help the students through these challenges?
3. Do you feel you receive enough training and support to be an effective teacher?
4. What do students need to do in your course to be successful?
5. When do you feel successful as an instructor?
6. What changes have you made [timeframe] to improve teaching and learning in your classroom (or online)?
7. What plans do you have (if any) for changing your approach in the classroom and what are the motivations for these changes? New technology? New methods (for example, more hands-on, more interaction, etc.)? Any other changes?
8. What would help enable you to facilitate student success within STEM at UNM?
9. How well prepared do you feel students are coming to your courses? How well prepared do you feel students are for a career within STEM once they earn their degree?
10. What can help with student preparedness?
11. Is there anything else you'd like me to know or experiences you'd like to share related to the STEM climate at UNM?

Guiding Questions for Staff

1. What is your level of interaction with STEM students at UNM?
2. How long have you been in this, or similar, position?
3. What do you see as major challenges or hurdles for STEM student retention at UNM?

4. What have been the challenges for you in assisting the students?
5. What changes (i.e., trainings, recourses) do you think would be most beneficial for staff, students, or faculty to increase student success within their courses?
6. What changes (i.e., trainings, recourses) do you think would be most beneficial for staff, students, or faculty to increase student preparedness for a career within STEM?

Exhibit 4. Email to Department Heads
Subject: UNM Internal STEM Needs Assessment

Dear Dr. <<LAST_NAME>>,

The STEM Gateway Program is doing an internal needs assessment. We are asking for the help of faculty to identify success factors and obstacles to success in STEM courses at UNM.

May I have a few minutes at your next faculty meeting to ask for volunteers for a small group to share perspectives and insights into how we might improve STEM teaching and learning at UNM?

Thank you,

Rob Giebitz
Graduate Assistant, STEM Gateway Program
http://stemgateway.unm.edu
505-850-5815
Cc: <<ASSISTANT>>
The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).

Guiding questions for faculty groups:

- What do you see as the challenges to student success in STEM courses, as well as STEM Career pathways at UNM?
- Do you have any thoughts on what can be done to help the students through these challenges?
- Knowing that only about 25% of students who start out in STEM at UNM actually earn a STEM degree, what can we do to encourage students to persist in STEM majors and careers?
- What would help enable you to further facilitate student success within STEM at UNM?
- Is there anything else you'd like me to know or experiences you'd like to share related to the STEM climate at UNM?

Exhibit 5. Email to Faculty

Subject: UNM Internal STEM Needs Assessment

Dear Dr. <<LAST_NAME>>

The STEM Gateway Program is doing an internal needs assessment. We are asking for the help of faculty to identify success factors and obstacles to success in STEM courses at UNM. May I have half an hour of your time for an interview around the following questions?

- What are students' challenges in pursuing a STEM career? What can be done to help students overcome these challenges?
- What are their strengths?
- What can we do to encourage students to persist in STEM majors and in STEM careers?
- What support do you receive that helps you help students to be successful? What support would you like to receive that you are not now receiving?
- What other thoughts do you have about the STEM experience at UNM?

Thank you,

Rob Giebitz
Graduate Assistant, STEM Gateway Program
http://stemgateway.unm.edu
505-850-5815
Cc:
The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).

Exhibit 6. Email to Staff

Subject: UNM Internal STEM Needs Assessment

Dear << >>,

The STEM Gateway Program is doing an internal needs assessment. We are asking for help from staff to identify success factors and obstacles to success in STEM courses and programs at UNM.

Can we meet for half an hour to discuss your insights and experience in helping students succeed in STEM courses and programs at UNM?

Thank you,

Rob Giebitz
Graduate Assistant, STEM Gateway Program
http://stemgateway.unm.edu
505-850-5815
The STEM Gateway program is funded through a U.S. Department of Education TITLE V grant, 2011-2016 (total anticipated funding $3.82 million).