GEMS: Gateways to Excellence in Math and Science: A Quality Enhancement Plan for UT Dallas

GEMS

Gateways to Excellence in Math & Science

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The University of Texas at Dallas

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1. Executive Summary

Gateways to Excellence in Math and Science (GEMS) is The University of Texas at Dallas' comprehensive plan to enhance the quality of student learning in mathematics and science by providing students with innovative, intensive, and active learning experiences both inside and outside the classroom. The project targets success, retention, and persistence in gateway math and science courses that play a critical role in influencing student decisions to continue their studies in degree programs heavily grounded in mathematics and the sciences as well as to continue their college careers. During the first five years of implementation, GEMS will involve a series of interventions, including curriculum alignment and realignment, course redesign, new course design, the introduction of new modes of curriculum delivery, and faculty development. The overall objectives of GEMS are to provide a foundation and locus for sustainable faculty and administrative activities that will (a) increase the retention of students in science, technology, engineering, and mathematics (STEM) fields; (b) decrease the number of 'D' grades, 'F' grades, and withdrawals (DFW) in STEM classes; and (c) create supportive, engaging learning opportunities.

New mainstream courses for students in calculus and chemistry will be developed to stimulate and help to prepare students for future research opportunities. Using an internally developed alignment and curriculum mapping method, gateway calculus and general chemistry sequences will be integrated with other STEM dependent courses inside and outside the School of Natural Sciences and Mathematics (NSM) to ensure that students are equipped with the skills and knowledge required for the advanced studies they will undertake. A highly visible GEMS Success Center will be established and serve as a centralized facility where a community of learners will be able to receive help with current courses from faculty members and peers and also work on self-paced advanced topics. Staffing of the center will include faculty, teaching assistants (TAs), and supplemental instruction instructors (SIs) as well as other student peer group leaders (GEMS-PLTL Leaders) who will facilitate deep learning of material through instructional approaches modeled after programs recognized for their success. A Mathematics and Science Education Council will foster communication among academic schools and programs engaged in STEM curricula at UT Dallas and promote innovative ideas for mathematics and science instruction. Using an integrated quantitative and qualitative assessment plan based on student learning outcomes, the council, in conjunction with the GEMS assessment team, will monitor and analyze assessment data concerning student performance and engagement to evaluate and to understand student performance more fully. The analysis of these data will provide the university with previously unavailable information about the undergraduate student experience to benefit the entire campus community as GEMS helps to ensure improved learning in gateway courses.

GEMS was developed after broad, intense discussions about possible QEP plans to enhance student learning at UT Dallas. In 2006, a sixteen-member QEP Council with broad campus representation was convened to review the potential impact upon student learning of the hundreds of suggestions gathered for the QEP from students, faculty, alumni, and friends of the university. The decision to develop specific interventions that target gateway courses emerged from the council's consideration of ongoing studies conducted for several years by the dean of undergraduate education; these data indicate problems in student performance in introductory math and science courses and some discouraging patterns concerning students' persistence in, or migration from, STEM courses and academic programs.

GEMS addresses STEM education issues that have been experienced and well documented at the national and international levels, but GEMS is specifically designed to operate within the context of a university whose founders in 1969 argued that "to grow industrially, the region (Texas) must grow academically; it must provide the intellectual atmosphere which will allow it to compete in the new industries dependent on highly trained and creative minds." With this charge in mind, UT Dallas' mission statement charges the university to serve "the Metroplex and the State of Texas as a global leader in innovative, high quality science, engineering, and business education and research." GEMS is organically related to both the vision of the founders of the university and the mission-critical role that UT Dallas must play in the development of a robust cadre of well educated young men and women who will dedicate their careers and their professional passion to the sciences.

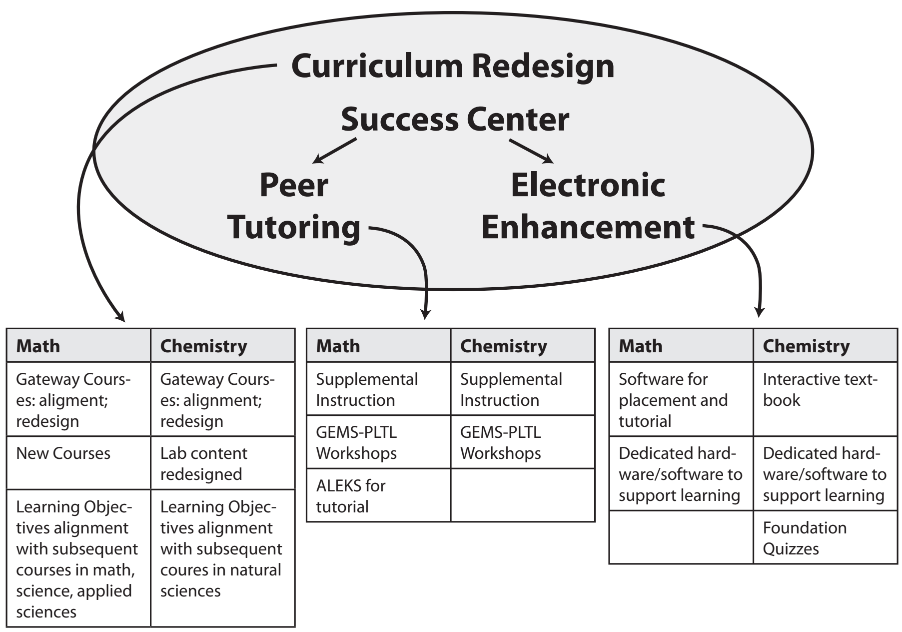

Figure 1. Component Areas of UT Dallas' GEMS

2. Introduction

Gateways to Excellence in Math and Science (GEMS) is a comprehensive plan prepared to meet the requirements specified in Core Principle 2.12 of the *Principles of Accreditation: Foundations for Quality Enhancement*. While GEMS is designed to improve the overall experience of students at the university, its specific focus is on improving the experiences of students in introductory "gateway" courses in order to increase success, retention, and persistence rates in these courses. By introducing innovative, intensive, and active learning experiences both inside and outside the classroom, GEMS will transform both the learning in these courses and the teaching thereof. As outlined below, based upon the university's mission and goals to foster excellence in the sciences and technology, GEMS targets gateway math and science courses that play a critical role in student decisions to continue their studies in STEM fields (science, technology, engineering, and mathematics) and to pursue their college careers to graduation. During the first five years of implementation, the GEMS initiative will undertake curriculum alignment and realignment, course redesign, new course design, the introduction of new modes of curriculum delivery, and faculty development—all aimed at improving success rates with designated student learning outcomes measured and evaluated by the faculty in UT Dallas' web-based assessment tool, AT6. The objectives of GEMS are to increase the retention of students in science, technology, engineering, and mathematics related areas; decrease the number of 'D' grades, 'F' grades, and withdrawals (DFW) in STEM and STEM dependent classes; and to create supportive, engaging learning opportunities.

3. Brief History of UT Dallas

UT Dallas is a relatively young institution. The university was authorized in 1969, by Section 70.01 of the *Texas Education Code (TEC)*, and began as a restructured Southwest Center for Advanced Studies (SCAS). The Center had been created in 1962 by the founders of Texas Instruments who wanted their company and the economy of the region to flourish in an environment of scientific inquiry and discovery at the highest level, like the one many of them had experienced while attending universities in the northeast. Instead, they found themselves forced to import talented engineers from outside the state as their company grew.

Realizing that high-quality education in science and technology was integral to the future development of the economy of North Texas, the founders observed that "to grow industrially, the region must grow academically; it must provide the intellectual atmosphere, which will allow it to compete in the new industries dependent on highly trained and creative minds." In order to advance this vision, they established the Graduate Research Center of the Southwest in 1961 and brought some of the most eminent scientists in the nation and the world to North Texas. The center, subsequently renamed the Southwest Center for Advanced Studies, was donated to The University of Texas System, and on June 13, 1969, Governor Preston Smith signed the bill that created The University of Texas at Dallas.

Initially, the university offered only graduate degrees in the sciences and awarded its first doctoral degree in physics in 1973. In 1974, the legislature authorized UT Dallas to enroll upper-division undergraduate students, triggering an increase in enrollment from 408 in 1974 to more than 3,300 in 1975. In 1986, the university established the Erik Jonsson School of Engineering and Computer Science, which currently has the second largest undergraduate enrollment in the university. Additional legislation authorized the university to admit freshman and sophomore students in 1990. Throughout the transition of the university from a private research center to a full-fledged university, there has been a continued emphasis on mathematics and science education and on the preparation of students who can transform ideas into actions and new technology. With this continued, strong emphasis on research in STEM fields in both its history and future plans, UT Dallas is well-positioned to be a leader in the innovative engagement and education of students in STEM content both in and out of the classroom.

4. The University's Mission and Goals

The link between the university's commitment to education and research in mathematics and the sciences and its institutional priorities is clearly communicated in the UT Dallas mission statement and in the institutional goals of its recently completed strategic plan:

4.1 Mission

The University of Texas at Dallas serves the Metroplex and the State of Texas as a global leader in innovative, high quality science, engineering, and business education and research.

The University is committed to (1) producing engaged graduates, prepared for life, work, and leadership in a constantly changing world, (2) advancing excellent educational and research programs in the natural and social sciences, engineering and technology, management, and the liberal, creative, and practical arts, and (3) transforming ideas into actions that directly benefit the personal, economic, social, and cultural lives of the citizens of Texas.

4.2 Goals

The University of Texas at Dallas aspires to be:

- A first-rank public research university with focused centers of excellence, prepared to meet the challenges of a rapidly changing, technology-driven global society
- A global force in innovative, transdisciplinary research and education in emerging areas of technology, science, and learning
- A ground-breaking leader in both framing and answering the questions faced by business, policy makers, healthcare, and the public
- A synergistic partner with local industry, government, and cultural organizations as well as local K-12 schools, community colleges, and universities
- One of the most creative, innovative universities in the nation and world.

The emphasis on education in emerging areas of technology, science, and research and on innovation are at the heart of GEMS and student success, persistence, and retention rates in gateway calculus and chemistry courses that are so crucial for success in STEM fields. As UT Dallas moves into its eighteenth year of enrolling freshmen in degree programs and teaching gateway calculus and general chemistry courses, GEMS, along with the university's strategic plan "Creating the Future," pave a synergistic path to realizing the mission of the university and to accomplishing the aforementioned goals by setting forth a series of strategic initiatives and strategic imperatives (action items) that are directly related to STEM fields:

4.3 Strategic Initiatives

- Discovering Tomorrow's Inventions Today (The initiative calls for investing heavily in areas of great opportunity for discovery and impact with specific emphasis on targeted STEM related and STEM knowledge dependent programs, such as the Research Enterprise Initiative that focuses on advancing Engineering and Computer Science, the BioWorld that focuses on advances in biomedicine, and Nanotechnology that focuses on regional leadership in transfer of this knowledge and technology to businesses.)
- Preparing Students for Tomorrow's Challenges (The strategic plan places primary emphasis on educating students and preparing them for a lifetime of contribution, leadership, and personal fulfillment in a rapidly changing, technology and science driven world that is increasingly global and flat because of advances in STEM related knowledge.)

4.4 Strategic Imperatives

- Build Faculty Size (Of the 228 new faculty to be added, 186 will be in STEM related fields: 15 new faculty in Brain and Behavioral Sciences; 89 in Engineering and Computer Sciences; 29 in Management; 53 in Natural Sciences and Mathematics.)
- Add 5,000 New Students (2,010 of the new students will be in new STEM related degree programs which rely heavily on the knowledge learned in early gateway courses such as calculus—50 of the new students will be in Brain and Behavioral Sciences; 1,040 in Engineering and Computer Sciences; 600 in Management; and 320 in Natural Sciences and Mathematics.)
- Enhance Graduation Rates (The strategic plan calls for increasing the four year graduation rate in 2015 to 47%, the five year rate to 62%, and the six year rate to 72%, which can only be done by dramatically increasing retention and success rates in gateway courses such as the calculus and general chemistry sequences.)
- Improving Operating Efficiency (The imperative requires optimizing instructional costs through careful allocation of resources and use of technology which will be accomplished through GEMS by the creation of GEMS Success Center and the innovations that GEMS will introduce into the classrooms.)

These strategic initiatives and imperatives work hand in hand with the objectives of GEMS as delineated below. Without strong, effective academic programs in mathematics and the sciences and without closely tracking and analyzing student learning outcomes in gateway courses, UT Dallas will fail to reach its aspirations and will fail to meet the needs of its unique, highly STEM dependent students who make up the majority of the existing and future student body. GEMS not only addresses the foundations of student success in STEM courses and programs, but also it provides for the institutionalization of innovative change in critical gateway courses.

5. QEP Topic Selection

In May 2006, Executive Vice President and Provost Hobson Wildenthal appointed Associate Professor of Chemistry John Sibert as the QEP director. Dr. Sibert immediately began organizing meetings with faculty, students, staff, alumni, and members of the corporate community to communicate the QEP process and solicit input for potential topics. Follow-up meetings with various members of the campus community continue to this date. The data collected from these meetings were supported by e-mail, website submissions, and internally-developed worksheets. In addition, a QEP blog facilitated discussion about a series of topics related to undergraduate education at UT Dallas and the QEP. Examples of submissions to the e-mail conversation, website, and blog are included in the appendices. A sample worksheet used to follow-up on ideas expressed in the stakeholder discussions can also be found in the appendices. In 2007, as the writing phase for GEMS began in earnest, Dr. Abby Kratz, assistant provost, agreed to serve as co-director of the QEP, bringing with her a vast knowledge of pedagogy and assessment.

UT Dallas data from The National Survey of Student Engagement (NSSE) were especially helpful in identifying weaknesses and strengths pertaining to student learning experiences, as were the data supplied by the Office of the Dean of Undergraduate Education on student performance in various courses on campus that documented substandard performance of undergraduate students in calculus and general chemistry. These data, combined with anecdotal evidence from focus groups regarding poor engagement and preparation in mathematics and documentation of a large student migration away from STEM degree programs, soon made it clear that student performance in the gateway math and science courses at UT Dallas was a major concern for the campus community as a whole.

A sixteen-member QEP Council with broad campus representation was assembled to analyze and to discuss the data that had been collected and to finalize a focused QEP topic. Throughout 2006-2007, the Council met at least twice a month and sometimes weekly and consisted of the following membership:

- John Sibert—QEP co-director; associate professor, Chemistry Department
- Kim Aaron—associate dean, Student Life, UT Dallas alumna
- Mary Chaffin—associate dean of undergraduate studies, School of Management
- Matt Goeckner—associate professor, Electrical Engineering Department
- Arthur Gregg—director, Multicultural Center
- Jessica Harpham—undergraduate student
- Jennifer Holmes—associate professor, School of Economic, Political, and Policy Sciences
- David Lewis—senior lecturer II, Mathematics Department

- Christa McIntyre—assistant professor, School of Behavioral and Brain Sciences
- Homer Montgomery—associate professor, Department of Science/Mathematics Education
- Jody Nelsen—associate vice president, Office of Business Affairs
- Robert Nelsen—vice provost; associate professor, School of Arts & Humanities
- Susan Rogers—vice president, Office of Communications
- April Taylor—undergraduate student
- Mary Jo Venetis—associate director, McDermott Library
- Scott Wright—associate dean and director, Health Professions Advising Center

After months of meetings that included presentations from various campus representatives such as the director of the Center for Excellence in Learning and Teaching, the dean of undergraduate education, and the director of the Learning Resources Center (who is responsible for training the student peers who serve as supplemental instructors in various undergraduate courses), the QEP Council voted on August 13, 2007 to endorse GEMS, Gateways to Excellence in Math and Science, as UT Dallas' official QEP topic.

5.1 Mathematics and Science Education - A National Problem

The observations that led the QEP Council to focus on mathematics and science education at UT Dallas reflect a problem that is not unique to UT Dallas. The generally poor performance of American students in math and science at the K-12 levels has been the subject of numerous reports in both technical and lay journals. Not surprisingly, there has been a growing concern with respect to both the interest and the ability levels of college students in the same areas. This problem has attracted the attention of academic institutions and the federal government (e.g., Center for Science, Mathematics, and Engineering Education, National Research Council, 1996; Committee on Science, Engineering, and Public Policy; Committee on Prospering in the Global Economy of the 21st Century, 2007). With respect to the former, there are numerous examples, notably the calculus reform movement, in which individual faculty or departments challenge traditional pedagogical methods, often with considerable resistance. In the congressionally requested report *Rising Above the Gathering Storm*, a distinguished Committee on Science, Engineering and Public Policy (COSEPUP), comprised largely of members from the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine, listed the need to increase America's talent pool by vastly improving mathematics and science education as the first of its four recommendations. The committee specifically noted poor student performance nationally in math and science in K-14 and the high attrition rates for undergraduate students in majors that depend upon a strong foundation in math and science. Similarly, Congressman Bart Gordon (D-TN), chair of the Science and Technology Committee of the U.S. House of Representatives, has argued that "because the foundation for future success is a well-educated workforce, the necessary first step in any competitiveness agenda is to improve science and mathematics education" (Gordon 2007). Clearly, if the U.S. is to compete in the increasingly flat, global marketplace of ideas and technology, there is a genuine need and a pressing directive to invest in efforts to enhance student learning in math and science.

5.2 Student Performance in Calculus and Chemistry

A recent article by Sadler and Tai in the journal *Science* describes a direct link between the level of rigorous preparation students receive in math courses and their success in future science courses (Sadler 2007). UT Dallas, like all academic institutions, offers a number of undergraduate degree programs that require mastery of mathematical skills and concepts. The placement of students and their subsequent performance in introductory math courses strongly influences student retention within degree programs, especially STEM programs, and their future career options and choices. Because of the emphasis at UT Dallas on science, engineering, mathematics, and the management of new technologies, these introductory gateway courses take on an even greater significance for the university's student population.

5.2.1 Gateway Calculus Courses

Many of the undergraduate degree programs at the university have, at their core, the requirement that students first master a set of mathematical skills considered necessary to their chosen disciplines. In the Schools of Engineering and Computer Science (ECS) and Natural Sciences and Mathematics (NSM) (two of UT Dallas' largest schools) this mathematical base is contained in two semesters of accelerated calculus, MATH 2417 and MATH 2419. Success in these classes is a prerequisite to further mathematics requirements unique to specific programs within each of the schools as well as numerous disciplinary courses that require the application of these foundation mathematical skills. Core calculus classes serve as portals through which students enter their disciplinary training, and the number of students who successfully pass through these gateways sets the upper limit of those who will ultimately receive degrees in the specific academic programs.

The undergraduate student population is comprised of two separate cohorts. One group is made up of entering freshmen who consistently have among the highest Scholastic Aptitude Test (SAT) scores in Texas. Most have completed a high school course in calculus within the last year. A second group is represented by continuing and transfer students who, for the most part, did not take calculus in high school. This group is certified for enrollment in MATH 2417 under different criteria. Entering freshmen must meet or exceed a benchmark score (currently set at 630) on the SAT Math IIC subject matter test in calculus. Most other students qualify for enrollment by virtue of having earned at least a grade of 'C-' in a pre-calculus course taught at UT Dallas or some other institution.

Table 1 presents the grade distribution in MATH 2417 for fall 2005 and 2007 partitioned by student classification. Grades have been compressed into whole letter grades for ease of presentation. Each cell contains both the number and percentage of students receiving a specific grade. The rightmost column summarizes the percentages of students who received either a grade of 'D' or 'F' or withdrew (DFW) from the class during the semester. While the DFW rates vary by course, the average DFW rate at UT Dallas is about 15%. The overall DFW rate for MATH 2417 was almost 39% for the two years under consideration and was substantially higher for non-entering freshmen. Interestingly, the DFW rate for entering freshmen dropped from 2005 to 2007 as the university raised the SAT Math IIC benchmark for entry into calculus from 530 to 630. The DFW rates for all other groups were substantially higher and represented a real impediment to their progress toward an undergraduate degree.

Whole Grade Distributions by Student Classification for Math 2417 Fall Enrollments 2005 and 2007

Class		Letter Grade - Fall 2005 A	B	C	D	F	W	WF	WP	TOTAL	DFW
Entering Freshmen	N	54	89	67	27	41	4	6	4	292	
	%	18.5%	30.5%	22.9%	9.2%	14.0%	1.4%	2.1%	1.4%	100.0%	28.1%
Continuing Freshmen	N		1	11		27	1	2		42	
	%		2.38%	26.19%		64.29%	2.38%	4.76%		100.00%	71.43%
Sophomore	N	6	5	14	11	19	5	5	2	67	
	%	9.0%	7.5%	20.9%	16.4%	28.4%	7.5%	7.5%	3.0%	100.0%	62.7%
Junior	N	2	6	15	4	17	7	7		58	
	%	3.4%	10.3%	25.9%	6.9%	29.3%	12.1%	12.1%	0.0%	100.0%	60.3%
Senior	N		8	8	1	5		1		23	
	%	0.0%	34.8%	34.8%	4.3%	21.7%	0.0%	4.3%	0.0%	100.0%	30.4%
Total N		62	109	115	43	109	17	21	6	482	
Total %		12.9%	22.6%	23.9%	8.9%	22.6%	3.5%	4.4%	1.2%	100.0%	40.7%

Class		Letter Grade - Fall 2007 A	B	C	D	F	W	WF	WP	TOTAL	DFW
Entering Freshmen	N	65	85	55	21	23	2	4		255	
	%	25.5%	33.3%	21.6%	8.2%	9.0%	0.8%	1.6%	0.0%	100.0%	19.6%
Continuing Freshmen	N		4	6	6	16		4		36	
	%	0.0%	11.1%	16.7%	16.7%	44.4%	0.0%	11.1%	0.0%	100.0%	72.2%
Sophomore	N	3	9	13	7	20		3	1	56	
	%	5.4%	16.1%	23.2%	12.5%	35.7%	0.0%	5.4%	1.8%	100.0%	55.4%
Junior	N	3	10	13	6	24	2	10	2	70	
	%	4.3%	14.3%	18.6%	8.6%	34.3%	2.9%	14.3%	2.9%	100.0%	62.9%
Senior	N	3	5	7	8	11	4	3	2	43	
	%	7.0%	11.6%	16.3%	18.6%	25.6%	9.3%	7.0%	4.7%	100.0%	65.1%
Total N		74	113	94	48	94	8	24	5	460	
Total %		16.1%	24.6%	20.4%	10.4%	20.4%	1.7%	5.2%	1.1%	100.0%	38.9%

Table 1. Whole Grade Distribution by Student Class for MATH 2417 Fall Enrollment 2005 and 2007

Of the 482 students who enrolled in MATH 2417 for fall 2005, 245 went on to take MATH 2419 Calculus II in the spring semester of 2006. While the DFW rate for MATH 2417 was almost 41%, those continuing to MATH 2419 in the spring had just under an 8% DFW rate for the fall, consisting mostly of students who earned a grade of 'D' for the first semester. Table 2 includes throughput information from MATH 2147 to 2419 for fall 2005. The cell entries read by row represent the grades earned in MATH 2417; whereas reading across the columns expresses the grades earned in MATH 2419. As an example, while almost 38% of these students earned a grade of 'B' in MATH 2417, only 24% earned a grade of 'B' in MATH 2419.

