Discovering the Art of Mathematics

Summary

This is a ***Phase I*** proposal for a project whose focus is the ***creation of learning materials and teaching strategies***. The goal of this three-year project is to develop, test, refine, and distribute a library of ten inquiry-based learning guides and supplemental teacher resources entitled Discovering the Art of Mathematics. The material's primary audience is college-level Mathematics for Liberal Arts (MLA) students, but also includes several secondary audiences (e.g. gifted or home schooled secondary students, independent study students, and adult non-specialists). As completed texts, each guide in the library will be approximately 100 pages in length. Any two of these guides will provide an appropriate body of curriculum materials for a typical semester-long MLA course. The guides will be largely independent of one another so teachers may choose any combination of the texts to use with a particular class.

The goal of the Discovering the Art of Mathematics library is to provide compelling, high quality curriculum materials and supplemental teacher resources with the following characteristics:

§ The pedagogy is radically student-centered, providing a striking alternative to traditional texts which are generally structured around a lecture dominant mode of teaching. By pragmatically employing insights from many different inquiry-based and active learning traditions, our approach supports a continuum of individual teaching styles without compromising the student focus. We expect this approach to promote a broad range of meaningful, positive cognitive, meta-cognitive, and affective student gains.

§ The content is engaging, intellectually challenging, and nurtures in-depth explorations of mathematical topics which demonstrate the continuing role of mathematics as a cornerstone of the liberal arts tradition. This liberal arts focus includes: the role of mathematics as an intellectual pursuit, its continuing impact in shaping history, culture, logic, philosophy, and knowledge, its status as humanistic and aesthetic discipline, and its extensive contemporary growth.

Since MLA is generally a "terminal" mathematics course we are not constrained by typical content and coverage demands. Instead, we have focused squarely on the two goals above in choosing content. Work on the initial stage of this project has brought appropriate topics to the fore. These have coalesced into themes for the ten volumes that will make up the library: patterns; the infinite; number theory; knot theory; music; geometry; calculus; games and puzzles; art and sculpture; reasoning, truth, logic, and certainty. When combined with inquiry-based learning, these themes provide powerful vehicles explore the deep connections between mathematics and the liberal arts with this audience.

The initial stages of this project have already demonstrated a high degree of ***intellectual merit***. Drafts of three complete guides and some teacher materials have been completed. Field testing of these materials has motivated transformative changes in the teaching/learning coaction in our classrooms. Evaluation has already demonstrated significant positive cognitive, meta-cognitive, and affective student gains. We will continue this evaluation. Formative and summative evaluation of our materials by students – largely positive thus far – will continue. Project research has already resulted in several scholarly papers. These initial stages have demonstrated the viability and sustainability of this project.

This project will have a ***broad impact***. We expect the full library to be widely distributed by a professional or commercial publisher. The project will be promoted through workshops and presentations at national conferences. A sizable advisory board, already including several nationally known mathematicians, will review, beta test, and provide feedback on each volume in the library.

Our project's direct ***broad impact*** on teaching and learning in Mathematics for Liberal Arts will be supplemented by its influence in important additional areas, including:

- Encouraging the broader use inquiry-based learning in lower division college mathematics courses,
- Illustrating how general education courses can be used to help develop healthier perceptions of mathematics among the general public, and,
- Providing a well-designed and intellectually sound liberal arts curriculum which is a healthy complement to quantitative literacy and applications curricula for MLA courses.

Funding the project Discovering the Art of Mathematics will help promote the health and prosperity of a large, diverse, important undergraduate student population.