DEMOS WITH POSITIVE IMPACT: A PROGRESS REPORT

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Introduction

DEMOS with POSITIVE IMPACT[1] is a project to connect mathematics professors with effective teaching tools. The project, initiated in 1998 and announced at the Eleventh International Conference on Technology in Collegiate Mathematics[1], will develop a web-based database of instructional demonstrations for teaching topics in undergraduate mathematics. This is a report of progress-to-date on this project and an invitation to participate in the project.

Background

At many institutions, classroom instruction is primarily 'instructor centered' and delivered in a lecture format. While student-centered approaches should be in our future goals, current physical environments, technology constraints, and current reward structures for development of teaching materials are not always favorable to a student-centered approach using technology. In general, faculty members do not have

- time to develop technology-enhanced lessons,
- confidence in ability to develop effective lessons utilizing technology, and
- motivation from administrators to encourage spending time on these activities.

In addition, new faculty members often do not have teaching experience, experience using available technology, experience in developing lessons that utilize technology. Instructors need to find ideas that are easily incorporated into a lesson, are field-tested when possible, do not require excessive preparation, and do not go beyond the constraints of equipment or expertise.

Thus, we see a need for a collection of carefully constructed resources designed to be used by the instructor for illustrating concepts across the mathematics curriculum. These resources should utilize various technologies that are available for a lecture setting. In addition, this resource should be widely available and in the public domain.

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'Demos' vs. Student-Centered Activities

Much of the work to date in the area of integrating technology into mathematics instruction has focused on making the classroom more student-centered. As a result, many projects have produced software-based notebooks, tutorials, exploratory modules as aids for student learning. In any form of instruction (lecture, software-assisted modules, self-study manual, lab investigation, or distance learning), however, the instructor plays an important role. Thus, good demonstrations that accompany the ideas and concepts in the lesson are a requirement. Presenting information in a manner that fosters an intuitive understanding of concepts is perhaps the greatest challenge of mathematics instruction[2].

What we have in mind is a vignette incorporated within a lecture, discussion, or presentation that engages the learner on a level beyond that created by the accompanying dialogue of the instructor. In contrast to student activities such as projects or lab activities, these vignettes are to be presented by the instructor.

We emphasize the use of instructional technology for DEMOS with POSITIVE IMPACT because technology encourages 'teacher-as-facilitator approaches' [3] while providing great flexibility for the instructor and for the student through visualization components inherent in technologies.

Project Goals

The main goal of DEMOS with POSITIVE IMPACT is to develop an extensive database of high quality instructional demonstrations for teaching mathematics and to connect this resource to undergraduate mathematics instructors. Our plan to achieve this goal is to

- make the database web-based,
- collect tried-and-tested ideas from colleagues and peers,
- evaluate merit of demos based on informal user feedback and formal peer review, and to
- disseminate information via peer networking as well as print and electronic media advertisement.

We envision this project to have four facets: we must GET ideas for demos, PROCESS the demos into a web-friendly format, DISSEMINATE information about the project, and EVALUATE the demos, database design and usefulness.

An important mission of this project is to seek out colleagues and peers who are willing to share their successful ideas and demos for adaptation and distribution via the web database. Experienced instructors have private toolboxes of instructional demos, conceptual approaches, or physical gadgets they use to encourage students to tune-in to the mathematics. By tapping this rich, but largely unharvested resource of tried-and-tested ideas, we will utilize the experience of our colleagues to build the demo database.

The issue of quality control of the demos in the database is an important one. A formal peer evaluation process will be established to review and judge the educational merit of each demo. In addition, an informal evaluation procedure will be put into place to allow users to critique the demos they use in their classes. Evaluation of the database will also involve an assessment of the appeal of the design of the database and its general educational usefulness.

This database will be beneficial only if we can effectively spread the word about the project. Thus, we will utilize various print and electronic media, as well as personal and professional contacts to advertise the database as an important resource of instructional materials for undergraduate mathematics faculty.

A Progress Report

A prototype database has been established at the URL:

http://www2.gasou.edu/facstaff/lroberts/demos.

The database is organized according to various instructional technologies and content (course) area (Fig. 1). This organization will make the database even more appealing to faculty members who lack experience, time, or confidence to develop technology-enhanced demos. Within this classification scheme, we plan to include demos from