While these students could be considered the successful products of MATH 2417, having a DFW rate of less than 8%, the DFW rate for MATH 2419 was almost 32%. Of the 245, entering this class, only 167 emerged with grades of 'C' or better, for a success rate of about 67%. Going back to fall semester MATH 2417, only 167 or about one-third of the original 482 students entering the calculus sequence completed the courses successfully in a single year. Only those students who completed MATH 2417 with a grade of 'A' were likely to maintain their grade in MATH 2419, and all others were likely to receive a lower grade in the second class. For those making a 'C' or less in MATH 2417, the DFW rate in MATH 2419 was over 60%

Obviously, a throughput of only 33% is far too low for the entering calculus sequence and necessarily extends the college career of many students and forces others to rethink their professional aspirations. Yet, the DFW rate for MATH 2417 varies substantially as a result of a student's classification. At 20% (2007), the DFW rate for entering freshmen may not be excessive for one of the most demanding gateway classes at the university; however, doubling that rate for non-entering freshmen is indicative of a major problem.

MATH 2417 FALL 2005	MATH 2419 SPRING 2006										
GRADE	A	B	C	D	F	W	WF	WP	TOTAL	PERCENT	DFW
A	36	15	4	2	1		1		59	24.1%	7.8%
B	6	33	38	11	4			1	93	38.0%	
C		11	22	19	14	1	5	2	74	30.2%	
D			2	3	10		1	1	17	6.9%	
F					1			1	2	0.8%	
TOTAL	42	59	66	35	30	1	7	5	245	100.0%	
PERCENT	17.1%	24.1%	26.9%	14.3%	12.2%	0.4%	2.9%	2.0%	100.0%		
DFW	31.8%										

Table 2. MATH 2419 Spring 2006

While the SAT IIC Mathematics Subject Test has proven useful as a placement measure for MATH 2417, most students without high school calculus qualify to enroll for MATH 2417 not through a placement test but rather as a function of having achieved a grade of at least C- in MATH 2312 Pre-calculus or its equivalent transfer from another institution. The data in the tables below brings into question the extent to which such a course is adequate preparation for MATH 2417.

Table 3 reviews the grading distribution for 327 students enrolled in MATH 2312 Pre-calculus during the fall semester of 2005. Most of these students (69%) were from ECS or NSM who were using the class as preparation for entering the MATH 2417/MATH 2419 calculus sequence. Just over 73% of the students were freshmen. The DFW rate for this class was almost 43%, comparable to that of MATH 2417. While freshmen had the lowest DFW rate, it was still higher than for the more advanced calculus class.

		Grade Distribution for MATH 2312 Fall 2005									
		LETTER GRADE									
CLASS		A	B	C	D	F	W	WF	WP	TOTAL	DFW
FRESHMAN	N	44	57	52	36	40		7	3	239	
	%	18.41%	23.85%	21.76%	15.06%	16.74%	0.00%	2.93%	1.26%	100.00%	35.98%
SOPHOMORE	N	3	9	3	2	13	1	2	1	34	
	%	8.82%	26.47%	8.82%	5.88%	38.24%	2.94%	5.88%	2.94%	100.00%	55.88%
JUNIOR	N	5	6	5	6	10	1	5	2	40	
	%	12.50%	15.00%	12.50%	15.00%	25.00%	2.50%	12.50%	5.00%	100.00%	60.00%
SENIOR	N	2	1		2	5	1	2	1	14	
	%	14.29%	7.14%	0.00%	14.29%	35.71%	7.14%	14.29%	7.14%	100.00%	78.57%
TOTAL NUMBER		54	73	60	46	68	3	16	7	327	
TOTAL PERCENT		16.51%	22.32%	18.35%	14.07%	20.80%	0.92%	4.89%	2.14%	100.00%	42.81%

Table 3. Grade Distribution for MATH 2312 Fall 2005

Table 4 summarizes the performance of 149 students who completed pre-calculus, MATH 2312, during fall - 2005 and enrolled in MATH 2417 during spring 2006. The row data represent grades in MATH 2312 while reading the columns represent grades for the same students in MATH 2417. The original DFW rate for MATH 2312 with 327 students was about 43%. Within this group almost 75% were entering freshmen and 65% were students in ECS or NSM. Another 15% were undecided students who are likely taking the class to gauge their chances in more advanced classes. The DFW rate dropped to 8% for those progressing on to MATH 2417. However, the DFW rate for MATH 2417 was again almost 43%. Only 16 of the 41 students who attained a grade of 'A' in pre-calculus were able to repeat their performance in first-semester calculus. Moreover, a student with a grade of 'B' or lower was most likely to be in the DFW group at the end of MATH 2417 (57%). This outcome was even higher for the 2004-2005 academic year (74%).

PRECALC FALL 2005	CALCULUS I SPRING 2006 WHOLE LETTER GRADE										
	A	B	C	A	F	W	WF	WP	TOTAL	PERCENT	DFW
	16	14	8		2			1	41	27.5%	8.1%
B	4	21	14	7	7	1	3	2	59	39.6%	
C		1	6	10	13		6	1	37	24.8%	
D			1	1	3	1	4		10	6.7%	
F							1		1	0.7%	
WF						1			1	0.7%	
TOTAL	20	36	29	18	25	3	14	4	149		
PERCENT	13.4%	24.2%	19.5%	12.1%	16.8%	2.0%	9.4%	2.7%			

Table 4. Calculus I Spring 2006

Of the original 327 students enrolled in MATH 2312 during fall 2005, only 85 completed MATH 2417 with a grade of 'C' or better for a two-semester throughput of about 25%. Moreover, the 43% DFW rate for pre-calculus is almost identical to the subsequent DFW rate for the ensuing MATH 2417 even though the MATH 2417 students are those who have been successful in the prerequisite class. This calls into question the extent to which the pre-calculus curriculum is designed to prepare students for entry into the calculus sequence.

5.2.2 Gateway Chemistry Courses

Gateway math classes are not the only courses that present problems for UT Dallas undergraduates who come to the university committed to careers in science, engineering, management, and healthcare. In particular, General Chemistry I and II (CHEM 1311 and CHEM 1312, respectively) are traditionally viewed as two of the more demanding freshman level courses. Poor student performance, as defined by percentage of 'D' and 'F' grades and student withdrawals, in General Chemistry has been a recent focus of the Office of Undergraduate Education. Analysis over a five-year span (2003-2007) revealed that 30 to 45% of the students in CHEM 1311 failed to achieve a grade of 'C' or higher. As with calculus, first-time freshmen make better grades than all other groups although their grades are lower in chemistry than in calculus. In addition, complaints about the associated laboratories (CHEM 1111 and 1112) in terms of challenge and interest have become a recurring theme in conversations with students.

	DFW Rates for Chem 1311 Fall 2003-2007									
	FALL 2003		FALL 2004		FALL 2005		FALL 2006		FALL 2007	
	% DFW	TOT N	% DFW	TOT N	% DFW	TOT N	% DFW	TOT N	% DFW	TOT N
ENTERING FRESHMEN	20.8%	317	30.6%	350	39.6%	298	32.2%	314	27.8%	327
CONTINUING FRESHMEN	50.0%	54	42.9%	28	57.6%	33	60.8%	51	52.8%	36
SOPHOMORES	54.7%	75	38.0%	79	65.5%	55	46.3%	67	49.4%	79
JUNIORS	36.8%	57	50.0%	66	57.4%	61	53.4%	73	35.2%	54
SENIORS	30.4%	23	34.8%	23	45.8%	24	42.5%	40	27.9%	43
TOTAL	30.8%	526	34.8%	546	46.5%	471	40.2%	545	33.4%	539

Table 5. DFW Rates for CHEM 1311 Fall 2003-2007

Since its inception, UT Dallas has based its mission on preparing students for careers in science, technology, and business; to do so successfully, the university must provide an excellent foundation in the math and science skills required of those disciplines. In examining the data from the Office of Undergraduate Education, the QEP Council solidified its decision to build UT Dallas' QEP around improving gateway courses. Career preparation in fields such as engineering, physics, and biology entails completing a highly stratified curriculum, and the content from gateway classes serves as the basic building blocks upon which the course of study is constructed. Difficulties in gateway courses reverberate throughout a student's career and can force some students to extend their college education while others rethink their career aspirations. These difficulties also create ramifications for the university at large, from altering retention and graduation rates to intensifying academic advising to manage the migration of students from one discipline to another.

6. GEMS: Gateways to Excellence in Math and Science

Based on the aforementioned data, the QEP Council decided to focus UT Dallas' QEP on improving instruction and learning in mathematics and science by providing students with innovative, intensive, and active learning experiences both inside and outside the classroom in order to improve success, retention, and persistence in gateway math and science courses. Accordingly, the QEP Council adopted the following vision statement, mission statement, and goals to guide the creation of GEMS:

6.1 Vision Statement

To achieve excellence in student performance and high levels of engagement in math and science gateway courses and dependent degree tracks at UT Dallas.

6.2 Mission Statement

The mission of GEMS is to provide students with innovative, intensive, and effective learning opportunities that ensure the opportunities for academic success and that enhance the quality of student learning in math and science gateway courses.

6.3 Goals

- Improved student performance in calculus and applied calculus course sequences
- Improved student performance in the general chemistry course sequence
- Increased opportunities for student engagement in introductory math and science courses
- Improved success of students in higher-level courses that depend upon general chemistry and calculus as pre-requisites
- Improved integration and assessment of innovative teaching strategies in math and science courses

To achieve these goals and to fulfill this mission, course design and curriculum alignment of key gateway courses in math and science are the cornerstones of GEMS. These elements will facilitate improved and more relevant class content. To ensure improved student learning in these courses, GEMS will use a series of distinct yet integrated strategies, including peer instruction, computer-aided learning, inquiry-based learning, engaged faculty in undergraduate education, preparation and advising of transfer students, faculty development, and innovative instruction of large enrollment courses to provide a more diverse array of course mastery opportunities and increase the likelihood of student success. In the assessment of progress toward the GEMS objectives, GEMS will generate both quantitative data on student learning and qualitative, reflective information concerning the undergraduate student learning experience and outcomes.

The relationships between the various GEMS initiatives can be symbolized using a "logic bridge" (Figure 1). As detailed by Dr. Barbara Jones in her workshops on QEP development and assessment, a logic bridge effectively illustrates the design of a QEP project, beginning with the identification of the problems to be addressed and progressing to the improvements that will result once the QEP has been implemented. GEMS begins by assessing the academic strengths and weaknesses of individual students in order to ensure that each student is placed on the path that best serves his or her needs. In the figure below, the path across, or bridge over, the successively higher buildings represents the courses students must traverse. In implementing GEMS, new courses will be created and existing gateway courses in math and science will be redesigned to improve this path or bridge. These courses, symbolized below as buildings in the logic bridge, serve to align the "course path" to ensure a connected route from start to finish. As individual students progress towards graduation and success, specific GEMS initiatives, such as those shown connected to the student through arrows below, will facilitate the crossing of the "bridge." These initiatives include new resources to enhance classroom content and the creation of a sustainable knowledge base for instructional innovation. Each component is described in detail in the following sections.

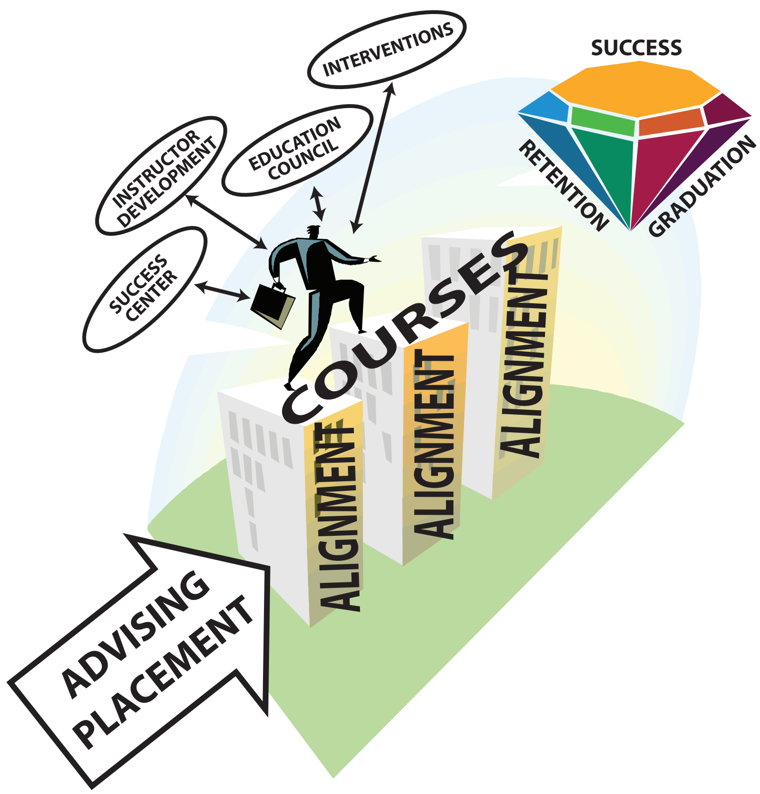

Figure 2. A Logic Bridge Depicting the Relationships among the Various Components of GEMS

7. GEMS Initiatives

7.1 Math and Science Education Council

As part of the implementation of GEMS, a standing Math and Science Education Council will be established to facilitate dialogue among stakeholders sharing common needs in mathematics and science education. The council will include representation from faculty, students, community colleges, high schools, and the corporate community. It will monitor data on student progress in STEM courses and programs, investigate promising developments in math and science education, and make recommendations concerning new programs and pedagogies that can contribute to building a robust arsenal of strategies for ongoing improvement in STEM education at UT Dallas.

The following individuals have been asked to serve on the Council:

- Rhonda Blackburn—assistant provost for educational enhancement
- Cy Cantrell—associate dean, Engineering & Computer Science
- Mary Chaffin—senior lecturer, School of Management
- Michael Coleman—dean, Undergraduate Education
- Mieczyslaw Dabkowski—assistant professor, Mathematical Sciences Department
- Gregg Dieckmann—associate professor, Chemistry Department
- Matthew Goeckner—associate professor, Engineering Computer Science
- Bob Hilborn—program head, Math and Science Education Department
- Ali Hooshyar—program head, Mathematical Sciences Department
- Joe Izen—professor, Physics Department
- Cynthia Jenkins—director of undergraduate advising
- Michael Kilgard—associate professor, School of Behavioral and Brain Sciences
- Abby Kratz—assistant provost; co-director, QEP
- Murray Leaf—professor, speaker of the Academic Senate
- David Lewis—senior lecturer, Mathematical Sciences Department
- Mike Panahi—UT Dallas math lab coordinator
- Torrence Robinson—manager, Texas Instruments DSP University Program
- Donna Rogers—dean of students
- John Sibert—associate professor, chemistry; co-director, QEP
- Tommy Thompson—Dallas County Community College District
- Li Zhang—program head, Biology Department
- Director of the GEMS Success Center
- Richardson School District—Math or AP chemistry coordinator
- Plano School District—Math or AP chemistry coordinator
- Student leader in calculus
- Student leader in chemistry

The high school and community college representation will link UT Dallas' curriculum to the community and provide insight on the preparation of traditional and transfer students. The high school and community college representatives, in turn, will better understand the expectations and learning environments that exist at UT Dallas and at institutions of higher education in general. The corporate membership will link the UT Dallas curriculum to the workplace and provide a reliable, ongoing resource for information regarding the skills and knowledge young professionals are expected to bring to their first jobs. Dr. Robert Hilborn, the newly hired chair of the Department of Math and Science Education and a nationally recognized expert in science education, will chair the council.

The council will request, receive, and act on student learning and engagement data, including teaching evaluations in GEMS courses, from the GEMS assessment team which will be comprised of the co-directors of the QEP (Dr. Abby Kratz and Dr. John Sibert), chair of the Math and Science Education Council (Dr. Robert Hilborn), the director of the GEMS Success Center, the data analyst in the Success Center, and the assistant provost for educational enhancement (Dr. Rhonda Blackburn). The council will also monitor the progress of the GEMS initiatives and make periodic reports to the Office of the Provost and to the Academic Senate. Using AT6, UT Dallas' web-based assessment tool, based upon the input of the council, the GEMS assessment team will input and update GEMS' objectives, the measures that will be used to assess those objectives, the findings based on those measurements, the actions planned to improve its operations, and an analysis of the process. These data will serve as the basis of the council's annual GEMS report that will include summary data for the previous year and recommendations for the coming year.

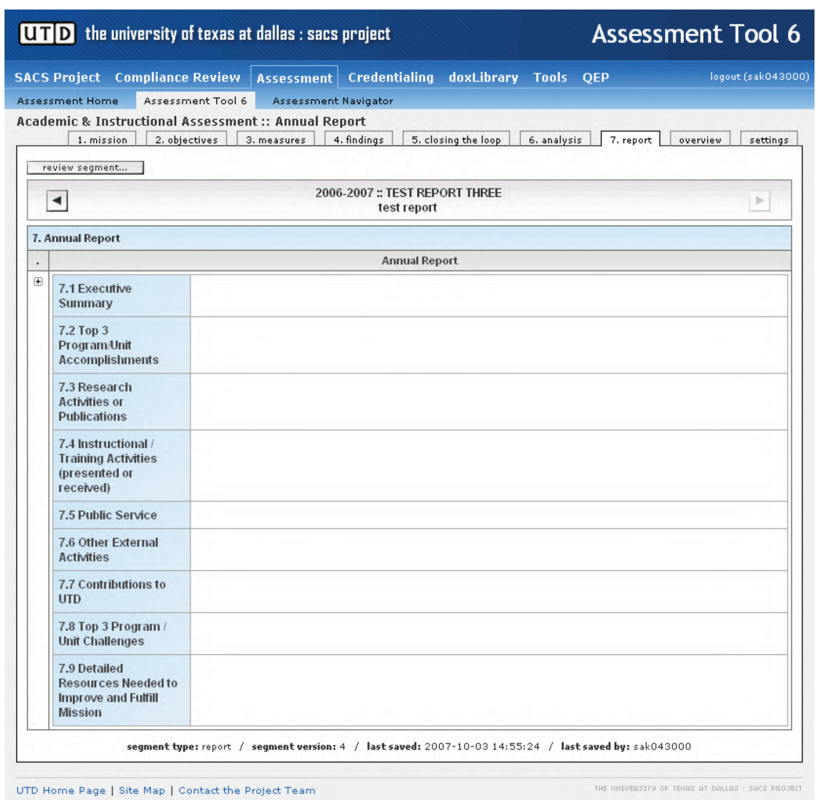

Figure 3. UT Dallas' Web-based Assessment Tool, AT6

In addition to working with the GEMS assessment team, the council will also work closely with personnel in the Office of Undergraduate Education and the Office of Strategic Planning and Analysis to use data generated in those offices to learn more about UT Dallas students, their varied academic backgrounds, and their progress toward degrees. In doing so, the council will address key questions that relate to student performance and engagement in math and science courses such as: Why are there differences among student satisfaction among various sections of the same course? What are good measures for placement of students in the proper courses? Can we identify at-risk groups and individuals early and provide the appropriate interventions to ensure every opportunity for success? What are appropriate interventions? What is working in the current plan and what is not? Do the GEMS initiatives and/or assessments need to be modified? The council will evolve as GEMS evolves to maintain relevancy with future student populations, the ever-changing university environment, and instructional innovation. They will provide an authoritative voice for the communication of GEMS progress to the greater campus community.

Beyond assessing the progress of GEMS and of student learning in gateway calculus and general chemistry courses, the council will sponsor a distinguished speaker seminar series discussed below in the section on faculty development. This series will promote innovative ideas for mathematics and science instruction, including those based on effective use of technology and on implications from emerging research on learning in science and mathematics such as computer-aided learning, inquiry-based learning, experiential learning, and peer instruction Additionally, the council will coordinate a Teaching Innovation Grants program (also discussed below in the section on faculty development) that will provide incentives to improve the learning in their classrooms. Finally, the council will identify and promote excellence in mathematics and science instruction by serving as an advisory board to the GEMS Success Center that will be established for GEMS. In this capacity the council will work with the director of the center to identify and promote innovations that can be tested and implemented within the context of the center to support the achievement of excellence in mathematics and science instruction and learning.

7.2 Pre-Testing and Tutorials

As noted in previous sections, the proper placement of students in foundation courses is crucial to retention, persistence, success in gateway courses as well as the subsequent courses that build upon the knowledge and skills learned in the gateway courses. Previously, at UT Dallas, students have been placed in gateway courses such as calculus courses solely based upon SAT scores or transcripts (or other such documents) that showed that prerequisite courses have been successfully completed. Such placement, especially placement of persons who have not completed the prerequisite courses at UT Dallas, can be very problematic because of, for example, the lack of curriculum alignment. Moreover, even completing UT Dallas' pre-calculus (as shown in the data from the Office of Undergraduate Education) does not guarantee success in UT Dallas' gateway calculus courses. One of the major initiatives—or perhaps better put, interventions—in GEMS will be the introduction of ALEKS, a tool that can be used as pre-testing instrument to determine students' mastery of the knowledge and skills necessary to be successful in UT Dallas' calculus courses. Currently, ALEKS is limited to mathematics—a new version that will work with general chemistry courses is in a beta version and will be adopted at UT Dallas once it has been fully developed.

ALEKS is a web-based, artificially intelligent assessment and learning system that will be used to identify better student proficiency in specific pre-calculus skills, thereby allowing more appropriate course placement of incoming freshman and transfer students. Experience at other universities, including the University of Illinois, indicates that ALEKS can be an effective diagnostic tool for course placement and for determining student math deficiencies. ALEKS also contains tutorial functions that, in turn, can remedy those deficiencies. As an important GEMS related improvement in student learning, if the assessment indicates a lack of proficiency in a predetermined set of skills, the computer-based remediation component will be used to bring the skills flagged as deficient up to par. The assessment and tutorial components of ALEKS will take advantage of resources in the GEMS Success Center (discussed below) while running concurrently with the course. The tutorial component will also be useful for students in chemistry courses who need help with basic algebraic functions inherent within chemistry education.

Based on each student's performance, ALEKS generates a histogram that contains information regarding the student's mastery of techniques in solving polynomial equations, trigonometric equations, etc. The results are available immediately upon completion of the test. After completing the test, each student is offered a specific path of instruction through a sequence of problems of varying difficulty that addresses deficiencies in the student's mathematical background. ALEKS will prove useful not only for analyzing data at an individual student level but also for creating profiles of entire student populations. These profiles will be used both by the Math and Science Educational Council as it assesses student success and creates effective measures of that success and by those who will be involved in curriculum alignment and course design.

In spring 2008, ALEKS is being administered in a pilot study to one section each of Applied Calculus I (MATH 1325), Pre-calculus (MATH 2312), and Calculus I (MATH 2417). The pilot study is designed to fine tune the implementation of ALEKS and determine its effectiveness in influencing the subsequent recommendation of courses tailored to each student's background. ALEKS scores will be used as follows:

- At the end of the semester student grades will be reviewed to see if ALEKS is an accurate predictor of student success in these courses so that it could be used as a future advising tool to help place students in proper courses, commensurate with their math background and abilities.
- ALEKS scores in the various areas of math skills needed for success in gateway courses will be studied in relation to importance and success in other math dependent courses. Of course, these scores will be different for MATH 1325, 2312, and 2417. Therefore, the pilot study will need to devise an appropriate scoring system.
- Students will be encouraged to volunteer to enroll in the tutorial component of ALEKS and make use of that training, and their performance at the end of semester will be compared to their counterparts in other sections.
- Based on the ALEKS pilot study, UT Dallas will determine the sub-areas of

students' mathematical backgrounds that are shown to have the strongest correlation with student success in MATH 1325 and MATH 2417. This knowledge will provide guidance for the design of appropriate "fallback courses" that address the weaknesses of students with low ALEKS scores.

- Identification of students with algebra deficiencies through ALEKS will be used for "just-in-time" help with the algebra intensive components within chemistry courses.

