Transforming Undergraduate Education: List of Funded Proposals

Program: Digital Calculus Coach
Institution: UT Dallas
Primary Investigator: Dr. Monica Evans

The *Digital Calculus C*oach is an educational game designed to teach the basic concepts of calculus to university students through good game design, visualization, applied problem solving, and immersive entertainment. In the game, players control an avatar through a variety of gameplay worlds that are powered by equations, functions, and calculus concepts. The player moves through these worlds in a non-linear but hierarchical way, so that introductory concepts are mastered before moving on to more complex concepts. Each world has a variety of games and challenges, each one expressing the concepts under investigation in a different way and with a different type of gameplay. The player's goal is to explore each world fully in order to gain points and achievements, to collect useful in-game items, and to complete a larger mystery about the worlds themselves.

The player is assisted by the Calculus Coach, a non-player character that offers assistance, solves example problems, explains concepts, and answers common real-life questions such as, "What is calculus good for?" and "How does this apply to my real life?" The Coach also grants access to multiple modes of play, including the "test preparation" mode in which players can take sample exams and work problems in traditional but interactive ways (as well as the non-traditional ways presented in the game spaces).

The *Digital Calculus Coach* has a wide range of applicability and addresses many of the difficulties with math and science education at the university level. By utilizing the principles of computer game design, visualization, social networking, and new research in educational technology, the *Digital Calculus Coach* is well suited to the needs of our technologically demanding students. The program increases student access to self-paced, individual calculus instruction, reduces costs for both students and the University, reaches out to underprivileged or at-risk students whose needs may not be met by traditional calculus instruction, and appeals to students accustomed to multiple media and technologies and who have high expectations for their sophistication, interactivity, and ease of use.

Transforming Undergraduate Education: List of Funded Proposals

Program: Transforming Engineering Programs in Order to Improve Retention and Graduation Rates
Institution: UT San Antonio
Primary Investigator: Dr. Mehdi Shadaram

Although the majority of our incoming freshmen pass Pre-calculus while in high school, unfortunately, about 75% of them fail the placement test and are not qualified to register in the Calculus I course. Typically, students have to take Calculus I followed by Calculus II and Physics classes in order to satisfy the pre-requisite requirements for the core engineering classes. Considering mathematics and science deficiencies among our students, it usually takes several semesters for the majority of them to register in the basic engineering classes.

The objectives of the proposed project are:

1) To create a new mathematics sequence, with the engineering applications, in order to prepare students for the basic engineering classes during their freshman year.
2) To revamp the engineering curriculum based on the changes in the mathematics sequence.
3) To develop a continuous quality improvement (CQI) model to monitor, track, control, and feedback performance outcomes on our program.

We aspire to incorporate the ideas from the newly developed course, known as EGR 101 “Introductory Mathematics for Engineering Applications” at the Wright State University to create an introductory mathematic course, Just in Time Mathematics (JITM), for students who are math and physics deficient. Taught by engineering faculty, the JITM course includes lecture, laboratory and recitation components. Using an application-oriented, hands-on approach, the JITM addresses only the salient math topics actually used in the core entry-level engineering courses, allowing students to advance in the engineering curriculum without first completing the required calculus sequence. This will shift the traditional emphasis on math prerequisite requirements to an emphasis on engineering motivation for math, with a "just-in-time" structuring of the new math sequence. To achieve our vital goal of improving retention and graduation rates, we will also need to modify the pre-requisite requirements for the basic engineering courses and incorporate application of math in specific engineering courses.

Transforming Undergraduate Education: List of Funded Proposals

Program: Transforming Undergraduate Education to Create Significant Learning
Institution: UT San Antonio
Primary Investigator: Dr. John F. Reynolds

The faculty in the departments of biology and history at The University of Texas at San Antonio (UTSA) and the University of Texas-Pan American (UTPA) propose to promote active learning in their introductory freshman level courses with the help of the internet and information technology. The designated courses are currently taught in large classrooms where the lecture serves as the primary mode of instruction. We will first develop a web enhanced version of our introductory biology and history courses where much of the content will be presented in modules designed for the web. This will free up class time to allow for discussions, problem based learning exercises, case studies or other collaborative activities to reinforce key concepts. It will also allow us to test out our modules and refine their content to maximize quality and clarity. In our second and third years we will expand these modules to develop hybrid or blended versions of these courses with more of the instruction taking place over the internet and students meeting once a week in smaller sections.