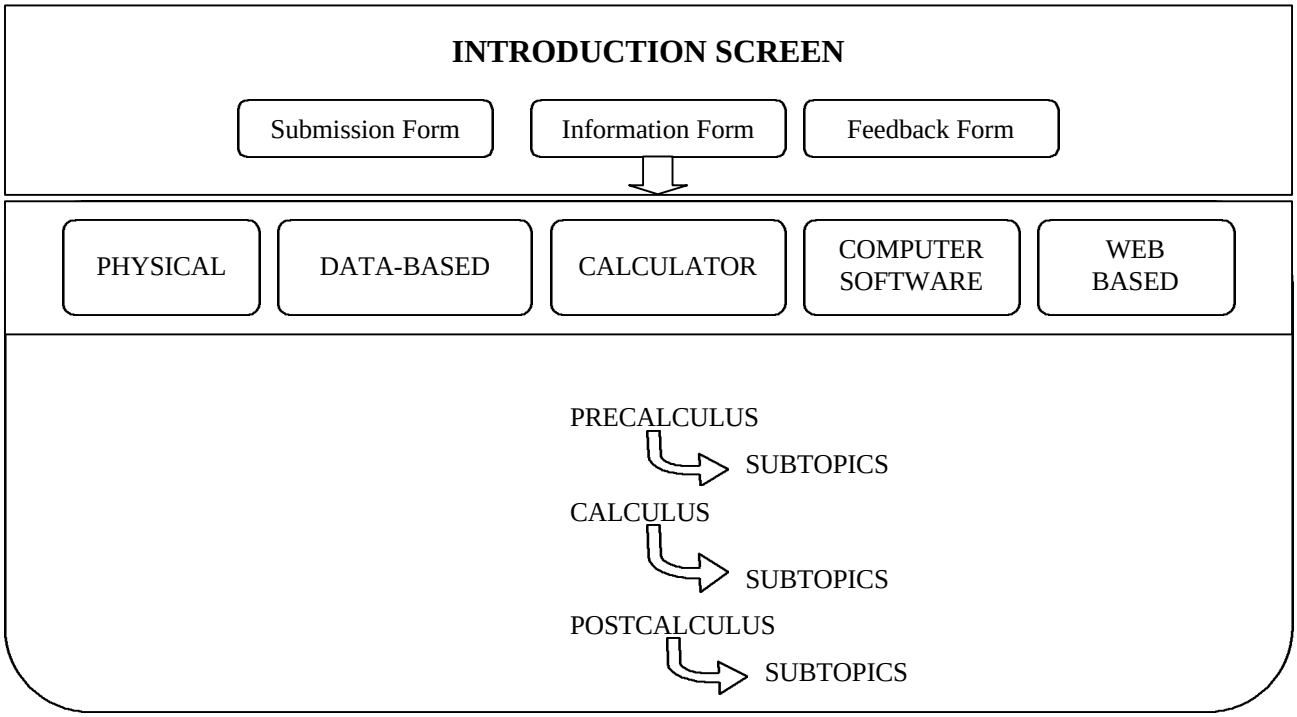

Figure 1. Schematic of Database Map

precalculus, calculus, and post-calculus areas of the undergraduate mathematics curriculum.

Currently, there are several demos on-line. In addition to those that were cited in [1], several others are noteworthy. The following is a list of recently included demos.

- **Investigating Conics: Eccentricity.** This is a software-based demo for analytic geometry that investigates the geometric effect of varying the eccentricity in a conic.
- **Sail Construction**. This is a physical demo that demonstrates various strategies for constructing a sail with maximum area using a pole of fixed length. This demo is presented from three different points of view: prealgebra, precalculus, and calculus.
- **Parabola!** This data-based demonstration shows in an immediate way that parabolas arise as graphs of natural phenomena. A ball is given a push up an inclined plane, and its progress up and then down is recorded by a motion sensor. The time vs. distance graph appears on a computer monitor. This demo is appropriate for precalculus and calculus.
- **Leaky Faucet**. This data-based demo illustrates that a leaky faucet can be modeled using a linear function and that the model can be used to predict how much water is wasted as a result of a leak.
- **Circular Functions**. This demo illustrates how sine and cosine can be defined by wrapping around a circle.

In the demos, animated graphics are employed whenever possible to show how a particular demo works. In addition, links are included to enable users to obtain relevant computer codes.

A recent development is that the National Science Foundation has agreed that the idea of an instructional resource of this nature would be an important and exciting contribution in mathematics instruction. NSF has awarded a CCLLI-EMD proof-of-concept grant to the authors to support the establishment of a permanent DEMOS with POSITIVE IMPACT instructional database on the World Wide Web.

An Invitation for Participation

In order to be able to develop a significant number of demos that represent the major concepts in undergraduate mathematics and to establish that this project is useful to a wide segment of the mathematical community, we must encourage active participation from a large number of our colleagues.

To that end, we invite our colleagues to submit ideas for demos. We do not expect 'web-ready' submissions but rather, ideas that have been tried and that work in the classroom to teach concepts in mathematics. In addition, we ask for feedback on the site as it develops as well as feedback on the demos that may be downloaded and used in class.

Tell us what works and what might need to be changed. Suggestions for greater accessibility and usability are also encouraged.

Summary

DEMOS with POSITIVE IMPACT is an exciting project that will provide a valuable instructional resource for mathematics professors at all levels of the undergraduate curriculum. We encourage our colleagues to visit the URL above, give us feedback, and contribute ideas that we can incorporate into the database. This project has excellent potential to make a positive impact on teaching and learning mathematics.

References

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3. Beth Mcgrath, 'Partners in Learning: Twelve Ways Technology Changes the Teacher-Student Relationship,' ***T.H.E. Journal***, Volume 25, No. 9, April, 1998.