7.3 Curriculum Alignment and Course Design

Curriculum alignment provides an efficient and effective sequencing of courses and learning objectives that allow students to gain knowledge in relevant and coherent ways. This relevance is particularly important for gateway courses. In implementing GEMS, UT Dallas plans to employ a "concept-mapping" model that was developed by Matt Goeckner, associate professor of electrical engineering, and has already been used successfully to align the engineering curriculum in the School of Engineering and Computer Science (ECS). The model will serve as a framework to align the content of the gateway courses in math and chemistry and to integrate those courses with other STEM dependent courses inside and outside the School of Natural Sciences and Mathematics (NSM) to ensure that students are equipped with the skills and knowledge required to be successful not only in these courses and their degree programs but also in their careers.

Goeckner's model is rooted in an understanding of how people learn and how creative individuals develop new ideas. As will be seen below, the model allows faculty to control the learning environment. Most importantly, the output of this alignment process makes education transparent to both faculty and students; linkages between courses and fundamental concepts are clearly delineated and displayed for all to see.

Since curriculum alignment will dictate and support content in the existing and new course designs, the alignment process will be among the most important tasks in the implementation of GEMS, and therefore among the first tasks undertaken. One of the more exciting aspects of this effort will be the cross-departmental and campus-wide conversations that will naturally be generated.

Some of these conversations have already begun. Faculty from engineering to computer science to business to the natural sciences are and will continue to be engaged in dialogue about student learning objectives in key gateway courses with an understanding that the acquisition, use, and ownership of fundamental information requires a "contract" between gateway and downstream courses. The process and the conversations are necessarily multi-dimensional, for the gateway courses provide the basic language, concepts, and skill sets for success in STEM dependent degree programs, while the downstream courses "reach back" to continue to reinforce the value of the foundational, gateway courses.

7.3.1 Concept Mapping - The Goeckner Model

The first step in Goeckner's concept mapping model typically involves the sequential ordering of classes in a chain-like fashion. For an entire degree program, this sequence reflects the order in which topics and courses need to be taught. Because GEMS focuses on the structure and content of gateway chemistry and calculus courses, this step will be quickly accomplished since, as foundational courses, these courses are necessarily placed early in the sequence. While the purpose of this exercise is to ensure that appropriate content and educational priorities are placed in key gateway math and chemistry courses, an added benefit will be the development of unique insights into a number of downstream chemistry and/or math dependent courses as to how and when content in the gateway courses is used.

The second step in concept mapping requires that faculty identify the fundamental concepts that are taught in their downstream undergraduate courses that list general chemistry and/or calculus as prerequisites. The third step asks the faculty to identify fundamental concepts in the prerequisite chemistry and/or calculus classes that are used (or applied) in their downstream undergraduate courses. This process will include, for example, the calculus faculty "reaching back" to algebra, trigonometry, and pre-calculus prerequisites. All of this information, coupled with student input in the form of end-of-class evaluations and interviews, is combined into a "fundamentals concept chart," the tangible product that clearly demonstrates what and where fundamental information is taught and subsequently used during the course of a student finishing a degree plan.

As new and redesigned courses are adopted into degree programs, needed modifications at the course level will be reconciled with the "fundamentals concept chart" to ensure course content remains relevant while allowing for quick determination of how change might affect downstream courses individually and as a whole. An abstract of an article on the Goeckner Model prepared for the journal *Advances in Engineering Education* is presented in the appendices.

In UT Dallas' electrical engineering department, concept mapping has resulted in the movement of topics within and between courses, rewording of topics to highlight linkages, identification of unnecessary overlap between courses, changes in listed prerequisites, and even reevaluation of the course sequence within a degree track. One of the benefits of concept mapping for engineering students has been the reduction of time to graduation by one semester. A more fundamental benefit is that concept mapping helps students be able to see (a) what exactly they are expected to be learning, (b) how topics are linked, and (c) why they are taking the classes they are taking at each point of their enrollment at UT Dallas.

Beginning in the spring semester of 2008, faculty representatives of stakeholder departments will meet with math and chemistry department faculty under the guidance of Matt Goeckner and faculty from the Department of Math and Science Education to begin the process of concept mapping which will be particularly important for aligning the aforementioned precalculus course (MATH 2312) with the calculus sequence and other courses. It is critical that the content mapping process be started early as the output will impact existing course redesign and the content and format of new courses.

7.3.2 Course Design and Redesign

The outcomes of the ALEKS pilot study and curriculum alignment discussions will have a determining influence upon the decisions that will subsequently be made concerning the content and format of new courses and the redesign of existing courses as GEMS is fully implemented. The following discussion, therefore, is somewhat tentative, though it remains based upon the QEP Council and faculty consideration of the data collected by UT Dallas' Office of Undergraduate Education.

The gateway calculus and general chemistry courses are among the most demanding gateway courses at UT Dallas, as they are at most institutions of higher education. These courses are large enrollment courses that provide a common educational foundation for a range of STEM related degree programs. As demonstrated in the previous tables, the data amassed by the Office of Undergraduate Education consistently have demonstrated a high percentage of troubling student performance in these courses. The reasons are complex and certainly not unique to this institution. With its curricular focus on gateway courses in math and chemistry, GEMS should yield results that will be of considerable interest to the higher education community in general while also serving as a local model for developing strategies to improve student learning and engagement across the campus.

The new course offerings proposed below as part of the implementation of GEMS will give UT Dallas students increased opportunities for success in a range of STEM related, math and chemistry dependent degree programs through the delivery of course content in a manner suitable to individual student's background experience and knowledge base. This intervention initiative, in context course design and redesign, will include changes in course delivery and course content in order to facilitate mastery of student learning objectives and/or increase student engagement.

7.3.2.1 Mathematics

UT Dallas currently offers two calculus sequences: MATH 2417/2419 for engineering, computer science, and physical/life science majors and MATH 1325/1326, Applied Calculus, for students pursuing degrees in the School of Management. While both sets of courses will be examined as part of GEMS, the MATH 2417/2419 sequence has been identified as consistently problematic for a significant population of UT Dallas' students and will receive particular attention.

UT Dallas is unique in offering only a single calculus sequence for all degree programs outside of business. In the early 1990s when freshmen were first accepted into the university, the majority view of the faculty who taught math-intensive disciplines was that their students needed learn some multivariable calculus and that the total semester credit hours for a required calculus sequence should be less than nine. This decision led to the adoption of a two-semester, eight semester credit hour "accelerated" calculus sequence (MATH 2417/2419) as the standard—and only—offering for the sciences. The sequence has remained in place to this day. By comparison, a traditional three-semester calculus sequence taught at many universities covers univariate calculus in the first two semesters and multivariate calculus in the final semester for a total of 9-12 credit hours.

UT Dallas is not alone in offering an accelerated calculus sequence, but it is unusual for the accelerated sequence to be the only calculus option available. Recognizing that UT Dallas has a diverse student body with a wide range of basic math skills and that many of the students simply do not have the incoming math proficiency and study skills to handle an accelerated calculus course, UT Dallas plans to introduce a regular-paced calculus sequence as one of the most significant early GEMS interventions. Using the Texas common course numbering system, the new calculus courses will be MATH 2413, 2414, and 2415. The first two semesters of the sequence will cover mostly univariate calculus and the third semester will cover multivariate calculus. The sequence can be labeled as a "slower-paced" calculus sequence only if it is being compared to UT Dallas' present "accelerated" calculus sequence (MATH 2417 and 2419). In reality, the proposed three-semester calculus sequence is more akin to the standard traditional calculus sequence taught at most well-known universities, such as The University of Texas at Austin (UT Austin) and the University of Illinois.

The preliminary course descriptions that have been prepared by the math department for the new three-semester calculus sequence are listed below with each of the courses currently assigned four semester credit hours for a total of twelve. It should be noted, however, that one could conceivably cover the material in the MATH 2417/2419 sequence in a nine credit hour, three-semester sequence as UT Austin currently does with its M408K/M408L/M408M sequence.

Another alternative under consideration is linking MATH 2413 with MATH 2417 such that students can drop down into the slower paced MATH 2413 from MATH 2417 within the semester if early indications suggest that they are overmatched. Rice University uses these types of "layered" calculus courses to allow for the natural "settling" of students into an appropriate calculus sequence by initially asking them to start in a calculus sequence that the student feels would be the most challenging. Such an approach would necessitate that both MATH 2413 and MATH 2417 be four credit hour courses for a smooth transition. However, the remaining two courses in the sequence, MATH 2414 and MATH 2415 could remain three credit hour offerings.

The final decision will rest with the faculty in the math department, the Committee on Core Curriculum, and the Academic Senate, but will not be decided without taking into consideration the findings resulting from Goeckner's Concept Modeling. The aforementioned alignment process in the spring semester of 2008 will facilitate the necessary conversations among the various stakeholders across STEM dependent disciplines. Conclusions reached through these discussions, coupled with data from ALEKS, will be used to reach a consensus on the total coverage of the new three semester calculus courses and the corresponding credit hours.

The following tentative course descriptions demonstrate the proposed changes to align and improve the math curriculum:

<u>MATH 2413 Differential Calculus</u> (4 semester hours)
Course covers topics in differential calculus of functions of one variable; topics

include limits, continuity, derivative, chain rule, implicit differentiation, mean value theorem, maxima and minima, curve sketching, derivatives of inverse trigonometric functions, antiderivative, substitution method, and applications. Three lecture hours and two discussion hours (MATH 2013) a week. Credit given for only one of MATH 1325, MATH 2413, or MATH 2417.

Prerequisite: A SAT II Mathematics Level IC Test score of at least 600, or two years of high school algebra, one year of high school geometry, trigonometry, pre-calculus or MATH 2312 with a grade of at least C-.

Co-requisite: MATH 2013.

<u>MATH 2414 Integral Calculus</u> (4 semester hours)
Course covers topics in integral calculus, sequences, and series. Topics include the fundamental theorem of calculus, methods of integration, improper integrals, and applications. Sequences, series convergence tests, power series. Introduction to the multivariable calculus, partial differentiation, double and iterated integrals. Three lecture hours and two discussion hours (MATH 2014) a week. Credit given for only one of MATH 1326 or MATH 2414.

Prerequisite: A grade of C- or better in either MATH 2417 or in MATH 2413 or equivalent.

Co-requisite: MATH 2014.

<u>MATH 2415 Calculus of Several Variables</u> (4 semester hours)
The course covers differential and integral calculus of functions of several variables. Topics include vector valued and scalar functions, partial derivatives, directional derivatives, chain rule, Lagrange multipliers, multiple integrals, change of variables in double and triple integrals. Three lecture hours and two discussion hours (MATH 2015) a week. Credit given for only one of MATH 2415 or MATH 2419.

Prerequisite: A grade of C- or better in MATH 2414 or equivalent.

Co-requisite: MATH 2015.

In addition to designing a new calculus sequence, GEMS will focus on lower level math courses to prepare students better for success in either calculus track. For example, a new course in trigonometry (MATH 1316) will be introduced to enable greater success in pre-calculus and calculus courses. Based on the results of the alignment and placement interventions within GEMS, the curriculum may also be modified by requiring students to have both MATH 1316 Trigonometry and MATH 1314 College Algebra as prerequisites to MATH 2312 Pre-calculus. This intervention would allow the needed redesign of MATH 2312 to include coverage of additional topics to better prepare students for calculus.

7.3.2.2 CHEM 1311 General Chemistry I

Using a coordinated effort that involves interventions in the beginning general chemistry lecture course and a complete redesign of the laboratory co-requisite (CHEM 1111), GEMS will focus on improving student performance, engagement, persistence, and retention in CHEM 1311 General Chemistry I. The goal of these interventions extends beyond improving student learning in General Chemistry

I; these interventions will be the testing grounds for ultimately providing a general framework for success in large enrollment science courses. As such, many of the results of the GEMS initiatives with CHEM 1311 will dictate course structure and student learning environments for CHEM 1312 General Chemistry II and the downstream Organic Chemistry I and II courses while serving as a model for introductory science courses outside of the chemistry department.

Currently a single two-semester general chemistry sequence is the only option available to UT Dallas students. The course is traditional in terms of content and structure. Lectures meet three times weekly for fifty minutes with optional help sessions outside of class. The exams are common across sections with the final exam being the American Chemical Society standardized exam. The course moves quickly and covers a great deal of material. Class sizes have grown dramatically in the past eight years and now typically exceed 150 students per section. In the current format, the varied math and science backgrounds of the students, individual student motivations and anxieties, and the impersonal nature of the auditorium environment challenge the discipline of the average learner to reach his or her potential in terms of knowledge gained and appreciation for the relevance of course content. This combination contributes to poor performance on graded work and a disconnected attitude toward the course.

The GEMS approach to improving student performance and engagement in General Chemistry I involves, initially, the reexamination of content of the course (concept mapping and curriculum alignment) followed by the use of two key interventions outside the classroom discussed below in the sections regarding the GEMS Success Center and Peer to Peer Learning as well as the restructuring of the laboratory experience so that the students' experiences in the laboratory more directly enhance the learning in the lecture.

7.3.2.3 CHEM 1111 General Chemistry I Laboratory

One of the challenges any science curriculum faces is the reconciliation of the natural interest and curiosity of students with the academic regimen necessary to show proficiency in a particular subject matter. The laboratory represents a significant opportunity to synergistically produce just such a reconciliation.

At the present time, prior to the implementation of GEMS, the structure for class-related chemistry labs is traditional—students spend one three-hour period in lab and a one-hour period per week in an orientation session. The lab experiments are appropriate for their content but are "cookbook" type exercises that seldom engage the student. This lack of student engagement becomes obvious when one interviews a General Chemistry I laboratory class (CHEM 1111) at the end of the semester. Additionally, in some cases, lab experiments are taught out of sequence with the classroom lecture, causing frustration for both the students and the teaching assistants.

As currently configured, CHEM 1111 represents a missed opportunity to provide interesting, relevant lab experiences in a collaborative learning environment. The proposed redesign focuses not only on the lab experiment content but also on how the informal lab environment can be used to foster discussions about key ideas in both laboratory and lecture.

New lab experiments will be chosen to support the key fundamental concepts identified in the concept mapping and alignment process for CHEM 1311 General Chemistry. Particular attention will be paid to identifying experiments that allow for variation in procedure and outcome to keep the students engaged in their work. Pre- and post- lab discussion time will also be allocated for collaborative learning opportunities that will help link the laboratory to the lecture.

The first thirty minutes of lab will involve groups of four students working on scripted questions that the students have not seen prior to the laboratory period. These questions will be used to reinforce concepts or calculations associated with the lab and lecture. In this exercise, the teaching assistant (TA) will become a facilitator for the students rather than a source of answers. This thirty-minute preamble to the experimental time will allow students to learn from one another and to prepare them better for the upcoming experiment. Once the experiment is complete, the students will again work in small groups to discuss the results of the experiment and its implications to their understanding of lecture content. The discussion will be facilitated through the use of scripted post-lab questions (similar to those used to stimulate the pre-lab discussion). Both the pre- and post- lab questions will be turned in each week as part of the lab reports. The lab redesign will take place over the 2008-09 academic year with implementation planned for fall 2009.

7.4 The GEMS Success Center

To house and showcase many of the GEMS initiatives designed to improve success, persistence, and retention in gateway math and science courses, UT Dallas will create a GEMS Success Center that will be designed to serve as an extension of the classroom or laboratory and will be used to facilitate a wide range of learning activity from remediation to current class content to self-paced advanced topics. Most importantly, it will provide a highly visible space and energetic environment where the shift from a passive classroom lecture experience to one of active student participation can be accomplished.

The learning of math and science can be viewed as a “contact sport.” To succeed students need contact with the material, contact with instructors, and contact with each other. They need to develop an understanding of concepts and acquire skill sets by doing math and science, not by listening to how it is done. Each of the components within the GEMS Success Center is designed to nurture this active, “learning by doing” approach. The center will contain two group learning rooms where supplemental instruction classes and smaller peer-led “GEMS-PLTL” workshop sessions based on the Peer-Led Team Learning (PLTL) model can be conducted. Two unassigned offices will provide space where instructors, TAs, and faculty will be able to provide walk-in assistance. The center will house computer facilities where course relevant software, online content and tutorials, “dry” labs, and emporium-style online learning opportunities will be made available. Approximately 50 student workstations will be configured so that shared desk space will be positioned between neighboring computers for one-on-one peer instruction, collaboration, and small group work. These resources will also present faculty with opportunities to test and become familiar with various new instructional methods such as computer-aided learning, ranging from course supplements to full emporium-style classes.

The GEMS Success Center will be situated inside the university's Conference Center building, conveniently located between student housing and the Engineering/Computer Science complex. A map of the location is provided in the appendices. In addition to having sufficient space to accommodate the Success Center, the Conference Center contains large classroom space and an auditorium that can be used for large Supplemental Instruction sessions, exam reviews, seminars, and public programs. The expected hours of operation for the GEMS Success Center will match the hours that the library is open: Monday-Thursday, 8 a.m. until 2 a.m.; Friday, 8 a.m. until midnight; Saturday, 9 a.m. until 8 p.m.; and Sunday, 1 p.m. until 2 a.m.

The GEMS Success Center will complement the Science/Engineering Project-Based Learning Facility, being developed by Nobel Laureate and UT Dallas physics professor Russell Hulse. The Hulse facility will create a campus focal point for math and science education and community outreach featuring project-based learning initiatives for undergraduate students and K-12 audiences. Among a variety of activities designed to engage students outside the classroom, the facility will provide technical resources to support projects such as Lego Robotics and will link the university to the Dallas Museum of Science and Nature through exhibits designed by UT Dallas students and a rotating display of Museum exhibits on the UT Dallas campus.

The GEMS Success Center staff will be headed by a director who will serve on the Math and Science Education Council and who will play a key role in initiating opportunities for instructors to learn more about instructional strategies and resources. The director will administer the programs associated with the Success Center, respond to recommendations from the faculty and the Math and Science Education Council, and work with faculty and research staff to design and conduct studies of the effects of GEMS initiatives on student learning. The director will head the GEMS assessment team and will work closely with the Office of Educational Enhancement to ensure the success of GEMS and to measure the effectiveness of the various GEMS interventions. The director will supervise a staff that will include an administrative assistant, a statistician, a technician, and a group of peer leaders, who will serve as GEMS-PLTL Leaders. As discussed below, these GEMS-PLTL Leaders will work directly with math and science faculty to structure learning activities that will lead to student success in STEM coursework.

7.4.1 Computer-Aided Learning

The creation of the GEMS Success Center will dramatically increase the number of computers available to students in a controlled learning environment that includes onsite math and science instructional personnel. As a result, instructors will be able to engage more students than is currently possible at UT Dallas via technology and will be able to involve them in significant, innovative learning activities. In addition to targeted, faculty-developed assignments, access to dedicated software and online resources will allow students to supplement their understanding of course content and develop skill mastery through self-paced exercises. Faculty teaching gateway math and science courses will be encouraged to create innovative assignments that will utilize the computer facilities, and the GEMS-PLTL Leaders will be available to help with those assignments as well as with other computer-aided learning and testing activities such as the "Foundation Quizzes" discussed below.

7.4.2 Foundation Quizzes

As one of the interventions to improve success in CHEM 1311 General Chemistry I, the chemistry faculty plans to use the computing facility in the GEMS Success Center as a testing center for weekly quizzes. Beginning in fall 2008, General Chemistry I students will be given computer-based "Foundation Quizzes" in a trial study aimed to teach content, assess knowledge, and encourage regular attendance and homework practice.

Constraining the quizzes to the GEMS Success Center will ensure that each student is doing his or her own work and that students quickly become familiar with the Success Center. The quizzes will be initially accessed through WebCT, a server-based software system that has quizzing and grading capabilities. The quizzes will become available on the Thursday of each week with a closing time the following Monday. Students will be allowed to retake the quiz multiple times with only their best score being recorded. As an overall component to the final semester grade, these quizzes will count no more than 15%, the current course standard for traditional in-class quizzes. Studies have shown that these types of assignments promote a constant, rather than sporadic, study effort from students while providing instantaneous feedback on their understanding of the quiz material.

"Foundation Quizzes" take their name from their power to reinforce fundamental components of a course. Quiz content can reach back to earlier material to reinforce its significance and maintain its application in the more advanced current content topics. Key concepts in current content can also be the subject matter of foundation quizzes. In addition, these quizzes can be used to remediate math skills from manipulation of log functions to the graphical representation of data to basic algebra skills. Poor performance in basic algebraic functions on these quizzes can be corrected with the aforementioned tutorials in ALEKS.

Students will be able to take the quizzes and receive the immediate feedback multiple times until they feel they have mastered the concepts. The quiz questions, but not the concepts, will change each time a particular weekly quiz is taken. Studies in calculus have shown that students will retake quizzes multiple times thereby taking ownership of the subject matter, even if their initial score is passing, because they have the opportunity to obtain a higher grade. Thus, the quizzes become a learning tool and not simply a static assessment of student knowledge.

7.5 Supplemental and GEMS-PLTL Instruction

The GEMS Success Center will be the principle site for conducting supplemental instruction (SI) and peer-led, small group learning sessions known as GEMS-PLTL Workshops. These structured learning activities have been applied with considerable success in other institutions and have been extensively documented in the professional literature on innovation in higher education (Arendale 1997; Congos 2005; Drewniany 2006; Gosser 1998; Kenney 1994; Martin 1993; Maxwell 1998; Tribe 2007). They represent significant out-of-class interventions that GEMS will employ to encourage active, collaborative learning.

A core value of SI and PLTL programs is that they are designed to help all students in a class master the content and to stimulate the development of learning and study strategies, rather than just fostering improved performance by students who might be identified as "at risk." The concentration on collaborative learning to enable strategy building and conceptual mastery in all students makes these interventions particularly suitable for implementation in GEMS. The activities implemented at UT Dallas will be adapted for GEMS from models for SI and Peer-Led Team Learning (PLTL) developed in other universities.

7.5.1 Supplemental Instruction (SI)

The first Supplemental Instruction program was developed to provide academic assistance and improve retention in the medical school at the University of Missouri - Kansas City in 1973. It was designated as an Exemplary Educational Program by the U.S. Department of Education in 1981, and dissemination of the program was supported with federal funding from the National Diffusion Network for several years until the network was disbanded in 1996. The program has been adopted by hundreds of institutions of higher education, including UT Dallas (Arendale, 1997).

According to the International Center for Supplemental Instruction, the aims of SI are: (1) to increase retention within targeted historically difficult courses; (2) to improve student grades in targeted historically difficult courses; and (3) to increase the graduation rates of students (http://www.umkc.edu/cad/SI/). No stigma is attached to participation because historically difficult courses, rather than high-risk students, are targeted.

SI leaders are students, and sometimes instructional staff members, who have demonstrated a high level of achievement in the targeted courses, have been approved by the course instructor, and have received training in proactive learning and study strategies.

Under the leadership of Mary Kay Adams, director of learning services, UT Dallas has offered Supplemental Instruction for students in a small number of historically difficult courses since 1996. The sessions have covered courses in the natural and social sciences, but mathematics was not included among the SI supported courses until summer 2007. Semesterly reports compiled since fall 2003 demonstrate a pattern of higher grades and higher retention among students who participate in SI. Table 6 demonstrates the positive effects of the SI program on student performance and DFW rates.