Our course redesign has several benefits to the students and the institutions they attend. Numerous studies have demonstrated that the standard “chalk and talk” lecture format is inefficient or perhaps even counterproductive to fostering the “deep learning” college courses are expected to impart. We need to engage students’ imaginations and cognitive skills in the classroom with exercises that get them thinking and acting like scientists or humanists. UTSA and UTPA will reap the benefits of this new format of instruction in higher course completion rates that promise to improve retention and graduation rates. In addition, the prospect of more student learning taking place outside the classroom will alleviate an increasingly critical space utilization problem faced by UTSA, UTPA and other University of Texas institutions

For an independent opinion of our teaching modules and in-class activities, we have called upon the history faculty at UTPA. They will play a key role in furnishing feedback from an institution with a student profile similar to UTSA. Some UTPA historians will participate in pedagogical workshops at UTSA as well. In the spring of 2011 UTSA participating faculty will bring their modules, handouts, syllabi and other course materials to UTPA for a full day workshop. In this way, the UTPA faculty will help with disseminating the instructional materials prepared through the grant.

Transforming Undergraduate Education: List of Funded Proposals

Program: Building Immersive Instructional Experiences and Learning Communities in Second Life
Institution: UT Austin
Primary Investigator: Dr. Leslie H. Jarmon

This project would offer a creative approach to undergraduate instruction that makes innovative use of a 21st century free online virtual world technology called Second Life (SL). Web 2.0 and Web 3.0 (three-dimensions) converge with this technology, and it increases student access to higher education and improves undergraduate learning experiences and opportunities. We intend to initiate a UT System-wide virtual learning community that supports individual student success and long-term learning while reducing overall instructional costs. We also envision that the UT System can use this high-profile pilot to leverage its ROI and to enhance its position in securing state and federal American Recovery and Reinvestment Act funding as well as new NSF and NIH funding for pioneering cyber-learning and cyber-infrastructure educational projects.

At the UT System level this proposal recommends that, after a high-level briefing of participating campuses during summer 2009, the UT System purchase and create a virtual archipelago of islands in SL. The UT System Archipelago will consist of three islands per campus with one central island for System-wide collaboration activities for a total of 49 islands. The proposed model suggests that for each campus, one island might be used for administrative, training and orientation operations while the other two islands can evolve in ways decided by individual colleges, departments, faculty members and/or by those identified as early adopters or “change agents” on each campus.

At the course level, this proposal presents strategies to transform the learning experiences and opportunities for the successful individual undergraduate student. Introduction and integration of virtual learning activities into existing curricula can apply to undergraduate courses offered in the classroom as well as to distance-learning courses offered online.

The creation of the System’s virtual collaborative learning community of students, faculty, researchers and administrators will allow everyone to learn, share, collaborate and grow alongside one another as new models emerge and as diverse needs and challenges surface. Step by step in our evolving system-wide virtual learning community, we want to imagine all of these players - and especially our undergraduates – as learners with expanded roles: learners as scientists, learners as designers, learners as researchers, learners as communicators, learners as collaborators. The ethic is generosity: passing it on to colleagues and peers and thereby widely extending one’s own support network.