CLASS	Supplemental Instruction # Contacts	Group	Gr Ave	Ds	Fs	Ws	DFW%	No Supplemental Instruction Group	Gr Ave	Ds	Fs	Ws	DFW%
BA 3341	101	49	2.55	8	5	1	28.0%	22	2.33	4	3	1	34.8%
BA 3341	84	39	2.56	7	1	0	20.5%	34	2.48	3	4	2	25.0%
BIO 3301	126	36	2.77	4	0	0	11.1%	46	2.31	6	6	3	30.6%
CHEM 1311	159	31	2.19	1	3	3	20.6%	29	2.10	6	3	0	31.0%
CHEM 1312	390	42	2.37	7	1	5	27.7%	12	1.90	4	0	2	42.9%
CHEM-2323	123	22	3.06	1	1	0	9.1%	7	2.04	0	1	1	25.0%
CHEM 2325	356	49	2.97	3	0	1	8.0%	10	2.23	2	0	3	38.5%
MATH 2419	131	26	2.5	5	0	1	22.2%	27	1.51	9	6	6	63.6%
PHYS 2325	59	13	2.84	2	0	1	21.4%	8	1.50	1	3	3	63.6%
PHYS 2326	37	7	2.28	1	0	0	14.3%	20	1.86	10	1	3	60.9%
PHYS 3341	90	9	3.26	0	1	0	11.1%	7	2.09	1	2	0	42.9%
SOC 3321	47	23	2.81	2	1	0	13.0%	16	3.18	1	0	0	6.3%
Totals	1703	346	2.65	41	13	12	18.4%	238	2.17	47	29	24	38.2%

Table 6. Supplemental Instruction Summer 2007

As can be seen in Table 6 and in the spreadsheet included in the appendices summarizing the results for spring 2007, the average grades of participants are consistently higher than those of non-participants; moreover, the withdrawal rates are consistently lower for participants in every semester reported except summer 2006 when withdrawal rates were nearly the same for the two groups. Typically, less than half the eligible students have taken advantage of this voluntary program. Locating the SI program for gateway calculus and general chemistry courses in the GEMS Success Center will bring more awareness to the students of this important resource, and the expansion of the SI program under GEMS will provide expanded support for students enrolled in the introductory mathematics classes as well as increased opportunities for participation by students in the natural science classes already included in the programs.

7.5.2 GEMS-PLTL Instruction

The introduction of Peer-Led Team Learning (PLTL) is a major, completely new intervention designed to improve student success, persistence, and retention in gateway calculus and general chemistry courses at UT Dallas. This highly collaborative program will be adapted for GEMS from the innovative Peer-Led Team Learning Workshop model originally developed for science education at the City University of New York in the mid 1990s. With support from the National Science Foundation (NSF), Peer-Led Team Learning has been adopted by more than 100 institutions of higher education (Arendale, 2007; Varma-Nelson, 2004). Like SI, PLTL presents an opportunity for students to build learning and study strategies and gain subject mastery through engagement with content material, peer instructors, and fellow students. However, unlike SI, PLTL is not voluntary, and the groups are limited in size, usually to fewer than ten members. Meetings are held weekly and normally are two hours long. Attendance is required.

PLTL Leaders are trained to ensure students are actively engaged with the course material and with each other. According to the official Peer-Led Team Learning webpage, PLTL Leaders facilitate learning by: "using various techniques for problem solving; offering timely assistance when a group is stuck; and providing guidance and encouragement. Workshop leaders don't dispense answers; they must know when to help, and when not to" (http://www.sci.ccny.cuny.edu/~chemwksp/). Mary Kay Adams, who, as mentioned above, trains the SI Instructors, has agreed to develop a program for training the peer leaders who will work with the student groups and the course professors participating in this GEMS intervention.

In the fall semester of 2008, UT Dallas will initiate the use of GEMS-PLTL workshops in CHEM 1311 General Chemistry I. Subsections of the class, with no more than 25 students each, will convene at the GEMS Success Center. They will then be split into smaller groups of four to five students. The GEMS-PLTL Leaders will distribute course relevant content in the form of questions, problems, and discussion points. Rather than depending on textbooks or notes, students will use each other and the GEMS-PLTL Leaders as primary resources. None of the work completed in these sessions will be turned in for a grade, and these workshop sessions will not replace traditional homework assignments. Instead, the groups will focus on developing a deeper understanding of content and problem solving skills in a non-threatening, collaborative environment. One of the great benefits of this program is its potential to create a campus-wide "Community of Scholars" where learning is a shared endeavor among peers.

7.6 Faculty Development

Ongoing programs for faculty development are important initiatives in GEMS. These programs will encompass a variety of accessible learning opportunities that will engage GEMS instructors and the entire campus community in activities where they can learn about best practices in STEM education and research regarding undergraduate students and their education.

The educators and administrators associated with GEMS will be proactive in generating and sponsoring collaborative programs. The Math and Science Education Council, the GEMS Success Center, and UT Dallas' Office of Educational Enhancement will engage in a synergistic exchange of information concerning speakers and programs that can engender and make substantive contributions to an ongoing campus dialogue on education and learning. Additionally, GEMS faculty will be afforded multiple opportunities to come together with noteworthy teachers and scholars from inside and outside the university.

7.6.1 Faculty Colloquiums

The Office of Educational Enhancement has agreed to facilitate meetings, panels, workshops, and lectures that will feature content relevant to the improvement of undergraduate education and provide opportunities to develop and hone instructional skills for face-to-face instruction and for the virtual classroom. A series of bi-weekly Friday workshops was launched by the Office of Educational Enhancement at the beginning of the spring 2008 semester. Collaborative programming for public events focused upon education and learning will be undertaken to take advantage of the mutual interests of GEMS, the Hulse Project-Based Learning initiative, and the new UT Dallas UTeach Program that is focused on the preparation of increased numbers of math and science teachers for PK-12 education.

GEMS will also sponsor a series of luncheons, two in the fall and three in the spring of each year, where faculty members recognized for their excellence in teaching will present a short introduction and commentary to stimulate open, informal discussion at the tables on a selected instructional topic.

7.6.2 Distinguished Speakers' Seminars

To develop an environment of committed faculty engagement in undergraduate education at the gateway level, the Math and Science Education Council will stimulate interest and discussion through a new seminar series focused on math and science education at the university level. Participants will share insights with distinguished speakers such as Robert Hilborn (identification of thriving math and science departments), Carl Wieman (computer-aided learning), Russell Hulse (project-based learning), Chris Rogers (Project Kaleidoscope), Mike Williams (emporium style teaching), and Uri Treisman (peer instruction; creating a community of scholars).

7.6.3 Incentive Educational Enhancement Grants

The GEMS Math and Science Education Council will have competitive funds to award to GEMS faculty and others interested in improving learning and success rates in gateway math and science courses. These funds can be used, for instance, to defray travel expenses for attendance at educational conferences and workshops. They may also be used to purchase innovative software, etc.

To facilitate the use of the information that comes from the Distinguished Speakers' Seminar program and to encourage existing faculty to invest time in modern instructional practices, the Math and Science Education Council will administer a Teaching Innovation Grants program that will provide resources and rewards to faculty for testing and/or incorporating innovative math and science instruction. The council also will facilitate the preparation and submission of relevant externally funded grant applications.

8. The Assessment of Student Engagement

The interventions outlined above as the heart of GEMS are designed to engage students more fully in the learning process so that they are successful in their coursework, especially in courses that traditionally have low persistence and retention rates. The relationship between engagement and persistence in college and university studies, as well as in degree programs, has been the topic of much educational speculation and study (Christophel 1990; Comstock 1995; Conley 2003; McCroskey 1992; Moore 1996; Oliver-Hoyo 2004; Rovner 2006; Sanders, 1990; Schneck 2007). Belief in the important, positive effect of engagement is the major premise behind the widespread use of annual NSSE surveys in institutions of higher education. In a qualitative study of student attrition in the sciences that is of particular significance for GEMS, Seymour and Hewitt (1997) sought "to identify aspects of the structure, culture, pedagogy, or other features of science, mathematics and engineering departments, schools, and colleges which encourage attrition or impede retention for the whole undergraduate population, and for important sub-sets of it" (p. 14). The investigators found that "contrary to the common assumption that most switching is caused by personal inadequacy in the face of academic challenge…a high proportion of factors cited as significant in switching decisions arose either from structural or cultural sources within institutions, or from students' concerns about their career prospects" (p. 32).

Seymour and Hewitt's research supports earlier findings of Tinto (1987) and others in reporting that students who persist in their majors credit group study, "working together to understand materials presented at speed," for their successes or, in their words, their "survival" (p. 173). In summarizing their findings, Seymour and Hewitt conclude "peer group learning…in the almost unanimous opinion of students…is so clearly and immediately effective in increasing persistence" (p. 177).

Because the interventions in GEMS rely heavily on peer group learning and because all the interventions, including faculty development, are intended to increase student engagement, among the many assessments that GEMS will undertake, GEMS will measure and assess the relationships between GEMS initiatives and three engagement factors that are understood to be integral to learning activity: (a) cognitive engagement, (b) motivational engagement, and (c) affective engagement.

8.1 Sample Surveys to Measure Student Engagement

To measure the three engagement factors above, each semester, beginning in the spring 2008 semester in order to gather the baseline data, the GEMS assessment team with the aid of a professional data analyst will administer a set of learning engagement surveys to targeted gateway courses. The purpose of administering these surveys is to assess how various students from designated treatment groups (discussed in more detail below) are impacted by the interventions in GEMS, such as curriculum alignment, GEMS-PLTL, placement via ALEKS, foundation quizzes, etc. These surveys are designed to help understand student attitudes, levels of comprehension, etc., in order to gage the depth of student engagement and changes that interventions may cause for better or for worse, and the surveys will measure student outcomes not easily captured by other sources of information.

The seven sample surveys below will be employed by the GEMS assessment team to evaluate classroom environments and student learning style preferences. These instruments have been thoroughly validated, are regularly and successfully employed by members of UT Dallas' Department of Science/Mathematics Education to improve university curricula, and have also been used in medical schools. Use of the instruments to capture data for GEMS has been approved by the UT Dallas Institutional Review Board. Copies of the full surveys are included in the appendices.

- **Relevance:** Measures the level of relevance of a topic to a student. Relevance or significance of the material has been repeatedly found to be associated with a student's motivation to study. When considered with immediacy data, relevance accounted for significant variance in student's motivation. UT Dallas seeks to minimize student concerns as they ask, "What's in it for me?"
- **Immediacy:** Measures students' perceptions about the instructor and serves as an instructor-specific measure rather than an outcome associated with individual students in order to control for effects related to teaching style that might be an intervening factor in student outcomes. The concept of immediacy as originally defined by Mehrabian (1971) is applicable to personal behaviors that determine whether one person likes or dislikes (approaches or avoids) another person. Immediacy is defined as the "perceived physical and/or psychological closeness between people" (Christophel, 1990). These behaviors may be verbal or non-verbal. Strong positive relationships exist between teacher immediacy, effectiveness, positive evaluations of teachers (Moore, et al., 1996), willingness to follow instructions (student compliance) (Kearney, et al., 1988), and enhanced learning (Comstock, et al., 1995; Kelley and Gorham, 1988; Sanders and Wiseman, 1990). Gorham (1988) reported a strong relationship between total verbal and nonverbal immediacy scores and both affective learning (attitude) and cognitive learning (knowledge) perceptions.
- **Motivated Strategies for Learning Questionnaire:** Measures how much students value a task, how well they believe they can learn and perform well on academic tasks, their general level of test anxiety, their motivation, and their specific study strategies.
- **Approaches to Learning Scale—Learning Goal Mastery:** Measures whether a student wants to master material or just get a grade, whether a student is deeply engaged, and whether a student believes he/she has the ability to succeed.
- **Epistemological Beliefs Scale:** Measures students' beliefs about knowledge—whether it is fixed or not, whether authority develops it, whether learning is quick or not, whether knowledge is simple or not, and whether people have innate abilities to learn or not.
- **College and University Classroom Environment Inventory (CUCEI):** Evaluates learning environments at the university level particularly to assess student-teacher interaction and differences in student and teacher perceptions upon the application of new methods in the classroom. Reaction to change is evaluated and clear areas for improvement are suggested (Fraser, 1992).

- **Learning Loss:** Measures student learning. This short measure is built on strong evidence that students can report accurately on their own learning in the classroom. This survey is based on the work of McCroskey and Richmond (1992) and many others into student self-performance reporting that is compared to actual measures of cognitive learning. UT Dallas uses the Learning Loss survey as a rapid measure of cognitive learning in the classroom.

By using where appropriate approaches to learning questions, involvement questions, leaning objective comprehension questions, etc., these surveys and the analysis thereof will guide the Math and Science Education Council as it seeks to improve success rates in gateway courses.

8.2 Timeline

These surveys will be administered initially in spring 2008, prior to GEMS interventions.

Each semester for the following five years, beginning fall 2008 and ending summer 2013, the GEMS assessment team will administer a full battery of surveys to students in the targeted gateway courses. The research design for this study and for the overall assessment of the implied impact of GEMS interventions on student engagement outcomes is described below.

9. Research Design and Analysis

To assess the efficacy of GEMS and its interventions, the GEMS assessment team will use an integrated quantitative and qualitative assessment approach, involving the surveys discussed above as well as comparisons of historical data collected by the Office of Undergraduate Education with similar data collected during the five year timeline laid out below. The Math and Science Education Council, the GEMS assessment team, and the Office of Undergraduate Education will work closely with instructors to gather and to analyze the data, and these data and analyses will be housed in UT Dallas' web-based assessment tool, AT6.

An applied study such as GEMS does not lend itself easily to a single evaluative design or analytic shell from which to analyze results. UT Dallas lacks environmental control to conduct actual experiments which forces the university, all too often, to resort to statistical methods to control for hypotheses that rival notions of what the outcomes mean. At the same time, the GEMS interventions do not always have clean edges that allow them to be neatly studied in separation from each other. As with much of applied research, the GEMS assessment team and the Math and Science Education Council will be far more certain that "something happened" without necessarily being able to determine fully the precise causal antecedents. UT Dallas, however, does have the advantage of having a strong historical record of student characteristics and their performance in the gateway classes under scrutiny. In addition, both the introductory calculus and general chemistry classes have a common curriculum across sections of the courses, and all sections use common quizzes and examinations.

In large part, GEMS calls for using an interrupted time-series design to study the university's efforts to enhance both the academic content and the instructional methodology used to transmit the course information. The analyses will focus on comparisons between cohorts who completed these classes historically versus those who receive the planned interventions. Variables of interest will include attendance, quiz scores, examination scores, semester grades, throughput for the two-semester course sequences, retention rates after the freshman year, migration out of science and technology majors following the freshman year, overall retention and long-term graduation rates, and performance in subsequent classes that list these gateway classes as prerequisites.

The GEMS assessment team will also conduct quasi-experiments using nonequivalent control group designs. Selecting individuals at the level of the course section, some students will receive additional academic support (treatments) such as GEMS-PLTL and SI while others have access to more traditional academic support through the Learning Resource Center. These groups will be compared on many of the variables described in the previous paragraph as well as relevant variables identified through analysis of data gathered from interviews and focus groups. Prior scholastic aptitude and prior academic accomplishments will be used as covariates to equate the groups before evaluating their academic success.

The five-year duration of the program also allows for a number of longitudinal analyses of students to determine the latency and duration of the project's effects. Many of the survey instruments designed to gauge students' approaches to learning, epistemological beliefs, and strategies for learning will be assessed over several points in time.

9.1 Identification of Treatment Groups

The treatment groups will be selected at the classroom level. The term "treatment group" refers to the groups who are subject to a particular intervention, such as GEMS-PLTL. When possible, as part of the assessment process, individual students will register for classes without knowing whether the particular class is in the treatment or control groups. In order to prevent self-selection into the treatment group after the initial implementation, it is recommended that new treatment groups be selected each semester so that, at the time of registration, students will not know whether their particular class will participate in either the tutoring or electronic enhancement treatment groups. Self-selection may occur in subsequent semesters as students involved in the treatment groups communicate their experiences with the treatment to other students. Depending on the perception of students currently enrolled in treatment groups, the perceptions of students contemplating enrollment in future semesters, and the ability of students to identify classes in which the treatment is offered, self-selection into or out of treatment groups may present problems such as biased estimates of the treatment effect.

10. Overall Assessment of GEMS Interventions

As detailed above, GEMS contains a variety of initiatives to improve students' experiences within gateway calculus and chemistry courses. Because of the importance that UT Dallas places on the success of its students, especially in STEM fields, UT Dallas has chosen to take a multi-pronged approach and will implement several of these instructional interventions simultaneously. This type of implementation will not afford the opportunity to holistically use traditional treatment research methods to determine the effects of each layer of instructional change in its courses. However, because all interventions are based on current best practices in STEM teaching, the university is confident that the additive value of the initiatives combined will allow GEMS to achieve its aforementioned goals more quickly and effectively than adding and studying each intervention one at a time.

Surveys alone will neither suffice to evaluate the effectiveness of the various initiatives within GEMS nor ensure that student learning in gateway courses improves. Instead, the assessment of the interventions must closely monitor student persistence, retention, and success in gateway courses. Therefore, the GEMS assessment team and the Math and Science Education Council will develop extensive assessment plans with multiple measures for each portion of each intervention (for example, assessing the effectiveness the foundation quizzes in CHEM 1311).

10.1 Analysis of Gateway Core Curriculum Student Learning Outcomes

The basis for these plans has already been laid in the assessment of the core curriculum (i.e., required general education courses) in UT Dallas' web-based assessment tool. MATH 2417 and MATH 2419 are core curriculum courses as is CHEM 1311. These courses have specific course objectives and at least two (usually three) measures to ensure that these course objectives are met. Each core course faculty member enters the results of his or her course assessments into an online core course assessment report, along with: (a) copies of the actual assessments used, (b) a discussion analyzing the meaning of the results, and (c) proposed future actions to be taken to improve student achievement of learning objectives (a sample for each of these gateway courses is provided in the appendices). The Core Curriculum Committee reviews all reports and provides corrective feedback where necessary. With the advent of GEMS, these assessment reports will also be reviewed by the Math and Science Education Council. This review process will give the council an excellent opportunity to assess the learning in the class, to evaluate differences between sections of the same course, and to suggest improvements.

10.2 Assessment of Implementation of GEMS Initiatives

As each intervention is put into place in the targeted gateway courses, faculty will be able to track the success of the interventions by assessing the results as part of the findings in AT6 and the analysis thereof. To help with these efforts, the Office of Educational Enhancement will run workshops on how to write strong assessment plans that will effectively measure these interventions.

Each of interventions in all of its permutations will be tracked in AT6. The GEMS assessment team, consisting of the co-directors of the QEP (Dr. Abby Kratz and Dr. John Sibert), chair of the Math and Science Education Council (Dr. Robert Hilborn), the director of the GEMS Success Center, the data analyst in the Success Center, and the assistant provost for educational enhancement (Dr. Rhonda Blackburn) will be responsible for writing assessment plans for the interventions and for monitoring their success. The GEMS assessment team will also work closely with the Office of Undergraduate Education to collect and analyze the data discussed above such as DFW rates in these gateway courses and SI reports. The results of these analyses will be collected in the aforementioned report by the Math and Science Education Council to the executive vice president and provost and to the Academic Senate.

Writing the actual assessment plans will require the input of the faculty teaching the courses each semester as well as the GEMS assessment team. To ensure continuous improvement, these plans will need to be adjusted in accordance with the student learning data previously collected. Sample assessment templates for various interventions are provided below. These samples are by no means exhaustive and are intended only as guides to help the faculty to design effective assessment plans.

10.2.1 Course Redesign

Measure 1

Measure: Percentage of students successfully mastering core curriculum learning objectives

Analysis: Analysis of data reported by instructors in AT6

Expected Outcomes: Faculty will increasingly report an increase in the numbers of students reaching specified student learning objectives in the targeted gateway courses

Measurement Timeframe: Every semester, beginning with fall 2008 (first implementation year) using data in AT6 for 2006-2007 as the baseline

Measure 2

Measure: Student participation in class

Analysis: Class attendance records

Expected Outcomes: Class attendance increases to 80% average and stays at least that high

Measurement Timeframe: Every semester beginning with baseline in spring 2008

Measure 3

Measure: Engagement surveys (pre-levels in spring 2008 and post-levels in subsequent semesters)

Analysis: Combination of measures including EBI, Teacher Immediacy, MSLQ, Involvement questions, and Approaches to Learning

Expected Outcomes: Students' reported engagement increases over the term of GEMS

Measurement Timeframe: Every semester in targeted calculus and general chemistry courses beginning with baseline in spring 2008

10.2.2 Supplemental Instruction

Measure 1

Measure: Incorporate more and more-intensively trained SI leaders into gateway courses

Analysis: Log of students who attended SI sessions (will be tied to student course performance)

Expected Outcomes: The numbers of students and at-risk students who attend SI sessions will increase

Measurement Timeframe: Every semester beginning with baseline Measure in spring 2008

Measure 2

Measure: SI interviews with students about student learning during their sessions

Analysis: Analysis of transcripts of SI interviews

Expected Outcomes: SI leaders will increasingly report that students are learning at higher levels over the term of the QEP

Measurement Timeframe: Every semester beginning with baseline Measure in spring 2008.

10.2.3 GEMS-PLTL Workshops

Measure 1

Measure: Student focus groups about their learning based on SI and PLTL

Analysis: Analysis of transcripts of focus groups

Expected Outcomes: Students will increasingly report that they are learning at higher levels and increasingly using PLTL resources over the term of the QEP

Measurement Timeframe: Every spring semester (once an academic year) beginning with spring 2009 (after first semester's implementation of the program)

Measure 2

Measure: Recruit and train GEMS PLTL Leaders

Analysis: Log of students who attended GEMS-PLTL workshops (will be tied to student course performance)

Expected Outcomes: The success rate of students, especially at-risk students, who are included in GEMS-PLTL workshops will increase

Measurement Timeframe: Every semester beginning with baseline Measure in fall 2008 of students who have not attended PLTL workshops

Measure 3

Measure: PLTL Leaders interviews about student learning during their workshops

Analysis: Analysis of transcripts of PLTL Leaders interviews

Expected Outcomes: PLTL Leaders will increasingly report that students are learning at higher levels over the term of the QEP

Measurement Timeframe: Every semester beginning with baseline Measure in spring 2008

Measure 4

Measure: Student focus groups about their learning based on GEMS-PLTL

Analysis: Analysis of transcripts of focus groups

Expected Outcomes: Students will increasingly report that they are learning at higher levels and increasingly using PLTL resources over the term of GEMS

Measurement Timeframe: Every spring semester (once an academic year) beginning with spring 2009 (first implementation year)

10.2.4 Faculty Development

Measure 1

Measure: Number of faculty applying and receiving Teaching Innovation Grants

Analysis: Analysis of quality of applications

Expected Outcomes: Number of faculty applying will increase and quality of proposals will steadily improve

Measurement Timeframe: Every spring semester (once a year) beginning with summer 2009 for baseline

Measure 2

Measure: Interviews with faculty who have attended 3 or more faculty development workshops about implementation of engagement strategies and student learning

Analysis: Analysis of transcripts of faculty interviews

Expected Outcomes: Faculty will report being aware of and using more engagement strategies in addition to reporting impressions that students are learning at deeper levels over the term of the QEP

Measurement Timeframe: Every spring semester (once a year) beginning with spring 2008 for baseline

Measure 3

Measure: Targeted questions added to end of semester course evaluations of faculty who have received Teaching Innovation Grants and those who have not

Analysis: Content analysis of open-ended questions completed by students and averages of means for relevant likert-type questions and comparison of answers for faculty who have received Teaching Innovation Grants and those who have not

Expected Outcomes: Students in courses whose instructors have received Teaching Innovation Grants will report being more engaged, will be able to provide specific examples of engagement, will report that faculty are more approachable, and will give ratings of at least 3 (somewhat) on scales (1 not at all-5 definitely) rating aspects of their learning and engagement

Measurement Timeframe: Every fall semester beginning with fall 2009 for baseline

10.2.5 Advising and Placement

Measure 1

Measure: DFW rates for calculus and general chemistry courses

Analysis: Comparison of DFW rates of those using ALEKS diagnostics and those who did not

Expected Outcomes: The DFW rate will significantly improve as number of students who used tutorial in ALEKS based on diagnostic tests increases

Measurement Timeframe: Every year beginning with spring 2008 for baseline

Measure 2

Measure: Surveys for advisors asking their perceptions about the usefulness of advising in calculus and general chemistry courses

Analysis: Averages of means for relevant questions on advising questionnaires; open-ended questions

Expected Outcomes: Advisors will report that the advising process for calculus and general chemistry courses adequately and accurately placed students in courses matched to students' ability levels

Measurement Timeframe: Every spring semester (once a year) beginning with spring 2008 for baseline

Measure 3

Measure: Surveys for students asking their perceptions about the usefulness of advising in calculus and general chemistry courses.