Transforming Undergraduate Education: List of Funded Proposals

Program: Use of Gaming Technology to Improve Minority/Disadvantaged College Students' Performance in Organic Chemistry

Institution: UT Southwestern

Primary Investigator: Dr. Lewis E. Calver

This project will be designed for undergraduate students preparing to take organic chemistry, typically in the sophomore year of college. The computer game which teaches organic chemistry will be evaluated in a group of disadvantaged/minority undergraduate students from the Dallas-Fort Worth area who are participants in the Student National Medical Association (SNMA) Scholars Program at UT Southwestern Medical School. The SNMA scholars program, directed by Byron Cryer, M.D., is currently a six-week enrichment experience which emphasizes clinical exposures for minority/disadvantaged undergraduate students with practicing physicians. Dallas-Fort Worth undergraduates are selected for this program through a competitive process for clinical preceptorships with physicians for six weeks during the school year (February to April). For the currently proposed project, the SNMA Scholars program will be modified to a 12-week experience in the summer for minority/disadvantaged students who have completed their freshman year of college and are preparing to take organic chemistry in the fall of their sophomore year. In this proposed project, a classroom preparatory organic chemistry course will be added to their clinical experience. This course will be taught by doctoral students in the Biochemistry Department at UT Southwestern School of Biomedical Sciences under the direction of Dr. John MacMillan. Numerous graduate students in Biochemistry at UT Southwestern have expressed a desire for teaching opportunities such as this.

The main objective of this proposal is to determine to what extent organic chemistry knowledge (functional groups, stereochemistry, and bonding theory) is improved as a result of utilizing gaming technology for learning in undergraduate students. An experimental design will be used to test the effectiveness of organic chemistry gaming technology. Furthermore, we will measure specific achievement outcomes which we anticipate will provide evidence of a causal relationship between our gaming technology intervention for learning organic chemistry and student achievement (content knowledge and cognitive level).

Transforming Undergraduate Education: List of Funded Proposals

Program: The Large Class Dashboard: Incorporating Technology to Promote Student Success in Large Classes

Institution: UT El Paso

Primary Investigator: Dr. Charles Ambler

This two-year project will introduce technology solutions in large class settings to facilitate student success and enhance faculty efficiency. A "dashboard" based in a digital grade book will enable faculty to monitor participation, communicate with class members, make effective interventions with at-risk students, and manage these activities efficiently. It will also facilitate assessments of these activities that incorporate information from institutional databases, thereby permitting continuous research on student success. The dashboard will be piloted in the PI's large classes and then extended to other UTEP classes. The goal is an approach that can be adopted for use in large classes across the UT System.

This project will develop easy-to-use, scalable technology-based approaches that permit intensified engagement with individual students while reducing workloads for instructors. Student populations are rapidly evolving in terms of their preparation and approaches to learning. Thus, continuous evaluation built into the approach makes it possible for instructors to be selective in the interventions they introduce and flexible in the development of new strategies.

The first phase of this project focuses on the introduction and evaluation of technology-enhanced interventions (developed in consultation with colleagues on other UT System campuses) in the PI's large classes and the introduction of a campus-wide seminar series on large-class instruction. Based on an assessment of this effort, the second phase extends the project with the introduction of these interventions in other large classes on the UTEP campus and the presentation of preliminary results on UT System campuses. A third phase involves assessment of results from phase two and the dissemination of findings on the UTEP campus, on UT System campuses, at national meetings and in published form. A final report will assess the success of the project in terms of increased student success in targeted classes and faculty participation, satisfaction and efficiency.

Transforming Undergraduate Education: List of Funded Proposals

Program: Inquiry Learning Across the Sciences: A New Model for Teaching Science to Non-Science Majors

Institution: UT Austin

Primary Investigator: Dr. Sacha E. Kopp

The College of Natural Sciences at UT Austin seeks to transform how undergraduate service courses in the sciences are offered. We wish to focus our curriculum on ensuring non-science majors graduate with core scientific understanding and a clear understanding of the scientific method essential for an informed citizenry. Our current core science curriculum consists of 9 credits, at least six of which must be a sequence. At present, students enroll in science courses offered by specific departments. Most are 'scaled down' versions of courses offered to majors, and thus discipline-specific skill-building courses, rather than ones that offer a broad overview of the sciences. By construction, this system guarantees an incomplete coverage of the sciences as a whole. Further, technical jargon in discipline-specific courses can obscure scientific concepts that transcend all the sciences, and obscure the interconnectedness of the various disciplines in the College.

This project seeks to re-focus how undergraduate service courses in the sciences are offered. Faculty from multiple disciplines will collaborate to develop and teach the new classes, bringing multiple perspectives to the curriculum. Such collaboration has the positive effect of a more successful explanation of physical phenomena, removed of technical jargon of each individual field. Topics in the course are selected to be those that form the foundational bases of all the sciences. This new curriculum will be available as part of the science core for the entire university. With this curriculum, graduates will leave with a basic understanding of the "Big Ideas" in the sciences.

The course is organized in topical modules, with each module using the tools of all the disciplines. The module-based format conforms to some of the best research on project-based instruction being used to engage student interest. The first semester, focusing on energy and atomic theory, is the core foundation for the subsequent curriculum. The theme of matter and energy flow through systems will be the foundational basis for all subsequent modules. After Semester 1, students can branch off into any or all of the subsequent semesters.

Transforming Undergraduate Education: List of Funded Proposals

Program: Development of a Game-Based Experiential Learning Program to Help Students Adapt to University of Texas Culture

Institution: UT Dallas

Primary Investigator: Dr. Michael J. Savoie

The purpose of this research study is to develop cognitive and analytical skills in freshman using a gaming/simulation model to create an online learning environment about something that directly affects students in their day-to-day lives on campus but which is rarely addressed on any of the UT campuses – financial and time management. While the basic outcome of this grant is the development of a ready-to-present course, this proposal is about more than course development. The goal is to develop a methodology and framework for an online learning environment that promotes analytical thought and problem solving skills, rather than the "seek and find" framework of current online methodologies. It is also intended the make the student more proactive in understanding what is expected of them by the university and showing them where help is available on campus should they need it.

The project will begin with an analysis of existing outreach programs at the various UT campuses. From this analysis, we will create a Game Profile Document (GPD) which will highlight the key learning objectives of the game, the game platform and the desired user interface. The GPD also provides a high-level overview of the game environment (i.e. campus, classrooms, bookstore, local restaurants, retailers, etc.). The GPD is then fleshed-out into the Game Development Document (GDD) which provides the details of each aspect of the game along with sample scenes, illustrations, etc. The GDD is added and enhanced by the various team members and ultimately becomes the script for the game. Along with our partners, we will use the Game Development Document to create the various assets (images, objects, etc.) to be used in the game. These will be stored in an Asset Library so they can be reused in future games.

Utilizing the GDD, an initial game will be constructed and tested. Various focus groups will be used to test the platform, interface, and look and feel of the game. Surveys as well as in-person interviews are used to determine if the game is meeting the learning objectives and desired outcomes. Once alpha testing is complete, the game will be made available to students at UTD and UTA for beta testing. Students will be monitored and surveys administered throughout the academic year to see if students find the game helpful in dealing with the issues facing them on campus. Results of the surveys and student feedback will be used to upgrade the existing game. This information will also be used as input for the design of new games to meet the needs of current and future students.

Transforming Undergraduate Education: List of Funded Proposals

Program: Peer-Led Team Learning: Creating a Community of Scholars in Math and Science
Institution: UT Dallas
Primary Investigator: Dr. John W. Sibert

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. Peer-Led Team Learning (PLTL) is a highly collaborative program that we are adapting 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. It involves small group, mandatory weekly study sessions with typically scripted questions led by a more senior undergraduate student. Faculty involvement is restricted to the creation of that week's set of questions/problems. They are not present or involved in the actual group work. In various forms, it has proven to be a powerful method for engaging student interest in STEM (and other) fields, enhancing student engagement through active learning, improving student ability to work in groups, and developing student leadership. It is a "learning by doing" approach. Importantly, a core value of PLTL is its design 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."

We propose to introduce PLTL into organic chemistry I and II and the gateway physics course sequence which are all large enrollment offerings with multiple downstream linkages to upper division coursework across many STEM majors. Extending across these disciplines will engage faculty in linking and reinforcing concepts common to a more cohesive, aligned curriculum. In fact, a multidepartmental, cohesive PLTL program would allow for faculty to *identify* the key concepts needed in the large enrollment introductory courses and *reinforce* those concepts with clear connections to concepts that will be needed in later courses through the PLTL exercises. This fits well with UT Dallas' interest and current efforts in developing an aligned curriculum for its math and science intensive degree programs.