Analysis: Averages of means for relevant questions on advising questionnaires; open-ended questions

Expected Outcomes: Students will report that the advising process for calculus and general chemistry courses adequately and accurately placed students in courses matched to students' ability levels

Measurement Timeframe: Every spring semester (once a year) beginning with spring 2008 for baseline

10.2.6 GEMS Success Center

Measure 1

Measure: Log of voluntary student use of the Success Center

Analysis: Number of students using the center

Expected Outcomes: Baseline of zero the semester the center is opened to increase by at least 20% per semester over 5 years

Measurement Timeframe: Every semester excluding summers

Measure 2

Measure: Faculty use of the Success Center to aid their students

Analysis: Number of faculty members reporting that they promoted the center during their classes

Expected Outcomes: Baseline of zero the semester the center is opened to increase to all faculty members by the third semester the center is opened with 100% of targeted faculty members mentioning the center (verbally and/or in a syllabus) consistently every semester

Measurement Timeframe: Every semester survey of faculty and content analysis of syllabi

Measure 3

Measure: Student satisfaction with the Success Center

Analysis: Number of students reporting satisfaction with the center and its offerings

Expected Outcomes: At least 75% of students completing satisfaction surveys report levels of satisfaction that average 3.5 on a 5 point scale (5 is highest level of satisfaction)

Measurement Timeframe: Surveys tallied at the end of every semester

10.3 Institutional Assessment of the Impact of GEMS

The overarching goal of GEMS is to increase student success in historically difficult calculus and general chemistry courses and thereby increase overall student retention and persistence at UT Dallas. Institutional assessments are those that suggest how STEM students fare based on administrative indicators, for example, DFW rates in targeted classes, NSSE reports (with over-sampling on STEM courses) year-by-year comparisons with 2007-2008 baseline data, and students' continuation in STEM majors over three years after taking calculus and general chemistry. When combined with the assessment plans above and the core curriculum assessments, these institutional assessments provide a pathway to continuous improvement.

10.3.1 DFW Rates

Measure 1

Measure: DFW rates in targeted courses

Analysis: Average DFW rates across all calculus courses and all general chemistry courses separated by groups: community college transfers, traditional freshmen, etc.

Expected Outcomes: DFW rates in all targeted groups will decrease significantly between the first semester of interventions and the final semester of the QEP

Measurement Timeframe: Every semester with spring 2008 as the baseline

10.3.2 NSSE Reports

Measure 1

Measure: NSSE reports

Analysis: Questions (2007 NSSE) of interest that would relate to learning in calculus and general chemistry are: 1a, 1f, 1g, 1h, 1j, 1l, 1m, 1n, 1p, 1q, 1r, 1t, 2a-e, 3a, 4a-b, 5, 6d, 6f, 8a-c, 9a, 10a, 10b, 10g, 11e, 11f, 11g, 11h, 11j

Expected Outcomes: The average of students' answers on the targeted questions will show a significant positive increase from the baseline year 2007-2008 to the final year of the QEP

Measurement Timeframe: Every year with 2007-2008 as the baseline

10.3.3 STEM Migration

Measure 1

Measure: Student migration from STEM majors

Analysis: Numbers of students each semester who change out of STEM majors into other programs at UTD

Expected Outcomes: The number of students changing out of STEM programs after taking calculus and general chemistry will decrease significantly from the baseline year (2007-2008) to the final year of the QEP project

Measurement Timeframe: Every semester with 2007-2008 as the baseline

10.3.4 Faculty Engagement in GEMS

Measure 1

Measure: DFW rates for calculus

Analysis: Comparison of DFW rates of those using ALEKS diagnostics and those who did not

Expected Outcomes: The DFW rate will significantly improve as the number of students who used tutorials in ALEKS based on diagnostic tests increases

Measurement Timeframe: Every year beginning with fall 2008 for baseline

10.3.5 Math and Science Education Council Assessment

The council is to function as a type of board of trustees who oversee the policy and ideological aspects of the GEMS Success Center as well as other STEM initiatives. As such, there should not be operational measures of this group's success. However, the council will be asked to produce a yearly report with the following information: meeting times/dates, agendas, minutes, and suggestions/ recommendations. In addition, the council will be asked to produce a brief yearly statement summarizing their success as a group. Criteria for the success of this group will be that they meet regularly (not necessarily often), that they have specific agenda items, that they discuss those agenda items, that they have at least one recommendation per meeting, and that they summarize their success as ongoing and positive.

11. Qualitative Assessment of Curriculum Realignment

The assessment data collected in AT6 will be crucial to the success of GEMS, but without analysis, without actual conversations about the data, chances for improvement will be lost. To ensure that those conversations take place, one final qualitative assessment will take place each semester as a closing the loop exercise.

As noted above, curriculum alignment is the cornerstone of GEMS. The Goeckner Model of curriculum alignment requires the systematic examination of curricular goals during the concept mapping phase. Once these goals become explicit and agreed-upon among faculty, the individual course objectives are matched with those goals. Doing so often uncovers "holes" in the curriculum, which must, in turn, be filled so that all curricular objectives are met.

Obviously, as the curriculum changes, as knowledge increases, and as the needs of students change, curriculum alignment must be an ongoing process. Therefore, during the course of GEMS, UT Dallas intends to assess the success of the curriculum alignment by asking participating faculty three simple questions at the end of each semester:

- Do you agree with the stated and expressed curricular learning objectives that have been identified during the alignment process project? If not, what would you add or change?
- Do you believe that the learning objectives in your courses, as discussed in alignment project meetings, are feasible for your course? If not, what are your specific thoughts and remedies?
- What "holes" do you see in the curriculum that are not being met by course learning objectives? How would you propose to fill in those holes?

Once faculty answer these questions via a survey, the GEMS assessment team will compile the answers. These answers in aggregate will be discussed in a once-a-semester facilitated meeting with all program faculty until the outstanding issues are resolved. This formative assessment process will serve to build consensus and create ownership of the curriculum. It will also promote further discussion among the faculty about the curriculum and about why students are succeeding or why they are not. Without active engagement of the faculty in the assessment process, student engagement alone cannot ensure that GEMS, as well as those students participating in GEMS-related activities, succeed.

12. Tentative Implementation Schedule

Spring/Summer 2008 (Preparatory Activities)

- Identify and recruit SI Instructors and GEMS-PLTL Leaders
- Begin concept mapping
- Administer baseline engagement assessment survey
- Renovate Conference Center space for GEMS Success Center
- Purchase equipment, furniture for GEMS Success Center
- Recruit/Appoint Success Center director & staff
- ALEKS pilot test and assessment of the test
- Math Faculty prepares three-semester calculus sequence
- Prepare foundation quizzes
- Train SI Instructors & GEMS-PLTL Leaders

Fall 2008

- Concept mapping continues
- Faculty works on course and program redesign
- GEMS Success Center opens
- ALEKS facilitates placement for beginning math students
- SI sessions support all math and chemistry gateway courses
- Three-semester calculus sequence is introduced
- General chemistry incorporates GEMS-PLTL into one class
- Students take foundation quizzes in the GEMS Success Center
- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Teaching Innovation Grants Program is designed and announced
- Two faculty development luncheons take place

Spring 2009

- Modification of gateway courses based on concept mapping analysis
- ALEKS facilitates placement for beginning math students
- Three-semester calculus sequence is evaluated
- General chemistry assesses all semesters of GEMS-PLTL
- Chemistry faculty assess outcomes of foundation quiz use
- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council awards grants for FY 2010
- Three faculty development luncheons take place

Summer 2009

- Modification of gateway courses based on concept mapping analysis
- Faculty prepares general chemistry lab redesign
- ALEKS facilitates placement for beginning math students
- Three-semester calculus sequence is evaluated
- Administer engagement surveys and analyze results
- Conduct focus groups
- Train newly appointed SI Instructors & GEMS-PLTL Leaders
- Prepare/Submit annual report for 2009

Fall 2009

- Modification of gateway courses based on concept mapping analysis
- ALEKS facilitates placement for beginning math students
- Chemistry incorporates GEMS-PLTL into additional classes
- Chemistry implements new design of general chemistry lab
- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council prepares and presents report to the provost
- QEP co-directors determine priorities based on assessment of progress and prepare budget for next FY
- Two faculty development luncheons take place

Spring 2010

- ALEKS facilitates placement for beginning math students
- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council awards grants for FY 2011
- Three faculty development luncheons take place

Summer 2010

- ALEKS facilitates placement for beginning math students
- Three-semester calculus sequence is evaluated
- Administer engagement surveys and analyze results
- Train newly appointed SI Instructors & GEMS-PLTL Leaders
- Prepare/Submit annual report for 2010
- Plan expansion of the GEMS Success Center into a new facility

Fall 2010

- ALEKS facilitates placement for beginning math students
- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council prepares and presents report to the provost
- QEP co-directors determine priorities based on assessment of progress and prepare budget for next FY
- Finalize plans for new GEMS Success Center facility
- Two faculty development luncheons take place

Spring 2011

- ALEKS facilitates placement for beginning math students
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council awards grants for FY 2011
- Three faculty development luncheons take place

Summer 2011

- Construction of the expanded GEMS Success Center
- ALEKS facilitates placement for beginning math students
- Three-semester calculus sequence is evaluated
- Administer engagement surveys and analyze results
- Conduct focus groups
- Train newly appointed SI Instructors & GEMS-PLTL Leaders
- Prepare/Submit annual report for 2011

Fall 2011

- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council prepares and presents report to the provost
- QEP co-directors determine priorities based on assessment of progress and prepare budget for next FY
- Two faculty development luncheons take place

Spring 2012

- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council awards grants for FY 2012
- Three faculty development luncheons take place

Summer 2012

- ALEKS facilitates placement for beginning math students
- Administer engagement surveys and analyze results
- Train newly appointed SI Instructors & GEMS-PLTL leaders
- Prepare/Submit annual report for 2012

Fall 2012

- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council prepares and presents report to the provost
- QEP co-directors determine priorities based on assessment of progress and prepare budget for next FY
- Two faculty development luncheons take place

Spring 2013

- Administer engagement surveys and analyze results
- Conduct focus groups
- Math and Science Education Council meets
- Math and Science Education Council awards grants for FY 2012
- Three faculty development luncheons take place

Summer 2013

- Math and Science Education Council meets
- Final assessment reports are compiled and analyzed
- Train newly appointed SI Instructors & GEMS-PLTL leaders
- Submit final report to SACS COC

13. GEMS Budget

UT Dallas is fully committed to GEMS and to ensuring that the students at UT Dallas not only succeed in gateway STEM courses such as calculus and general chemistry but also master the knowledge and skills that they will need throughout their time at UT Dallas and beyond. To prepare to launch GEMS, the university will invest $300,000 to renovate the Conference Center so that it can become the showcase for engaged learning on the campus. New workstations will be installed and computers will be purchased, with a total capital outlay for the preparatory year of $448,000.

Initial Capital Outlay (Year -0-) for QEP Proposal	
Cost Description	**Projection**
Renovation of Conference Center, South End (avg)	$ 300,000.00
Eight S-Shaped Work Stations for PLTL & SI	$ 60,000.00
Dell Workstations	$ 58,800.00
Networked Printers	$ 1,200.00
Workstation (Center Director)	$ 3,000.00
Workstation (Center AA)	$ 2,500.00
Lounge Furniture	$ 7,500.00
Chairs	$ 15,000.00
Anticipated Initial Capital Outlay	**$ 448,000.00**

Table 7. Initial Capital Outlay (Year -0-) for QEP Proposal

13. GEMS Budget

The five year budget demonstrates UT Dallas' long term commitment to GEMS—from 2008-2013, UT Dallas will dedicate over $1,710,000 to improve student learning in classes that have historically created roadblocks for so many students, forcing them into other majors or even out of the university. Within the budget, there are incentives to create faculty buy-in, and there are funds to support the assessment of student learning outcomes so that improvements can be made inside and outside the classroom. Hiring a first-rate GEMS Success Center director to head the GEMS assessment team is an important step in helping students destroy those roadblocks, and implementing SI and PLTL instruction will help even more. The investment in the Success Center and in GEMS is an investment in both UT Dallas' students and its future.

Basic QEP Proposal	Year One	Year Two	Year Three	Year Four	Year Five
Cost Description	**Projection**	**Projection**	**Projection**	**Projection**	**Projection**
Director, Success Center	$ 60,000.00	$ 61,800.00	$ 63,654.00	$ 65,563.62	$ 67,530.53
Admin Assistant (Success Center Director)	$ 28,500.00	$ 29,355.00	$ 30,235.65	$ 31,142.72	$ 32,077.00
TA, Statistical Support	$ 12,500.00	$ 12,875.00	$ 13,261.25	$ 13,659.09	$ 14,068.86
Supplemental Instruction Assistants (Chemistry)	$ 30,000.00	$ 46,350.00	$ 47,740.50	$ 49,172.72	$ 50,647.90
Supplemental Instruction Assistants (Calculus)	$ 18,000.00	$ 27,810.00	$ 28,644.30	$ 29,503.63	$ 30,388.74
Benefits (Director, AA, SSS)	$ 24,780.00	$ 25,523.40	$ 26,289.10	$ 27,077.78	$ 27,890.11
Salaries and Benefits	**$ 173,780.00**	**$ 203,713.40**	**$ 209,824.80**	**$ 216,119.55**	**$ 222,603.13**
Cost Description	**Projection**	**Projection**	**Projection**	**Projection**	**Projection**
Conferences for Participating Faculty	$ 10,000.00	$ 10,300.00	$ 10,609.00	$ 10,927.27	$ 11,255.09
Speakers & Travel	$ 12,500.00	$ 12,875.00	$ 13,261.25	$ 13,659.09	$ 14,068.86
Operating Expenses (Supplies, photocopying, etc.)	$ 15,000.00	$ 15,450.00	$ 15,913.50	$ 16,390.91	$ 16,882.63
Printing Costs (Surveys, etc.)	$ 2,500.00	$ 2,575.00	$ 2,652.25	$ 2,731.82	$ 2,813.77
Phones	$ 2,500.00	$ 2,575.00	$ 2,652.25	$ 2,731.82	$ 2,813.77
Software & Licensing (upgrades & purchases)	$ 6,000.00	$ 6,180.00	$ 6,365.40	$ 6,556.36	$ 6,753.05
Development Grants & Faculty Release (course re-design)	$ 42,000.00	$ 49,440.00	$ 50,923.20	$ 52,450.90	$ 54,024.42
Equipment Maintenance & Replacement	$ 16,000.00	$ 16,480.00	$ 16,974.40	$ 17,483.63	$ 18,008.14
QEP Director 1 (Travel)	$ 5,000.00	$ 5,150.00	$ 5,304.50	$ 5,463.64	$ 5,627.54
QEP Director 2 (Travel)	$ 5,000.00	$ 5,150.00	$ 5,304.50	$ 5,463.64	$ 5,627.54
Supplemental Materials	$ 7,500.00	$ 7,725.00	$ 7,956.75	$ 8,195.45	$ 8,441.32
Maintenance and Operations	**$ 124,000.00**	**$ 133,900.00**	**$ 137,917.00**	**$ 142,054.51**	**$ 146,316.15**
Expected Expenditures for Basic QEP Proposal	**$ 297,780.00**	**$ 337,613.40**	**$ 347,741.80**	**$ 358,174.06**	**$ 368,919.28**

Table 8. Five Year Budget for QEP Proposal

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14. Appendices

15. Appendices

From emsalter@utdallas edu [mailto emsalter@utdallas edu]

Sent Fri 9/22/2006 4 06 PM

To Sibert, John W

Subject QEP

John,

I hope that the plans for QEP are starting to gel I would still like to offer my suggestion about "Interdisciplinanty - the key to the future" This is a sufficiently broad topic that it could include interdisciplinary research/projects between universities, between schools within the university, and with outreach programs, such as the ones that are dust being strated up through student life (Terry Hockenbrough is one of the people involved with these new programs.) The other factor of importance with this topic is that it is one of the founding principles upon which UTD was established. QEP would provide a wonderful opportunity to fertilize this idea.

All the best, Liz Salter

P.S. are you finished with my copy of the last assessment of General Studies that I sent you. It was my only copy, and if you are finished I would appreciate having it back. Thanks again.

From: Chidi Nnamdi Achilefu

Sent: Wednesday, September 06, 20061 37 33 AM

To: QEP

Subject: suggestion

Greetings,

Since unfortunately I cannot submit my own QEP, I will merely offer a few suggestions. After a discussion with friends of mine who are also majoring in the natural sciences, we all decided that the chemistry courses (especially Organic Chemistry) also deserve a workshop. A strong foundation in the chemical sciences has proven to be an integral part of a scientists success, therefore the curriculum should further minor this dependence. Just a one hour/one time a week workshop, led by a PROFESSOR, that allows the students to tackle and begin to grasp the tough concepts. As well as giving students an opportunity to ask questions pertaining to suggested homework problems and or course materials that may be relevant for the majority of the class. This could decrease student dependence on SI's or TA's, as well as cut down the number of monotonous office visits the professors may get with students asking the same questions.

I also had a personal suggestion. As a third year biology student, I have now completed 7 labs. I do not have any suggestions for any of the labs in particular, but one that applies to all of them. Although, I am aware that lab equipment is not cheap and not necessarily abundant, I do believe that one gains more from performing an experiment by themself, than from splitting up steps with a lab partner. I have seen way too many students slide through labs without learning anything because they could rely on their partner to get it done. Although it is ultimately up to the individual whether they want to do something, I think in an individual setting, one is forced to learn more. Maybe designing and planning to throw in a few individual experiments that deal with the more important fl topics could be a start.

Thanks

Chidi Achilefu

Junior, Biology-Premed

From: Sheel Dodani [SMTP SCDODANI@YAHOO COM]

Sent: Thursday, October 19, 2006 11 57 16 AM

To: QEP

To whom it may concern:

I am currently a senior chemistry mayor and after taking three and half years of chemistry laboratory courses, I think it is important to address the quality of these laboratory classes through an alternate and more receptive forum than the end of year evaluations/bubble sheets The current sequence of these lab classes correlates well with the lecture sequence, however, the actual content of the experiments in addition to the facilities available in the teaching labs is poor.

In order to improve the quality of these classes it will be a good idea to have a senior student panel evaluate the lower level lab classes, because communication of problems from students to faculty in the end of year evaluations is much different than students interacting with students In addition, in general a student panel to make contributions/comments to the lab experiments would be an effective way to evaluate the content and actual application of the experiments in the laboratory setting. Furthermore, in order for the quality of the lab experiments to be properly evaluated another chemistry professor in the department besides the one that designs the class should review the content of the experiments to make sure that material and skills gained by the student are maximized. To be honest, the experiments from the general chemistry classes to the advanced instrumental classes, don't make effective use of the time allotted to the class to actually teach something to the students In the general chemistry classes we usually get out early after doing a 30 minute exercise and in the advanced classes we spend the entire class period trouble shooting a bad instrument or just go home because an instrument is not working. The lack of functioning equipment and facilities needs to be seriously taken. I don't know how many times students have said that in lab when we are filtering and using the aspirator, it takes twice as long to do because the aspirators don't work well. The other thing is how does a lab period where I filter empty water for 3 hours, teach me anything except that if I was a better equipped university that actually allocated funds for undergraduate teachings labs that I might be doing something that I can actually learn from. Another issue that brings together both equipment issues and quality of the learning experience is that some of the techniques that we learn are outdated. A student at the University of California Berkley is probably sitting through a lab class where they actually get to use equipment (instruments and computers) that is not circa early 1990s and they probably get to touch the expensive equipment. How can a student graduating from UTD be competitive in a market with students graduating from UC Berkley or UT Austin if they are provided with the resources through undergraduate teaching labs. Overall there is lack of intellectual stimulation in most of the labs, especially the sophomore organic labs, and this needs to be addressed.

Thank you for your time

Sheel Dodan

Subject: QEP Idea - Website Submission

Date: Tuesday, November 28, 2006 9 35 AM

From: qep home@utdallas edu <qep home@utdallas edu>

To: "sak043000@utdallas edu" <sak043000@utdallas edu>, "sibertj@utdallas edu" <sibertj@utdallas edu>, "huckaba@utdallas edu" <huckaba@utdallas edu>

Issues related to health and wellness of the student population could be enhanced by developing a Wellness Program for students. Learning content might include navigating health care systems - Now and in the future as well as recognizing real costs in health care.

Subject: QEP Idea - Website Submission

Date: Sunday, December 3, 2006 12 36 PM

From: qep home@utdallas edu <qep home@utdallas edu>

To: “sak043000@utdallas edu” <sak043000@utdallas edu>, “sibertj@utdallas edu” <sibertj@utdallas edu>, “huckaba@ utdallas edu” <huckaba@utdallas edu>

Clearly there are essential components necessary to enhance and improve student learning. These are not hard to identify:

1. Smaller classes. Students who are taught in “herds” are not in an effective learning environment. Material is pitched to the lowest common denominator, distributed via the most efficient means possible, and evaluative instruments are necessarily truncated and streamlined for more efficient grading to a point where nothing is really tested or judged other than attendance and memorization.. Writing and expressive components are reduced in proportion to class size; reliance on “graders” becomes the most frequent practice; professorial contact is also produced in ratio to class size; and opportunity for discourse and discussion virtually disappears. Education by means of “mega section” isn’t education; it’s processing.

2. A richer and better quality of library and laboratory facilities.

3. A larger faculty, particularly in traditional areas of learning that provide the foundations for more advanced study, especially in math, science, language, literature, history, and the social sciences.

4. Better campus morale, from top to bottom. For students, this means an more active and innovative student life program with more activities and opportunities to identify closely with the campus and school, not merely as students, but as part of the community of the university; for faculty, this means more equitable salary disbursement, with less emphasis on “superstar” and celebrity scholars and trendy programs and more on the nuts and bolts of foundation education. Fewer administrative and bureaucratic constraints and less micro-managing of programs and curriculum would also help, as would more resistance to standardization and quantifiable results.

5. Stronger emphasis on an intellectual atmosphere that emphasized learning fundamentals and their applications so graduates could feel that they have been properly prepared and are a cut above the average, especially in key areas such as math, science, writing, literature, history and philosophy, and social sciences. UTD graduates should be articulate and elastic in their thinking and imaginations, able to compete in a world that knows that “impactful” is not a word and that appreciating and understanding fields outside one’s primary interest is not an unrealistic goal.

Subject: QEP Idea - Website Submission

Date: Wednesday, December 6, 2006 7 41 PM

From: qep home@utdallas edu <qep home@utdallas edu>

To: sak043000@utdallas edu” <sak043000@utdallas edu>, “sibertj@utdallas edu” <sibertf@utdallas edu>, “huckaba@ utdallas edu” <huckaba@utdallas edu>

As the university and many courses grow larger and larger, I am concerned with the old issue of writing across the curriculum. While it is presumably a commitment of UTD--and is built rather artifically into the curriculum--most of my colleagues would agree that it is more and more difficult to instructors (or even their TAs) to give the requisite attention to student writing, either in exams or lab reports or in real papers. If we have not already fallen, I fear we are falling into the regretable pattern of most large public universities. Our students are not writing enough, and too many instructors are merely glancing over what they do write. In my view, our chief efforts should go into helping students sharpen their analytical and writing skills. We are on an exciting venture to develop a fine research university, and we pride ourselves on high standards. Unless we focus more attention on serious constructive criticism of our students’ writing skills, however, we are hypocritical in claiming to be a first-rate educational institution. To prove and implement our good intentions, we should encourage and reward individual instructors---give them smaller classes (or more and better trained TAs) and insist on our being a university that really does have serious writing across the entire curriculum.

Gerald Soliday

Emeritus, History, Arts & Humanities

Date: Tuesday, October 31, 200612 57 PM

From: Matthew Goeckner <goeckner@utdallas edu>

To: <sibertj@utdallas edu>

John

Here are the files that I promised you (Sorry it took so long to get them to you!)) Also for your records are my thoughts on how to truly become a tier one university (I dislike that term!)

1) High quality UG students - which we have

2) High quality UG curriculum - which we have issues (Teachers need to know how to teach, Students need to know how to learn and the Curriculum needs to have a strong overall structure. We are missing on these points.)

This leads to:

3) High quality Grad Students

Then we need

4) High quality Grad curriculum (We are probably close) This leads to

5) High quality research

then finally

6) High research funding

It does not work the other way around. Think of building a house on sand vs building a house on a good foundation

My two cents

Subject: Request for input from Biology Dept

Date: Saturday, June 8, 20074:02 PM

From: Gonzalez, Juan E <jgonzal@utdallas.edu>

To: “Sibert, John W” <sibertj@utdallas.edu> Hi Don and Juan,

Cc: “Gray, Donald M” <dongray@utdallas.edu>, “Salamon, Myron B” <mxs068100@utdallas.edu>

John, I agree with Don’s idea. I would expand it and give it a different twist to create something similar to what I saw some years ago on a visit to Northern Colorado. I was very impressed by their Mathematics and Science Teaching (MAST) Institute. This institute is devoted to improve mathematics and science education, within the University, the State, and nationally. It is sponsored by UNC’s School of Biological Sciences; school of Chemistry, Earth Sciences, and Physics; and School of Mathematical Sciences (which correlates closely with our school’s units) and at UTD, it should also be sponsored by EE and CS. Please visit their web page (http://mast.unco.edu/) at your convenience. As I mentioned, I was very impressed by the way in which they brought together all the University stakeholders, the surrounding community and the state to create new programs with the goal of improving science and math education. This could fit beautifully with our plans to build the new science education building and the effort to reenergize the SciEd program.

Juan

Juan E. Gonzalez

Professor of Molecular & Cell Biology

Associate Dean for Graduate Studies

School of Natural Sciences & Mathematics

University of Texas at Dallas

Richardson, TX 75083-0688

telephone: (972)883-2526

fax: (972)883-2409

E-mail: jgonzal@utdallas.edu

From: nsm.mcb.fac-bounce@utdallas.edu [mailto:nsm.mcb.fac-bounce@utdallas.edu] On Behalf Of Don Gray

Sent: Friday, June 08, 2007 4:02 PM

To: mcb-faculty@utdallas.edu; mcb-lecturers@utdallas.edu

Cc: Sibert, John W; Salamon, Myron B

Subject: [nsm.mcb.fac] Request for input from Biology Dept. for QEP

MCB faculty,

John Sibert would like our input regarding a QEP quality enhancement plan centered on math and science education for UTD. His email request and explanations are below.

My thought is that a good plan for our location in the North Texas area would be one that provides the faculty release time, space and funding to accommodate HS students, and our own majors, in science laboratory projects. I think we all receive many requests from our majors and from students in Plano and Richardson who want to be involved in science projects, but we are limited in the time and space that can be committed to help very many of them. Ross Perot commented just this past Tuesday on how poorly we are doing in encouraging the next generation of students to succeed in science.

I do not think that the QEP should emphasize the subject matter of a specific science.

Please send directly to John Sibert any comments or suggestions you may have. I would appreciate being copied.

Thanks.

Don

Request for input from Biology Dept.

Wed, 30 May 2007 15:21:20 -0500

John Sibert <sibertj@utdallas.edu>

Gonzalez, Juan E <jgonzal@utdallas.edu> <dongray@utdallas.edu>

Hi Don and Juan,

As you may recall, our university is required to develop a Quality Enhancement Plan (QEP) that will enhance student learning on campus. The plan needs to be focused and should be driven by data. A QEP Council with broad campus representation was formed and has been discussing a plan centered on improving math and science education at UTD (based, in part, on data collected from gateway courses in math and chemistry). Considering our history as a research center/university with an emphasis on math, science and engineering and our strategic plan, this QEP topic fits us well. As the director of the QEP, I am writing to request from you a list of resources/actions that you feel would improve student learning and enhance the student experience within your department. When compiling your list, please do not be resource limited. Obviously, our actual QEP will be tied to available resources. However, if our goal is excellence in math and science education, I think it is useful to identify everything that we would like to have/do. While the summer undoubtedly precludes a formal departmental meeting, perhaps a departmental leader can poll the faculty by e-mail or speak for the department and develop this list. A sampling of suggested action items from chemistry is as follows: creation of a Math and Science Success Center - perhaps placed in residential housing

Instructor/TA Development (It is difficult if not impossible to find a top notch research university that doesn't have a faculty/TA development center.)

Redesign general and organic chemistry laboratories

Offer Honors Chemistry with lab (offer honors courses across NS&M)

Provide funds for student organizations to perform community activities (our students are potentially terrific ambassadors for the university and would benefit from the civic duty)

Align the existing curriculum in chemistry

Rethink our current general chemistry I and II offerings

Provide funds for undergraduate student travel to present their research at a conference

Use ATEC (see below) to create media that will supplement existing courses or help "align" students coming to UTD

Expand the SI program (see below)

Thanks,

John

-- Dr. John W. Sibert

Associate Professor

Department of Chemistry

The university of Texas at Dallas

P.O. Box 830688

Richardson, TX 75083-0688

phone: (972) 883-2918

e-mail: sibertj@utdallas.edu

ATEC is Arts and Technology - it is run through A&H, but, as I understand, began as a joint venture between A&H and ECSS (http://iiae.utdallas.edu). Tom Linehan is in charge of it. They have the potential to provide creative mechanisms for helping students learn.

"SI" refers to "Supplementary Instruction", a program run by Mary Kaye Adams, the Director of our Learning Resource Center (http://www.utdallas.edu/dept/ugraddean/lrcsupp.html). In short, this program puts our best undergraduate students in the roles of supplementary instructor in various courses. It has been quite popular and successful in general chemistry.

Please keep in mind that these are just a few suggestions that have come from chemistry and are by no means an exhaustive list. Nor do they represent a final list of what we plan on doing. I provided them to give some examples of some ideas that have been considered. I am actually hoping to get new ideas from other departments in addition to thoughts about some of these suggestions.

Thanks for you help, Don.

Subject: QEP

Date: Thursday, May 10, 2007 9:26 AM

From: Gregg, Arthur L <agregg@utdallas.edu>

To: "Sibert, John W" <sibertj@utdallas.edu>

Dr. Sibert,

Here are some idea's I have for the QEP:

1. Utilizing the Living and Learning Communities to set up a Math & Science community. This community would be for math and science majors and it would be staff (the Peer Advisors would also be math and science majors). This idea was suggested by Dr. Darrelene Rachavong, Vice President for Student Affairs, and could be a part of the new Residential Life building which will have a classroom and office space.

1. The Math & Science "Mobil". As a kid growing up in a low income area there were no libraries in my neighborhood. However, every two weeks a large bus called the Book Mobil

would park on our street and it became our library on wheels. My concept is a Math &Science Mobil (staffed by stUdents) that would go into low income areas or any community and provide tutoring and help with math and science for kids. This would engage the community and the students in the excitement for learning math and science.

1. On the same line of the Math &Science "Mobil", partnering with Boys and Girls Clubs, the V's and Recreation Centers to hold math and science camps. The camps would be staffed by students, student organizations and faculty.

Arthur L. Gregg M.Ed

Multicultural Center, Director

The University of Texas at Dallas

Conference Center 1.126

P.O. Box 830688, CN 10

Richardson, Texas 75083-0688

(972) 883-6290 wk (972) 883-6101 fax

Subject: Physics Inputs

Date: Monday, June 4, 2007 5:02 PM

From: Xinchou Lou <xinchou@utdallas.edu>

To: John W Sibert <sibertj@utdallas.edu>

Cc: John H Hoffman <jhoffman@utdallas.edu>, Roderick A Heelis <heelis@utdallas.edu>, Phyllis Jean < Phyllis.Jean@utdallas.edu>

Dear John,

Please find Physics faculty's input:

1. Coordinate our undergraduate service courses more closely with the math department.

2. Institute "zero credit hour" recitation courses that the students must attend.

3. Hire a "lab czar" whose job is to maintain demo equipment, put together new demos, and set them up prior to each lecture.

4. support for student-faculty social events/trips.

5. support for real release time for faculty supervising undergraduate research. An undergrad requires as much attention if not more attention than a grad student, but the rewards are pretty meager. The coin of the realm should be release time.

6. Provide support for the Women in Physics summer camp so that the organizers have more time to focus on activities outside of fund-raising.

--Xinchou

Subject: RE: Quality Enhancement Plan

Date: Thursday, June 14, 2007 4:33 PM

From: Hulse, Russell A <rah043000@utdallas.edu>

To: "Sibert, John W" <sibertj@utdallas.edu>

Cc: "Keithly, Beth K" <keithly@utdallas.edu>

Hi John,

Good to hear from you, and also good to learn that you are heading up the QEP! I agree that this fits in well with UTD's goals, and I like the ideas you mentioned.

I will be at UTD next week and I would enjoy chatting with you about this. I have asked Beth Keithly to arrange something on my schedule. I will be spending almost all my time next week at planning meetings at the MNS, but should have some time Wednesday afternoon, if I recall correctly.

Here are a few thoughts off the top of my head. Not surprisingly, they correspond to things I have already been trying to do at UTD:

> Adding exciting and intriguing science and technology exhibits to public spaces, student gathering areas, etc. I have already had some discussions with Nicole Small at MNS about doing this. My idea is that students would also playa significant role in making this happen, as well as being the "audience".

> A more advanced version of the above is an idea to have a significant (multimillion $) science museum / science center facility on campus, again as a joint project with MNS. We actually started to plan on this recently, but came to the conclusion that it was premature, given present limitations on resources, including both people and fundraising capacity. However, we have just deferred this idea off into the future, we have not abandoned it. Such a center would be oriented for public use as well as use by UTD students, and UTD students would be involved with exhibit design, serve as docents for school groups, etc.

> Independently of the above, we can have UTD students work with MNS to create / support exhibits at MNS. These could include ones they already are planning as well as ones which highlight UTD research. As you know, I have already worked with students on such projects, and this is also very much in the spirit of the great things you are doing with the Chemistry students association.

> I am also an advocate of increased emphasis on project-based learning, and of starting this as early as possible and across as wide a range of students as possible. My friend and colleague Chris Rogers is the Director of the Center for Engineering Education at Tufts. The CEEO focuses on project-based learning from grade school through undergraduate, with a special emphasis on using Lego robotics kits to foster this. Chris is very interested in collaborations, and I would be happy to bring him in to these discussions. Partly as a result of my advocacy efforts in this area, the Engineering School will be using robotics in their summer experience for entering freshmen.

I note that these ideas have some significant overlap with what you are also thinking about. I look forward to discussing all this further with you!

Russell

QEP Blog

What is the QEP Blog

The QEP blog is simply a mechanism to allow for an active, ongoing discussion of topics related to education at UT-Dallas. It is somewhat unfortunate that I have tied this blog to the QEP component of SACS, which has an important but much more targeted focus (please see the main page of the QEP website), because it presents a terrific opportunity to enter into a range of topics that extend well beyond the task of a QEP. Importantly, all members of the UTD community (faculty, students, staff, alumni and members of the corporate community) along with others having a vested interest in the welfare of UTD are invited to participate in this innovative approach to openly identify and discuss significant issues associated with the educational mission of our institution. In this blog, I will write articles (in most cases, fairly brief) that are designed to activate the thoughts of others. Readers of the blog can then post their views on the topics at hand with a subsequent thread developing organically. My role as the principal blog writer will not be dictatorial with respect to discussion content or topic resolution. Instead, I view it more as a facilitator of campus-wide discussions. To encourage participation in as transparent a process as possible, I have no plans to edit the posts of others. Your voice counts – please share it! Further, I welcome the suggestion of blog topics via e-mail, phone or in a campus hallway, cafeteria, etc. Finally, it should be noted that I am not writing to express the views of the university. I am writing to learn the views of the university.

John Sibert

How do you identify an effective teacher?

How do you define effective teaching? How do you measure effective teaching? The answer is the Holy Grail for addressing learning at any level. That definition would allow for the recognition and, importantly, reward of those who are effective teachers. It would allow others who aspire to be effective teachers to follow in clearly marked footsteps of success. Unfortunately, this question probably doesn't have a definitive answer, but it should continue to be asked.

Is effective teaching directly tied to the performance of students on standardized (or other) tests? If so, then Harvard, Stanford and the like have cornered the market on best teaching practices. Do you believe that? I don't. In fact, to suggest so does a disservice to instructors at less renowned universities/colleges who do yeoman's work in the classroom, laboratory, on stage, etc., but work with students who, on average, lack the skill sets of an entering Harvard undergrad. If so, then the "No Child Left Behind Law" (http://www.ericdigests.org/2004-2/behind.html) that enforced annual standardized testing in K-12 education will weave its way into the fabric of the university. Is that the path that we want to take? I think much of the work that we are currently doing for SACS (learning outcomes, course assessments, etc.) is designed to demonstrate that we can govern our own teaching practices without the need for intervention from those outside the university community (worst case scenario – Capitol Hill). It may be one of the more important reasons to take SACS seriously.

Is effective teaching related to a conveyed genuine passion for the field of study in which the instructor is teaching? I think it is, but how do you measure that?! In the classroom and community, faculty members are ambassadors for their fields of study. It is an often overlooked, but extremely significant role – in particular at the freshman level. Student views of areas of study are shaped and, in some cases, created by their instructors. Their classroom success, I suggest, is tied to the energy and interest of the instructor. For example, to this day, I have an illogical and unfairly negative view of the broad and important field of sociology. Why? Because I had an instructor who demonstrated little interest in the course material and was generally unavailable for discussion outside of the dispirited classroom. The lack of passion and emphasis on the significance of the course content left, at best, an apathetic taste in my mouth. Is that the field of sociology's fault? Most certainly not! Contrast that with the other extreme, namely the spirited efforts of the Jacques Cousteaus and Carl Sagans of the world whose interests in their disciplines were/are downright contagious. My field, chemistry, is not immune. In fact, when those I meet outside of the university learn that I am a chemistry professor, I get a common response, "I hated chemistry when I took it". I remind myself of that prior to each of my lectures. Our students deserve better. If I'm not interested in the course content, why should they be? I don't aim to convert 160 general chemistry students into chemistry majors, but I fully recognize that these developing minds will be making decisions on important scientific issues throughout their lives and need to have an appreciation for the field of chemistry, in addition to some level of scientific literacy. Look what happened with the Board of Education in Kansas (http://www.msnbc.msn.com/id/9967813)!

The bottom line is that effective teaching is critical to student learning, student welfare and their subsequent retention at the university. So, what constitutes effective teaching and, perhaps the harder question, how do you measure it? A lot of folks want to know.

2 Responses to "How do you identify an effective teacher?

JoyLynn Reed Says:

June 7th, 2006 at 3:30 pm

I agree with your excellent points. Certainly your example of how a sociology professor killed any interest in that discipline is a common experience many of us have had. Two professors killed my interests in math and chemistry.

Many scholars who study teaching and learning have noted the importance of a teacher's enthusiasm for both the discipline as well as for teaching itself. My question is, what is the difference between an effective teacher in high school and an effective teacher at higher levels? Further, are the qualities that make an undergraduate teacher effective the same ones that help graduate students learn well?

Among many other roles teachers have, they are leaders. In this sense, I am defining leadership broadly to mean having an influence. As you said, you are not out to convert all undergraduates to be chemistry majors. However, as an effective leader in the classroom, you ARE going to have influence, maybe even in a non-academic way. For example, I remember wanting to be as organized To add to your list of questions, what are ways that university teachers lead students?

simon.kane Says:

June 8th, 2006 at 11:11 am

I too have experienced many ineffective teachers. Ineffective teaching can be the result of a lack of knowledge *or* a lacking in the skilled ability to transfer the knowledge to others.

Educating is skilled communication. If the people teaching can't communicate effectively to their audience, than how can they be effective teachers?

I see a good educator as someone who:

- Must want to be an educator - a reluctant researcher teaching a lecture course is not effective.

- Must have the time to communicate.

- Must speak a common language clearly.

- Has genuine interest (preferably passion/enthusiasm) in the subject being taught.

- Has had some instruction in the art of education – for example they should understand that everyone has different learning styles (auditory, visual, kinesthetic) and should know how to leverage that knowledge to teach effectively.

Unfortunately, we often assume that a person with an abundance of knowledge in a subject, is a good teacher in it. Skilled educating does not come naturally to most. Fortunately, it can be learned and practiced well by many. But we must accept the fact that not everyone can be good at it and so, not everyone can become a good educator.

You ask "what constitutes effective teaching?" I think one of the answers is to have skilled educators who want to educate running the courses.

CU

QEP Topic Worksheet (John Sibert)

Goal: Develop an idea that will improve student learning at UTD

STEP 1: List the strengths and weaknesses of UTD as an educational institution.

Strengths

Smaller class sizes

SI sessions

Weaknesses
(This can be something we are doing poorly or something we simply are not doing.)

~~[illegible]~~'s Office hours (often at same time as I take other classes)

STEP 2: Describe the components that you deem important in creating a university with an excellent standard in education. (You may wish to focus on your area of expertise within the university, but you most certainly do not have to!)

Small class sizes

Profs who know your name and care about your academic progress

Many research opportunities

STEP 3: Discuss the information in Steps 1 and 2 with other members of your group and look for themes or commonalities.

Concurrent with NSM & students

STEP 4: Either submit individually your own idea(s) or those of your entire group to QEP@utdallas.edu.

Examples: Creation of a campus-wide honors program; living-learning" communities on campus; new approaches to teaching large enrollment classes; more relevant/applied lab courses, etc. These are simply examples. You should feel free to submit any ideas as they relate to improving student learning at UTD. These can involve classroom issues, student life, etc. There are many, many factors that contribute to student learning. Your contributions are greatly needed and appreciated.

For large classes, assign students in small teams to ~~[illegible]~~ bolster ~~[illegible]~~ creation of study groups

Advances in Engineering Education

A method for coordinated undergraduate curriculum improvement in Electrical Engineering and other programs

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Abstract
Traditionally curriculum improvements are often based on comparisons with similar programs at other universities. By comparison, we have developed a generalizable method for coordinating curriculums that does not require such comparisons and furthermore allows one to tailor the program to fit the specific needs of the students. This method, involves the creation of program wide "fundamental concept maps". This mapping model approach to curriculum development sits between traditional models for curriculums and those that are integrated, or "just in time", in nature. While the maps we show here are specific to the electrical engineering program at UTD, it would be straightforward to modify them to fit the curriculum of virtually any educational program in the US. There are a wide range of ways these charts can be used to continually improve a curriculum: 1) By employing periodic reviews of the maps, they can be used to find solutions to course specific or curriculum global problems. 2) The maps can be used to help the students better understand the general program, by giving students a large-scale perspective. Such perspective allows them to better link concepts taught in multiple courses. 3) The maps can be used to link various programs across an entire university. 4) The maps can be used link to the needs of local industry. 5) The maps can be used link to feeder schools. Finally, because the maps can be used to determine if certain criteria are being met, 6) the maps can be used when the educational institutions or programs undergo periodical accreditation review, such as regional or program specific accreditation.

I Introduction

Electrical Engineering (EE) is relatively young but a very broad field of study. The first electrical engineering course of study was at Cornell in 1883 **[i]** with the first department at the University of Missouri in 1886. **[ii]** Currently, the *CollegeBoard* lists EE as "Electrical and communications engineering" or "Electrical and computer engineering" (ECE). **[iii]** The specific departmental title, and linkage with other related fields, will often depend on historical issues and internal dynamics within a given university.

In general, electrical engineers deal with any engineering topic involving electric/magnetic fields and their applications. This is a wide range of subjects, from electric generators for power generation to communication systems. Indeed, the *CollegeBoard* **[iii]** lists 8 major concentrations within ECE. These include: Electromagnetics, Electrical power, Electronic design, Communications systems, Computer systems, Digital systems, Control systems and Telecommunications. For the purposes of this article, and the internal need of our program, we will simplify this list to:

[=] Corresponding author: goeckner@utdallas.edu

UTD Campus Map

BUILDING ABBREVIATIONS AND NAMES			
AB	Activities Center	GR	Cecil H. Green Hall
AD	Administration	HH	Karl Hoblitzelle Hall *
AS	Visual Arts Studio	JO	Erik Jonsson Academic Center
ATEC	Arts and Technology Building	MC	Eugene McDermott Library *
BE	Lloyd V. Berkner Hall	MP	Multipurpose Building
BK	Bookstore	NB	North Office Building
CB	Classroom Building	OSB	Old Service Building
CBW	Classroom Building West	NL	North Lab
CM	Construction Management	PG	Police/Garage/Grounds Building
CN	Conference Center	PP	Facilities Management
CR	Callier Center Richardson	RL	Natural Science & Engineering Research Lab
ECSN	Engineering/Computer Science North	SB	Service Building
ECSS	Engineering/Computer Science South	SOM	School of Management
EP	Energy Plant	SU	Student Union
FA	Founders West Annex	TH	Theatre
FN	Founders North	VC	Visitor/Parking Information
FO	Founders Building	WSTC	Waterview Science and Technology Center
GC	Cecil and Ida Green Center		

* STUDENT SERVICE AREAS		
	Karl Hoblitzelle Hall (HH) Enrollment Services Admissions to UT Dallas	Eugene McDermott Library (MC) Bursar Financial Aid International Student Services Registrar

UNIVERSITY HOUSING			
Waterview Park Apartments 2800 Waterview Parkway, Suite 100 Richardson, TX 75080 (972) 454-5000 (866) 276-9982 Toll Free (972) 238-3612 Fax	1 Buildings 2-12 2 Buildings 14-23 3 Buildings 24-31 4 Buildings 33-36	University Village 2800 Waterview Parkway, Suite 200 Richardson, TX 75080 (972) 792-9100 (972) 792-9101 Fax	5 Buildings 38-41 6 Buildings 43-46 7 Buildings 48-51 8a Buildings 53-59 8b Buildings 61-63 9 Buildings 65-67

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For more information call the main switchboard at 972 883-2111.