Transforming Undergraduate Education: List of Funded Proposals

Program: Can Game Play Teach Student Nurses How to Save Lives -- An Undergraduate Training Proposal for Student Nurses in Pediatric Respiratory Diseases with a Living World Gaming Construct

Institution: UT Arlington, UT Dallas

Primary Investigator: Dr. Judy L. LeFlore

The purpose of this project is to develop an undergraduate training program for student nurses for pediatric respiratory disease content using a living world gaming construct. The project is lead by the University of Texas at Arlington's School of Nursing with substantial faculty collaboration and lab support from the Institute for Interactive Arts and Engineering from the University of Texas at Dallas. A living world gaming construct offers a nonlinear, unscripted process for experiencing and safely learning the cognitive complexity and nuance of situations through emergent high-fidelity simulation. The living world construct uses visual, auditory, behavioral, and cultural models for virtual training.

Phase One will involve the creation of a living world game. Using the living world construct put forth by the University of Texas at Dallas, we propose to create a virtual clinical experience for nursing students that will provide the most realistic setting possible, outside of a hands on traditional encounter, than has yet been created. The proposed game will present the student with pediatric scenarios. The patients will display symptoms that respond to student action and inaction. Students will need to assess the patient's condition, make judgments about care, implement care decisions and procedures in a timely manner, and interact with the patient's parents, the physician, and others on the healthcare team. The game can be set to challenge the level of the student by altering the degree of complexity, by changing the patient's symptoms that require changes in the treatment plan, by changing the age of the patient, and by changing the nature and intensity of environmental and interpersonal stressors (such as the parent's reaction). At the end of each session, the student receives an in-depth assessment of his/her care decisions and, if those decisions did not yield improvement in the patient's condition, a root cause analysis of care events that contributed to worsening of the patient's condition.

In Phase Two we will conduct an experiment that compares the learning approaches of those that receive the living world instruction versus traditional instruction methods. Phase Three will focus on an analysis of the outcomes which can then suggest further development criteria and cross system rollout of the program with a further virtual education plan.

Transforming Undergraduate Education: List of Funded Proposals

Program: Substantive Redesign: The Large American History Survey
Institution: UT Austin
Primary Investigator: Dr. Penne L. Restad

This proposal seeks to ensure broader student success and realize richer intellectual communication in the American history survey by more actively engaging students in the learning process, utilizing the motivational and intellectual advantages of students working collaboratively, and employing the vast pedagogical resources and possibilities available in computer-based databases. It seeks to engage students who otherwise feel lost in the passivity and anonymity of large lecture courses, enhancing the experience of even those students who would ordinarily "succeed" in the traditional large lecture by revitalizing the process of learning.

In planning a new approach to the survey, the proposal seeks a broader interaction with other units of the College and University and a role in the preparation of those entering middle school and high school teaching. It draws together a member of the history department, graduate assistants, instructors and students in UTeach, and group learning experts from DIIA. It thus seeks a model for an interactive continuum between regular college students, Liberal Arts students who are training to teach social studies in public schools throughout Texas, and advice from instructional experts whose major focus has been the application of group learning to the university setting.

Over the course of three years, the PI, with the assistance of a graduate research assistant (GRA) and students selected from the UTeach Liberal Arts program, will design, teach, and critically evaluate a history course that centers on collaborative, problem-based learning to utilize effectively the increasingly rich troves of primary and secondary history resources available through the Internet and university databases. The GRA, a graduate student in American History, and UTeach students enrolled in the history course will be closely involved in creating, critiquing, and implementing the new course. The project will take into consideration scholarship and professional opinion specifically related to teaching history and the history survey at the college level. It will also utilize fully the newest scholarship relating to teaching as a discipline in its own right.

The findings of the project will be disseminated through research presentations at appropriate professional conferences and in workshops. In addition, largely through its integration of UTeach, we will be developing teaching models adaptable to middle and high school history classes and providing a more seamless connection between pre-collegiate and collegiate educational experiences.