The University of Texas at Dallas
800 West Campbell Road
Richardson, TX 75080

www.utdallas.edu

Supplemental Instruction Summer '07

	Supplemental Instruction							No Supplemental Instruction					
CLASS	**# Contacts**	**Group**	**Gr Ave**	**Ds**	**Fs**	**Ws**	**DFW%**	**Group**	**Gr Ave**	**Ds**	**Fs**	**Ws**	**DFW%**
BA 3341	101	49	2.55	8	5	1	28.0%	22	2.33	4	3	1	34.8%
BA 3341	84	39	2.56	7	1	0	20.5%	34	2.48	3	4	2	25.0%
BIO 3301	126	36	2.77	4	0	0	11.1%	46	2.31	6	6	3	30.6%
CHEM 1311	159	31	2.19	1	3	3	20.6%	29	2.10	6	3	0	31.0%
CHEM 1312	390	42	2.37	7	1	5	27.7%	12	1.90	4	0	2	42.9%
CHEM- 2323	123	22	3.06	1	1	0	9.1%	7	2.04	0	1	1	25.0%
CHEM 2325	356	49	2.97	3	0	1	8.0%	10	2.23	2	0	3	38.5%
MATH 2419	131	26	2.5	5	0	1	22.2%	27	1.51	9	6	6	63.6%
PHYS 2325	59	13	2.84	2	0	1	21.4%	8	1.50	1	3	3	63.6%
PHYS 2326	37	7	2.28	1	0	0	14.3%	20	1.86	10	1	3	60.9%
PHYS 3341	90	9	3.26	0	1	0	11.1%	7	2.09	1	2	0	42.9%
SOC 3321	47	23	2.81	2	1	0	13.0%	16	3.18	1	0	0	6.3%
Totals	1703	346	2.65	41	13	12	18.4%	238	2.17	47	29	24	38.2%

UTD

The University of Texas at Dallas
Undergraduate Classroom Surveys

Thank you for participating in this voluntary research study. All results are anonymous. Each survey has a barcode and number to help with tracking. No personally identifiable information is linked to this number.

In these surveys you will be asked to make choices. The purpose of these surveys is to find out your opinions. You will indicate your choices by using a black or blue pen and completely darkening in the appropriate circle. Be sure to select only one choice for each question. If you change your mind about a choice, just erase or cross out the answer you do not want and darken a circle for the choice you prefer.

Below is a series of descriptions of things some teachers have been observed doing in some classes. We would like to know your opinion about what this class is actually like.

1 Never	2 Rarely	3 Occasionally	4 Often	5 Very often

	1	2	3	4	5
1. Uses examples to make the content relevant to me.	O	O	O	O	O
2. Provides explanations that make the content relevant to me.	O	O	O	O	O
3. Uses exercises or explanations that demonstrate the importance of the content.	O	O	O	O	O
4. Explicitly states how the material relates to my career goals or to my life in general.	O	O	O	O	O
5. Links content to other areas of content.	O	O	O	O	O
6. Asks me to apply content to my own interests.	O	O	O	O	O
7. Gives assignments that involve the application of the content to my career interests.	O	O	O	O	O
8. Helps me to understand the importance of the content.	O	O	O	O	O
9. Uses own experiences to introduce or demonstrate a concept.	O	O	O	O	O
10. Uses student experiences to demonstrate or introduce a concept.	O	O	O	O	O
11. Uses discussion to help me understand the relevance of the topic.	O	O	O	O	O
12. Uses current events when teaching a topic.	O	O	O	O	O

Below is a series of descriptions of things some teachers have been observed doing in some classes. Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Never	2 Rarely	3 Occasionally	4 Often	5 Very often

	1	2	3	4	5
1. Uses personal examples or talks about experiences she/he has had outside of class.	O	O	O	O	O
2. Asks questions or encourages students to talk.	O	O	O	O	O
3. Gets into discussions based on something a student brings up even when this doesn't seem to be part of his/her lecture plan.	O	O	O	O	O
4. Uses humor in class.	O	O	O	O	O
5. Addresses students by name.	O	O	O	O	O
6. Addresses me by name.	O	O	O	O	O
7. Gets into conversations with individual students before or after class.	O	O	O	O	O
8. Has initiated conversations with me before, after or outside of class.	O	O	O	O	O
9. Refers to class as "my" class or what "I" am doing.	O	O	O	O	O
10. Refers to class as "our" class or what "we" are doing.	O	O	O	O	O
11. Provides feedback on my individual work through comments on papers, oral discussions, etc.	O	O	O	O	O
12. Calls on students to answer questions even if they have not indicated that they want to talk.	O	O	O	O	O
13. Asks how students feel about an assignment, due date or discussion topic.	O	O	O	O	O
14. Invites students to telephone or meet with him/her outside of class if they have questions or want to discuss something.	O	O	O	O	O
15. Asks only questions that have specific, correct answers.	O	O	O	O	O
16. Asks questions that solicit viewpoints or opinions.	O	O	O	O	O
17. Praises students' work, actions or comments.	O	O	O	O	O
18. Criticizes or points out faults in students' work, actions or comments.	O	O	O	O	O
19. Will have discussions about things unrelated to class with individual students or with the class as a whole.	O	O	O	O	O
20. Is addressed by his/her first name by the students.	O	O	O	O	O
21. Sits behind desk while teaching.	O	O	O	O	O

		1	2	3	4	5
22.	Gestures while talking to class.	O	O	O	O	O
23.	Uses monotone/dull voice when talking to class.	O	O	O	O	O
24.	Looks at class while talking.	O	O	O	O	O
25.	Smiles at the class as a whole, not just at individual students.	O	O	O	O	O
26.	Has a very tense body position while talking to the class.	O	O	O	O	O
27.	Moves around the classroom while teaching.	O	O	O	O	O
28.	Sits on a desk or in a chair while teaching.	O	O	O	O	O
29.	Looks at the board or notes while talking to the class.	O	O	O	O	O
30.	Stands behind podium or desk while teaching.	O	O	O	O	O
31.	Has a very relaxed body position while talking to the class.	O	O	O	O	O
32.	Smiles at individual students in the class.	O	O	O	O	O
33.	Uses a variety of vocal expressions while talking to the class.	O	O	O	O	O

The following questions ask about your motivation for and attitudes about this class. Indicate your opinion about each statement by darkening in the circle corresponding to one of the options. Please ignore the question numbering scheme. It is purely for statistical analysis.

1 Not at all True of me	2	3	4	5 Very true of me

		1	2	3	4	5
1.	In a class like this, I prefer course material that really challenges me so I can learn new things.	O	O	O	O	O
2.	If I study in appropriate ways, then I will be able to learn the material in this course.	O	O	O	O	O
4.	I think I will be able to use what I lean in this course in other courses.	O	O	O	O	O
5.	I believe I will receive an excellent grade in this class.	O	O	O	O	O
6.	I'm certain I can understand the most difficult material presented in the readings for this course.	O	O	O	O	O
7.	Getting a good grade in this class is the most satisfying thing for me right now.	O	O	O	O	O
9.	It is my own fault if I don't learn the material in this course.	O	O	O	O	O
10.	It is important for me to learn the course material in this class.	O	O	O	O	O
11.	The most important thing for me right now is improving my overall grade point average, so my main concern is getting a good grade.	O	O	O	O	O
12.	I'm confident I can learn the basic concepts taught in this course.	O	O	O	O	O
13.	If I can, I want to get better grades in this class than most of the other students.	O	O	O	O	O
15.	I'm confident I can understand the most complex material presented by the instructor in this course	O	O	O	O	O
16.	In a class like this, I prefer course material that arouses my curiosity, even if it difficult to learn.	O	O	O	O	O
17.	I am very interested in the content area of this course.	O	O	O	O	O
18.	If I try hard enough, then I will understand the course material.	O	O	O	O	O
20.	I'm confident I can do an excellent job on the assignments and tests in this course	O	O	O	O	O
21.	I expect to do well in this class.	O	O	O	O	O
22.	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	O	O	O	O	O
23.	I think the course material in this class is useful for me to learn.	O	O	O	O	O
24.	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	O	O	O	O	O

		1	2	3	4	5
25.	If I don't understand the course material, it is because I didn't try hard enough.	O	O	O	O	O
26.	I like the subject matter of this course.	O	O	O	O	O
27.	Understanding the subject matter of this course is very important to me.	O	O	O	O	O
29.	I'm certain I can master the skills being taught in this class.	O	O	O	O	O
30.	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others,	O	O	O	O	O
31.	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	O	O	O	O	O
33.	During class time I often miss important points because I'm thinking of other things.	O	O	O	O	O
34.	When studying for this course, I often try to explain the material to a classmate or friend.	O	O	O	O	O
35.	I usually study in a place where I can concentrate on my course work.	O	O	O	O	O
36.	When reading for this course, I make up questions to help my reading,	O	O	O	O	O
37.	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	O	O	O	O	O
38.	I often find myself questioning things I hear or read in this course to decide if I find them convincing.	O	O	O	O	O
40.	Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	O	O	O	O	O
41.	When I become confused about something I'm reading for this class I go back and try to figure it out.	O	O	O	O	O
43.	I make good use of my study time for this course.	O	O	O	O	O
44.	If course readings are difficult to understand, I change the way I read the material.	O	O	O	O	O
45.	I try to work with other students from this class to complete the course assignments.	O	O	O	O	O
47.	When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.	O	O	O	O	O
48.	I work hard to do well in this class even if I don't like what we are doing,	O	O	O	O	O
49.	I make simple charts, diagrams, or tables to help me organize course material.	O	O	O	O	O
50.	When studying for this course, I often set aside time to discuss course material with a group of students from the class.	O	O	O	O	O
51.	I treat the course material as a starting point and try to develop my own ideas about it.	O	O	O	O	O
52.	I find it hard to stick to a study schedule.	O	O	O	O	O
54.	Before I study new course material thoroughly, I often skim it to see how it is organized.	O	O	O	O	O

		1	2	3	4	5
55.	I ask myself questions to make sure I understand the material I have been studying in this class.	O	O	O	O	O
56.	I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	O	O	O	O	O
57.	I often find that I have been reading for this class but don't know what it was all about.	O	O	O	O	O
58.	I ask the instructor to clarify concepts I don't understand well.	O	O	O	O	O
60.	When course work is difficult, I either give up or only study the easy parts.	O	O	O	O	O
61.	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.	O	O	O	O	O
65.	I have a regular place set aside for studying.	O	O	O	O	O
66.	I try to play around with ideas of my own related to what I am learning in this course.	O	O	O	O	O
68.	When I can't understand the material in this course, I ask another student in this class for help.	O	O	O	O	O
70.	I make sure that I keep up with the weekly readings and assignments for this course.	O	O	O	O	O
71.	Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	O	O	O	O	O
73.	I attend this class regularly.	O	O	O	O	O
74.	Even when course materials are dull and uninteresting, I manage to keep working until I finish.	O	O	O	O	O
75.	I try to identify students in this class whom I can ask for help if necessary.	O	O	O	O	O
76.	When studying for this course I try to determine which concepts I don't understand well.	O	O	O	O	O
77.	I often find that I don't spend very much time on this course because of other activities.	O	O	O	O	O
78.	When I study for this class, I set goals for myself in order to direct my activities in each study period.	O	O	O	O	O
79.	If I get confused taking notes in class, I make sure I sort it out afterwards.	O	O	O	O	O
80.	I rarely find time to review my notes or readings before an exam.	O	O	O	O	O

The following statements represent opinions students might have about knowledge and knowing, and reasons that students might have for doing their school work. Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Not at all True of me	2	3	4	5 Very true of me

	1	2	3	4	5
1. I do my work in this class because I want to understand the ideas.	O	O	O	O	O
2. I can do the work in this class.	O	O	O	O	O
3. I do my work in this class because I like to perform better than other students.	O	O	O	O	O
4. I learn new material by relating new ideas with ideas I already know.	O	O	O	O	O
5. I do my work in this class because I will need to know it in future courses.	O	O	O	O	O
6. I don't do the work in this class so others won't realize I don't understand.	O	O	O	O	O
7. I do my work in this class because I like learning things.	O	O	O	O	O
8. When I study I underline main ideas in my notes.	O	O	O	O	O
9. I don't understand the ideas in this class very well.	O	O	O	O	O
10. I do my work in this class because I want to look smart to my friends.	O	O	O	O	O
11. I do my work in this class because knowing the material is important to my future goals.	O	O	O	O	O
12. When studying, I determine what material is least well understood and then focus my efforts on that material.	O	O	O	O	O
13. Next year in this subject I will probably have trouble understanding the ideas.	O	O	O	O	O
14. I do my work in this class because I can show other people that I'm smart.	O	O	O	O	O
15. I mainly read the textbook to get information needed for tests.	O	O	O	O	O
16. I don't do my work in this class so I can avoid looking stupid to others.	O	O	O	O	O
17. I do my work in this class because I like to understand what I am learning	O	O	O	O	O
18. I do my work in this class because I want to learn new things.	O	O	O	O	O
19. I do the work in this class because I like to show others that the work is easy for me.	O	O	O	O	O
20. When studying, I analyze concepts to see how they apply to me.	O	O	O	O	O

	1	2	3	4	5
21. I try to write down exactly what the teacher says in class	O	O	O	O	O
22. I don't do the work in this class so no one will know I'm having trouble with it.	O	O	O	O	O
23. I do my work in this class because I don't want to be the only one who can't do the work well.	O	O	O	O	O
24. Compared with other students in this class, I think I am doing well.	O	O	O	O	O
25. I do my work in this class because knowing the material will be useful in my future.	O	O	O	O	O
26. I do my work in this class because I don't want to look dumb to my classmates or teacher.	O	O	O	O	O
27. I recopy my notes to help me learn the material in my classes	O	O	O	O	O
28. Compared with other students I don't know very much about this class.	O	O	O	O	O
29. When studying, I think about how the theories and concepts are related to each other	O	O	O	O	O
30. I do my work in this class because I like the challenge of learning new things.	O	O	O	O	O
31. I understand the ideas in this class.	O	O	O	O	O
32. I do my work in this class because I like to score higher than the other students.	O	O	O	O	O
33. I do my work in this class because I will need to know it for a job someday.	O	O	O	O	O
34. When studying, I write out lists of terms and definitions.	O	O	O	O	O
35. I do my work in this class because I want to understand it really well.	O	O	O	O	O
36. I am doing well in this class compared to others.	O	O	O	O	O
37. I create new examples of my own to check my understanding of theories and concepts learned in my classes.	O	O	O	O	O
38. I do my work in this class because I don't want to be embarrassed about not being able to do the work.	O	O	O	O	O
39. I do my work in this class because knowing the material will help me in my future.	O	O	O	O	O
40. When studying, I copy down details exactly as they are stated in the textbook.	O	O	O	O	O
41. When learning new material, I summarize it in my own words.	O	O	O	O	O

The following statements focus on how you perceive knowledge. Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Strongly disagree	2 Disagree	3 Neither agree or disagree	4 Agree	5 Strongly agree

	1	2	3	4	5
1. Most things worth knowing are easy to understand.	O	O	O	O	O
2. What is true is a matter of opinion.	O	O	O	O	O
3. Students who learn things quickly are the most successful.	O	O	O	O	O
4. People should always obey the law.	O	O	O	O	O
5. People's intellectual potential is fixed at birth.	O	O	O	O	O
6. Absolute moral truth does not exist.	O	O	O	O	O
7. Parents should teach their children all there is to know about life.	O	O	O	O	O
8. Really smart students don't have to work as hard to do well in school.	O	O	O	O	O
9. If a person tries too hard to understand a problem, they will most likely end up being confused.	O	O	O	O	O
10. Too many theories just complicate things.	O	O	O	O	O
11. The best ideas are often the most simple.	O	O	O	O	O
12. Instructors should focus on facts instead of theories.	O	O	O	O	O
13. Some people are born with special gifts and talents.	O	O	O	O	O
14. How well you do in school depends on how smart you are.	O	O	O	O	O
15. If you don't learn something quickly, you won't ever learn it.	O	O	O	O	O
16. Some people just have a knack for learning and others don't.	O	O	O	O	O
17. Things are simpler than most professors would have you believe.	O	O	O	O	O
18. If two people are arguing about something, at least one of them must be wrong.	O	O	O	O	O
19. Children should be allowed to question their parents' authority.	O	O	O	O	O
20. If you haven't understood a chapter the first time through, going back over it won't help.	O	O	O	O	O
21. Science is easy to understand because it contains so many facts.	O	O	O	O	O

	1	2	3	4	5
22. The more you know about a topic, the more there is to know.	O	O	O	O	O
23. What is true today will be true tomorrow.	O	O	O	O	O
24. Smart people are born that way.	O	O	O	O	O
25. When someone in authority tells me what to do, I usually do it.	O	O	O	O	O
26. People shouldn't question authority.	O	O	O	O	O
27. Working on a problem with no quick solution is a waste of time.	O	O	O	O	O
28. Sometimes there are no right answers to life's big problems.	O	O	O	O	O

How involved were you in various aspects of this course? By involvement, we mean psychologically engrossed. In other words, how psychologically engrossed were you in the following parts of this class? Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Not at all involved	2	3	4	5 Extremely involved

		1	2	3	4	5
1.	During most class lectures.	O	O	O	O	O
2.	During your favorite lecture all semester.	O	O	O	O	O
3.	While working homework problems.	O	O	O	O	O
4.	While studying for quizzes alone.	O	O	O	O	O
5.	While studying for exams alone.	O	O	O	O	O
6.	While studying for exams with classmates.	O	O	O	O	O
7.	While talking to classmates about class.	O	O	O	O	O
8.	While working on online problems.	O	O	O	O	O
9.	While working with an SI leader.	O	O	O	O	O
10.	While working with a tutor.	O	O	O	O	O

The following statements assess your motivation for and attitudes about this class. Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree

		1	2	3	4	5
1.	The teacher considers students' feelings.	O	O	O	O	O
2.	The teacher talks rather than listens.	O	O	O	O	O
3.	The class is made up of individuals who don't know each other well.	O	O	O	O	O
4.	The students look forward to coming to classes.	O	O	O	O	O
5.	Students know exactly what has to be done in our class.	O	O	O	O	O
6.	New ideas are seldom tried out in this class.	O	O	O	O	O
7.	All students in the class are expected to do the same work in the same way and in the same time.	O	O	O	O	O
8.	The teacher talks individually with students.	O	O	O	O	O
9.	Students put effort into what they do in class.	O	O	O	O	O
10.	Each student knows the other members of the class by their first names.	O	O	O	O	O
11.	Students are dissatisfied with what is done in the class,	O	O	O	O	O
12.	Getting a certain amount of work done is important in this class.	O	O	O	O	O
13.	New and different ways of teaching are seldom used in own pace this class.	O	O	O	O	O
14.	Students are generally allowed to work at their own pace.	O	O	O	O	O
15.	The teacher goes out of his/her way to help students. in this class.	O	O	O	O	O
16.	Students 'clockwatch' in this class.	O	O	O	O	O
17.	Friendships are made among students in this class.	O	O	O	O	O
18.	After the class the students have a sense of satisfaction.	O	O	O	O	O
19.	The group often gets sidetracked instead of sticking to the point.	O	O	O	O	O
20.	The teacher thinks up innovative activities for students to do.	O	O	O	O	O
21.	Students have a say in how class time is spent.	O	O	O	O	O

		1	2	3	4	5
22.	The teacher helps each student who is having trouble.	O	O	O	O	O
23.	Students in this class pay attention to what others are saying.	O	O	O	O	O
24.	Students don't have much chance to get to know each other in this class.	O	O	O	O	O
25.	Classes are a waste of time.	O	O	O	O	O
26.	This is a disorganized class.	O	O	O	O	O
27.	Teaching approaches in this class are characterized by innovation and variety.	O	O	O	O	O
28.	Students are allowed to choose activities and how they will work.	O	O	O	O	O
29.	The teacher seldom moves around the classroom to talk with new students.	O	O	O	O	O
30.	Students seldom present their work to the class.	O	O	O	O	O
31.	It takes a long time to get to know everybody by his/her first name in this class.	O	O	O	O	O
32.	Classes are boring.	O	O	O	O	O
33.	Class assignments are clear so everyone knows what to do.	O	O	O	O	O
34.	The seating in this class is arranged in the same way each week.	O	O	O	O	O
35.	Teaching approaches allow students to proceed at their own pace.	O	O	O	O	O
36.	The teacher isn't interested in students' problems.	O	O	O	O	O
37.	There are opportunities for students to express opinions.	O	O	O	O	O
38.	Students in this class get to know each other well.	O	O	O	O	O
39.	Students enjoy going to this class.	O	O	O	O	O
40.	This class seldom starts on time.	O	O	O	O	O
41.	The teacher often thinks of unusual class activities.	O	O	O	O	O
42.	There is little opportunity for a student to pursue his/her particular interest in this class.	O	O	O	O	O
43.	The teacher is unfriendly and inconsiderate towards students	O	O	O	O	O
44.	The teacher dominates class discussion.	O	O	O	O	O
45.	Students in this class aren't very interested in getting to know other students.	O	O	O	O	O

		1	2	3	4	5
46.	Classes are interesting.	O	O	O	O	O
47.	Activities in this class are clearly and carefully planned.	O	O	O	O	O
48.	Students seem to do the same type of activities every class.	O	O	O	O	O

This is the last survey – only three questions. Please indicate your opinion about each statement by darkening in the circle corresponding to one of the options.

1 Nothing	2	3	4	7 More than any other class I have ever taken

		1	2	3	4	5
1.	How much have you learned from the instructor teaching this course?	O	O	O	O	O
2.	How much do you believe you could have learned from your instructor if this course were taught by the “ideal” instructor?	O	O	O	O	O
3.	How well do you think you can learn the topic of this course?	O	O	O	O	O

AT6 Assessment Report: 07f: Calculus I - Chart 020 021

1. Core Curriculum Course Objective: Students will be able to formulate real world problems into mathematical statements.

1.0 Specific Objective: Given a narrative description of a problem that lends itself to mathematical analysis, the student will clearly define any variable quantities introduced and/or provide an appropriate equation, function, or formula relating those variables.

1.1.1 Plan:

1.1.1.1 Assessment Activity: Multiple choice question.

1.1.1.2 Success Criteria: 75% of students score at or above 70%.

1.1.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

1.1.2 Results:

1.1.2.1 Numerical Results: 64% of students score at or above 70%.

1.1.2.2 Assessment Items and Scoring Criteria: Assessment problem: Quiz3 #3 (4 pts) Find an equation of the line tangent to the graph of F(x) = -2x^2+3x-6 at the point where x = 1. Circle the best answer. a) x + y=0 b) 7x – y – 12 = 0 c) 7x + y – 6 = 0 d) x + y + 4 = 0 e) None of these Scoring Rubric: 0 points – incorrect answer 4 points - correct answer Criteria Not Met Comments: More examples using the point-slope form of the linear equation were presented in class this semester, yielding better results that those of last semester. The most common cause of error was failure to remember a formula for the line equation. Also, some students did not compute the corresponding y-values for the point in the point-slope form. A few tried to incorrectly apply the definition of the derivative to compute the slope, when the simple derivative rule would have been adequate.

1.1.3 Analysis:

1.1.3.1 Outcome: Failed to meet expectations

1.1.3.2 Influencing Factors: More examples using the point-slope form of the linear equation were presented in class this semester, yielding better results that those of last semester. The most common cause of error was failure to remember a formula for the line equation. Also, some students did not compute the corresponding y-values for the point in the point-slope form. A few tried to incorrectly apply the definition of the derivative to compute the slope, when the simple derivative rule would have been adequate.

1.1.3.3 Next Action: Continue to emphasize the point-slope form and remind the students that the definition of the derivative is not necessary unless specifically called for in the problem.

1.1 Specific Objective: Given a narrative description of a problem that lends itself to mathematical analysis, the student will clearly define any variable quantities introduced and/or provide an appropriate equation, function, or formula relating those variables.

1.2.1 Plan:

1.2.1.1 Assessment Activity: Rubric-scored exam question

1.2.1.2 Success Criteria: 75% of students score at or above 70%.

1.2.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

1.2.2 Results:

1.2.2.1 Numerical Results: 85% of students score at or above 70%.

1.2.2.2 Assessment Items and Scoring Criteria: Assessment problem: Exam2 #3a 3. A closed box is to be made with a square base. Find the minimum surface area possible if the volume is to be 64 cubic feet. (a) (4 points) Write a formula for the quantity to be optimized. Clearly define all variables introduced by labeling the sketch, or by simple written statements. (a diagram of a box is given for the students to label) Scoring Rubric: 2 points – labeling variables 2 points - writing the formula for quantity to optimize Criteria Met Comments: Problems involving volume and surface area formulas were emphasized class, so the outcome was improved over last years' results. The most common errors were setting up a volume formula instead of a surface area formula or failure to take into account all the surfaces in the area formula.

1.2.3 Analysis:

1.2.3.1 Outcome: Exceeded expectations

1.2.3.2 Influencing Factors: Problems involving volume and surface area formulas were emphasized class, so the outcome was improved over last years' results. The most common errors were setting up a volume formula instead of a surface area formula or failure to take into account all the surfaces in the area formula.

1.2.3.3 Next Action: Continue teaching this type of problem as before.

2. Core Curriculum Course Objective: Students will be able to develop solutions to mathematical problems at the level appropriate to each course.

2.0 Specific Objective: Given a limit statement of indeterminate form, the student will be able to apply appropriate algebraic or calculus based techniques to compute the limit.

2.1.1 Plan:

2.1.1.1 Assessment Activity: Rubric-scored exam question

2.1.1.2 Success Criteria: 75% of students score at or above 70%.

2.1.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

2.1.2 Results:

2.1.2.1 Numerical Results: 72.8% of students score at or above 70%.

2.1.2.2 Assessment Items and Scoring Criteria: Assessment problem: Exam 1, Problem #3(b) (9 points) The limit as x goes to -3 (from the positive side) of (x^2 + x – 6)/(x^2 + 8x +15) Scoring Rubric: 3 pts - factoring each quadratic correctly. 3 pts - evaluating the final answer. (1 pt off for sign errors) Criteria Not Met Comments: Among the salient errors were failure to recognize the indeterminate form, resulting in + or – infinity, and failure to compute the limit analytically instead of empirically. Some also did not factor the quadratic forms correctly.

2.1.3 Analysis:

2.1.3.1 Outcome: Failed to meet expectations

2.1.3.2 Influencing Factors: Among the salient errors were failure to recognize the indeterminate form, resulting in + or – infinity and failure to compute the limit analytically instead of empirically. Some also did not factor the quadratic forms correctly.

2.1.3.3 Next Action: Emphasize that one must always check the indeterminate form in a rational function before proceeding with computing a limit. Also, remind students to review factoring in their Precalculus Review document.

2.1 Specific Objective: The student will be able to evaluate an indefinite or definite integral of a continuous function.

2.2.1 Plan:

2.2.1.1 Assessment Activity: Multiple choice question.

2.2.1.2 Success Criteria: 75% of students score at or above 70%.

2.2.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

2.2.2 Results:

2.2.2.1 Numerical Results: 80.3% of students score at or above 70%.

2.2.2.2 Assessment Items and Scoring Criteria: Assessment problem: Quiz 10 2. (5 points) Find the indefinite integral. Circle the letter next to the correct answer. Find the indefinite integral of (1-x)/(x^2+16) with respect to x. a) arcsin(x/4) –(1/2)ln(x^2+16) + C b) (1/4) arctan(x/4) –(1/2) ln(x^2+16) + C c) –(1/2)ln(x^2+16) + C d) (1/4)arctan(x/4) + 1/(2(x^2+16)^2) + C e) None of the above Scoring Rubric: 0 pts – incorrect answer 5 pts - correct answer Criteria Met Comments: Results are an improvement over those of last semester. Problems were worked in class that involved both a logarithmic and an inverse trig. function in the antiderivative. Students were told that sometimes basic algebra must be performed before doing any integration. The most common errors were failure to "split" the function before integration and applying substitution or failure to correctly apply substitution after the "split."

2.2.3 Analysis:

2.2.3.1 Outcome: Exceeded expectations

2.2.3.2 Influencing Factors: Results are an improvement over those of last semester. Problems were worked in class that involved both a logarithmic and an inverse trig. function in the antiderivative. Students were told that sometimes basic algebra must be performed before doing any integration. The most common errors were failure to "split" the function before integration and applying substitution or failure to correctly apply substitution after the "split."

2.2.3.3 Next Action: Continue teaching this type of problem as before.

3. Core Curriculum Course Objective: Students will be able to describe or demonstrate mathematical solutions either numerically or graphically.

3.0 Specific Objective: Students will provide numerical results in a prescribed manner, as a percent, an interval, or with specified accuracy.

3.1.1 Plan:

3.1.1.1 Assessment Activity: Multiple choice question.

3.1.1.2 Success Criteria: 75% of students score at or above 70%.

3.1.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

3.1.2 Results:

3.1.2.1 Numerical Results: 67% of students score at or above 70%.

3.1.2.2 Assessment Items and Scoring Criteria: Assessment problem: Quiz 7 #1: (5 points) The velocity v, in meters/second, of an object is given by the formula v = sqrt(E/2) where E is the energy. The energy changes from 2 Joules to 2.02 Joules. Use differentials to estimate the resulting change in the velocity. Circle the best answer. a) 0.01 m/s b) 0.005m/s c) 0.02m/s d) 0.1 m/s e) none of these Scoring Rubric: 0 pts – incorrect answer 5 pts - correct answer Criteria Not Met Comments: Even though the criterion was not met, the results were still a dramatic improvement over those of last semester. Some of this improvement could be attributed to having provided the equation for them to differentiate instead of asking them for the original equation. This change was appropriate as we are trying to test understanding of the differential here, and not modeling. The main source of the error was simply incorrect differentiation of the right-hand side: students did not know how to handle the constant in the radical.

3.1.3 Analysis:

3.1.3.1 Outcome: Failed to meet expectations

3.1.3.2 Influencing Factors: Even though the criterion was not met, the results were still a dramatic improvement over those of last semester. Some of this improvement could be attributed to having provided the equation for them to differentiate instead of asking them for the original equation. This change was appropriate as we are trying to test understanding of the differential here, and not modeling. The main source of the error was simply incorrect differentiation of the right-hand side: students did not know how to handle the constant in the radical.

3.1.3.3 Next Action: Supply some simple derivative examples involving roots of a variable with either a whole-number or rational coefficient.

3.1 Specific Objective: Students will provide a sketch of a function which exhibits characteristics determined via calculus based operations.

3.2.1 Plan:

3.2.1.1 Assessment Activity: Rubric-scored exam question.

3.2.1.2 Success Criteria: 75% of students score at or above 70%.

3.2.1.3 Assessment Timeframe: Quiz 1-10, Exam1-3, Final

3.2.2 Results:

3.2.2.1 Numerical Results: 58.4% of students score at or above 70%.

3.2.2.2 Assessment Items and Scoring Criteria: Assessment problem: Final Exam #5. (32 points) For y = (2x^2 – 50)/(x^2-81) find parts (a) through (g). a) The domain of the function b) The x- and y-intercepts. c) Horizontal asymptote(s). d) Vertical asymptote(s). e) Intervals on which the function is increasing, decreasing. Identify any relative extrema. Give (x, y) values. f) Intervals in which the function is concave up/concave down. Identify any points of inflection. Give (x, y) values. g) (7 points) Using the above information, sketch the graph of the function on the next page. (Only part (g) was used as the assessment problem.) Scoring Rubric: 2 points – showing the regions where the function is increasing or decreasing 2 points – showing the regions where the function is concave up or down 3 points – showing vertical and horizontal asymptotes Criteria Not Met Comments: Results were an improvement over last semester. However, this problem type again yielded the lowest score of all the assessment problems. For the most part, errors in the graph can be attributed to incorrect differentiation and analysis of each derivative to determine where the function is increasing, decreasing, concave up, or concave down. Even if students could plot the correct intercepts and asymptotes they could not use the information from the derivative.

3.2.3 Analysis:

3.2.3.1 Outcome: Failed to meet expectations

3.2.3.2 Influencing Factors: Results were an improvement over last semester. However, this problem type again yielded the lowest score of all the assessment problems. For the most part, errors in the graph can be attributed to incorrect differentiation and analysis of each derivative to determine where the function is increasing, decreasing, concave up, or concave down. Even if students could plot the correct intercepts and asymptotes they could not use the information from the derivative.

3.2.3.3 Next Action: One possibility is to emphasize to students that, in case there is error in their derivatives, students can still use their skills from precalculus to help them graph the function.

4. Core Curriculum Course Objective: Please include below any other/additional non-core-curriculum course objectives you will assess and evaluate.

AT6 Assessment Report 07s: Calculus II - Chart 020

1. Core Curriculum Course Objective: Students will be able to formulate real world problems into mathematical statements.

1.0 Specific Objective: Given a narrative description of a problem that lends itself to mathematical analysis, the student will clearly define any variable quantities introduced and/or select/provide an appropriate equation, function, or formula relating those variables.

1.1.1 Plan:

1.1.1.1 Assessment Activity: Rubric-scored exam question

1.1.1.2 Success Criteria: 75% of students score at or above 70%.

1.1.1.3 Assessment Timeframe: Exam 2

1.1.2 Results:

1.1.2.1 Numerical Results: 70% scored above 70%

1.1.2.2 Assessment Items and Scoring Criteria: Exam 2, Problem 5(a)&(b) , points possible:0 - 5 Description: A closed right circular cylinder was to be manufactured with a radius of 3 in. and a height of 5 in. a) (2 points) Clearly label the variables on the figure provided. b) (3 points) Write a formula for the surface area of the cylinder Scoring, a) 1 each for radius and height b) 1 for introducing S (or other name) 2 for the formula.

1.1.3 Analysis:

1.1.3.1 Outcome: Failed to meet expectations

1.1.3.2 Influencing Factors: Many students did not know the formula for the surface area of a cylinder.

1.1.3.3 Next Action: Be certain that students are aware of which mensuration formulas they are responsible for.

1.1 Specific Objective: Given a narrative description of a problem that lends itself to mathematical analysis, the student will clearly define any variable quantities introduced and/or select/provide an appropriate equation, function, or formula relating those variables.

1.2.1 Plan:

1.2.1.1 Assessment Activity: Multiple choice question.

1.2.1.2 Success Criteria: 75% of students score at or above 70%.

1.2.1.3 Assessment Timeframe: Quiz, Exam, or Final Exam TBD

1.2.2 Results:

1.2.2.1 Numerical Results: 71% scored above 70%

1.2.2.2 Assessment Items and Scoring Criteria: Exam 2, Problem #7, points possible: 0 or 4 Description: The temperature at any point (x,y) on a flat metal roof is given by the function T(x,y)= 1500 -2x^2 +3y^2. In what direction from (-1,2) does the temperature increase most rapidly? Circle the letter next to the correct answer.

1.2.3 Analysis:

1.2.3.1 Outcome: Failed to meet expectations

1.2.3.2 Influencing Factors: Those that erred made computational errors or were unaware of this aspect of the gradient.

1.2.3.3 Next Action: Encourage them to do more homework and to pay more attention to the instructions in the problem sets.

2. Core Curriculum Course Objective: Students will be able to develop solutions to mathematical problems at the level appropriate to each course.

2.0 Specific Objective: Students will perform specified vector operations and distinguish the result as a scalar or vector quantity.

2.1.1 Plan:

2.1.1.1 Assessment Activity: Rubric-scored exam question.

2.1.1.2 Success Criteria: 75% of students score at or above 70%.

2.1.1.3 Assessment Timeframe: Exam 1

2.1.2 Results:

2.1.2.1 Numerical Results: 81% scored above 70%

2.1.2.2 Assessment Items and Scoring Criteria: Exam 1, Problem #4(a), points possible: 0-7 Students were asked to compute the cross product of two given vectors. Points were alloted for proper setup, computation of the 3, 2x2 determinants, and for the form of the result.

2.1.3 Analysis:

2.1.3.1 Outcome: Exceeded expectations

2.1.3.2 Influencing Factors: Overall student performance was fine, the most common errors were lack of knowledge of the definition of the cross product and sign errors, both of which can be attributed to a lack of practice.

2.1.3.3 Next Action: Continue to point out the most common errors and encourage them to practice.

2.1 Specific Objective: Given a multivariable function, students will compute a partial derivative of specified order and, if instructed, evaluate the partial derivative at a point in its domain.

2.2.1 Plan:

2.2.1.1 Assessment Activity: Multiple choice question.

2.2.1.2 Success Criteria: 75% of students score at or above 70%.

2.2.1.3 Assessment Timeframe: Quiz 6 or Exam 2

2.2.2 Results:

2.2.2.1 Numerical Results: 90% scored above 70%

2.2.2.2 Assessment Items and Scoring Criteria: Quiz 6, Problem #3, points possible: 0 or 4 Description: Compute the first partial of the function f(x,y) = exp(x^2+y^3) and evaluate at the point (1,-1).

2.2.3 Analysis:

2.2.3.1 Outcome: Exceeded expectations

2.2.3.2 Influencing Factors: The majority of errors occurred in the numerical evaluation of the partial derivative rather than the computation of the partial derivative itself. The few who got the wrong answer, failed to apply the chain rule or failed to apply it correctly.

2.2.3.3 Next Action: Continue with current approach.

2.2 Specific Objective: Students will determine the convergence or divergence of an improper integral or an infinite series.

2.3.1 Plan:

2.3.1.1 Assessment Activity: Rubric-scored exam queston

2.3.1.2 Success Criteria: 75% of students score at or above 70%.

2.3.1.3 Assessment Timeframe: Exam 3

2.3.2 Results:

2.3.2.1 Numerical Results: 61% scored above 70%

2.3.2.2 Assessment Items and Scoring Criteria: Exam 3, Problem #4, points possible: 0 - 14 Description: Evaluate the integral or determine that it diverges. definite integral from -2 to 14 of 1/(x-6)^4/3. Scoring: 0 pts if they did not identify the infinite discontinuity, 7 points if they did and wrote an appropriate limit statement, 11 if they then integrated correctly, and 14 if they passed to the limit and drew the correct conclusion.

2.3.3 Analysis:

2.3.3.1 Outcome: Failed to meet expectations

2.3.3.2 Influencing Factors: 34% of the students failed to see the infinite discontinuity at x = 6.

2.3.3.3 Next Action: Emphasize that improper integrals only fall into two categories one that is obvious the other requires they examine the integrand with a critical eye. Theinstructions alone should have clued them to be on the look out for an infinite discontinuity.

3. Core Curriculum Course Objective: Students will be able to describe or demonstrate mathematical solutions either numerically or graphically.

3.0 Specific Objective: Students will become familiar with polar coordinates and graphs of polar equations.

3.1.1 Plan:

3.1.1.1 Assessment Activity: Multiple choice question

3.1.1.2 Success Criteria: 75% of students score at or above 70%

3.1.1.3 Assessment Timeframe: Final Exam

3.1.2 Results:

3.1.2.1 Numerical Results: 80% scored above 70%

3.1.2.2 Assessment Items and Scoring Criteria: Final Exam, Problem #1, points possible: 0 or 6 Description: Find the equation for the graph shown in the figure. The graph was of a dimpled limacon, they were given 4 equations to select from as well as a "none of the above" option.

3.1.3 Analysis:

3.1.3.1 Outcome: Exceeded expectations

3.1.3.2 Influencing Factors: Most of those that erred, selected the equation of a limacon with inner loop, so they were in the correct family of polar curves.

3.1.3.3 Next Action: Emphasize that some familiarity with the family of curves together with knowledge of the quadrant intercepts will go along way to provide a rough sketch of the curve.

3.1 Specific Objective: Students will provide numerical results in a prescribed manner, as a percent, an interval, or with specified accuracy.

3.2.1 Plan:

3.2.1.1 Assessment Activity: Rubric-scored question

3.2.1.2 Success Criteria: 75% of students score at or above 70%.

3.2.1.3 Assessment Timeframe: Exam or Quiz TBD

3.2.2 Results:

3.2.2.1 Numerical Results: 40% scored above 70%

3.2.2.2 Assessment Items and Scoring Criteria: Final Exam, Problem #7, points possible: 0 - 18 Given the power series for ln(1+x) approximate the definite integral from 0 to .4 of root(x)(ln(1+x)) using the first 4 terms of the series expansion. Give your result to two decimal places. Scoring: Points were awarded as follows: 5 pts for the 4 terms of the power series, 4 pts for multiplying by root(x), 7 pts for integrating and evaluating, 2 pts for truncating.

3.2.3 Analysis:

3.2.3.1 Outcome: Failed to meet expectations

3.2.3.2 Influencing Factors: This type of problem is the culmination of two weeks of preparation with sequences and series. It was the last series problem presented in lecture and may not have received much attention by the students (the 27% that scored less than 2 points and 52% that scored less than 5 points may support such a statement). It is also a multistep problem which can go awry at any step along the way.

3.2.3.3 Next Action: This is a higher level sequence of manipulations and should not be used as an assessment question in the future.

4. Core Curriculum Course Objective: Please include below any other/additional non-core-curriculum course objectives you will assess and evaluate.

AT6 ASSESSMENT REPORT
07f: General Chemistry I - Chart 030 031

1. Core Curriculum Course Objective: Students will be able to describe laws, theories or findings basic to the science discipline.

1.0 Specific Objective: Students will be able to use basic concepts in quantum theory and chemical bonding theory to predict the electronic and 3-dimensional structures of representative compounds

1.1.1 Plan:

1.1.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

1.1.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

1.1.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

1.1.2 Results:

1.1.2.1 Numerical Results: Met expectations: 68.45% Failed to meet expectations: 31.55%

1.1.2.2 Assessment Items and Scoring Criteria: Set of 17 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

1.1.3 Analysis:

1.1.3.1 Outcome: Failed to meet expectations

1.1.3.2 Influencing Factors: Difficulties with quantum numbers, Bohr model of hydrogen atom, drawing and interpretation of Lewis structures contributed to those with unmet expectations

1.1.3.3 Next Action: Provide students with additional examples in lecture and exercises (on homework, quizzes or exams) regarding quantum numbers, Bohr model of hydrogen atom, and drawing/ interpretation of Lewis structures

1.1 Specific Objective: Students will be able to properly name/give the appropriate chemical formula of elements, molecules and compounds, and to predict and balance chemical reactions (demonstrating a basic understanding of the properties of chemical materials).

1.2.1 Plan:

1.2.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

1.2.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

1.2.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

1.2.2 Results:

1.2.2.1 Numerical Results: Met expectations: 84.42% Failed to meet expectations: 15.58%

1.2.2.2 Assessment Items and Scoring Criteria: Set of 11 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

1.2.3 Analysis:

1.2.3.1 Outcome: Met expectations

1.2.3.2 Influencing Factors: Students in general comfortable with naming elements and compounds, and with balancing chemical reactions helped achieve expectation goals

1.2.3.3 Next Action: Continue the successful presentation of this material

2. Core Curriculum Course Objective: Students will be able to apply scientific laws and principles of the discipline to arrive at problem solutions.

2.0 Specific Objective: Students will be able to predict the direction and magnitude of energy changes and perform thermochemical calculations (demonstrating an understanding of the role of energy in physical changes and chemical reactions)

2.1.1 Plan:

2.1.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

2.1.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

2.1.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

2.1.2 Results:

2.1.2.1 Numerical Results: Met expectations: 59.42% Failed to meet expectations: 40.58%

2.1.2.2 Assessment Items and Scoring Criteria: Set of 6 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

2.1.3 Analysis:

2.1.3.1 Outcome: Failed to meet expectations

2.1.3.2 Influencing Factors: Difficulty with heat of formation definition, and with the calculation of reaction enthalpy using bond energies (not covered in class) contributed to those with unmet expectations

2.1.3.3 Next Action: Provide students with additional examples in lecture and exercises (on homework, quizzes or exams) regarding these topics that students had difficulties with; cover use of bond energies for calculation of reaction enthalpy

2.1 Specific Objective: Students will be able to interpret experimental data (in text, tabular and graphical forms) by appropriately setting up and solving scientific problems using dimensional analysis with proper attention to scientific units and significant figures

2.2.1 Plan:

2.2.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

2.2.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

2.2.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

2.2.2 Results:

2.2.2.1 Numerical Results: Met expectations: 75.53% Failed to meet expectations: 24.47%

2.2.2.2 Assessment Items and Scoring Criteria: Set of 18 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

2.2.3 Analysis:

2.2.3.1 Outcome: Met expectations

2.2.3.2 Influencing Factors: Students in general comfortable with appropriately setting up and solving scientific problems using dimensional analysis with proper attention to scientific units and significant figures.

2.2.3.3 Next Action: Continue the successful presentation of this material

3. Core Curriculum Course Objective: Students will be able to explain how experiments or observations validate or test scientific concepts.

3.0 Specific Objective: Students will be able to apply the gas laws and kinetic molecular theory to processes involving gases (demonstrating an understanding of the properties of gases)

3.1.1 Plan:

3.1.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

3.1.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

3.1.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

3.1.2 Results:

3.1.2.1 Numerical Results: Met expectations: 66.88% Failed to meet expectations: 33.12%

3.1.2.2 Assessment Items and Scoring Criteria: Set of 5 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

3.1.3 Analysis:

3.1.3.1 Outcome: Failed to meet expectations

3.1.3.2 Influencing Factors: Difficulties with combined gas law and effusion calculations contributed to those with unmet expectations

3.1.3.3 Next Action: Provide students with additional examples in lecture and exercises (on homework, quizzes or exams) regarding combined gas law and effusion calculations

3.1 Specific Objective: Students will be able to use basic concepts, including quantum theory and chemical bonding theory, to predict the chemical properties (e.g. periodic trends, reactivities) of representative compounds and materials

3.2.1 Plan:

3.2.1.1 Assessment Activity: group of one or more multiple choice questions on a standardized final exam requiring a student to demonstrate these skills (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society)

3.2.1.2 Success Criteria: The class performance on each question (where class performance is the percent of students that get the question correct) will be averaged together to generate an overall average for all questions for this objective. At least a 70% overall average will be required to be deemed successful

3.2.1.3 Assessment Timeframe: Assessment will occur at the end of the semester using a standardized final exam

3.2.2 Results:

3.2.2.1 Numerical Results: Met expectations: 65.42% Failed to meet expectations: 34.58%

3.2.2.2 Assessment Items and Scoring Criteria: Set of 12 multiple choice questions on a standardized final exam (First Term General Chemistry Exam, Form 2006, prepared by the Examinations Institute of the American Chemical Society). We are not allowed to duplicate actual contents of questions--each is written in a multiple choice format, with 4 answers possible. Each question was graded as right or wrong for each student. The class performance on each question (where class performance is the percent of students that get the question correct) was averaged together to generate an overall average for all questions for this objective. At least a 70% overall average was required to be deemed successful.

3.2.3 Analysis:

3.2.3.1 Outcome: Failed to meet expectations

3.2.3.2 Influencing Factors: Difficulties with periodic trends, bond electronegativity, and the relationship between lattice energy and other physical properties contributed to those with unmet expectations

3.2.3.3 Next Action: Provide students with additional examples in lecture and exercises (on homework, quizzes or exams) regarding periodic trends, bond electronegativity, and the relationship between lattice energy and other physical properties

4. Core Curriculum Course Objective: Please include below any other/additional non-core-curriculum course