



The Art of Teaching Mathematics to Nonmath Majors

By Julian F. Fleron

Many of our liberal arts and humanities students, including our majors in art, history, English, theater, music, dance, and philosophy, are served by single-semester courses generally known as mathematics for liberal arts (MLA) courses. Here are some sobering and perhaps surprising statistics about MLA courses:

- In 2005, MLA was the fourth-largest college mathematics cohort (Conference Board of Mathematical Sciences [CBMS] report, 2007).
- In 2005, 55 percent of courses for MLA students at four-year colleges were taught by faculty who were neither tenured nor tenure track (MAA Committee on the Undergraduate Program in Mathematics [CUPM], 2007).
- As of 2005, 79 percent of MLA courses were taught at two-year colleges using the lecture mode (CBMS, 2007).

Combined with the many challenges MLA students typically bring to such a course—weaker mathemat-

ical preparation, fewer disciplinary connections, negative prior experiences with mathematics, and negative perceptions of the subject—providing a positive, useful experience seems like an enormous task.

A New Vision

The project Discovering the Art of Mathematics (DAoM), started nearly five years ago, has a vision of liberal arts students actively involved in authentic mathematical experiences that

- Are both challenging and intellectually stimulating;
- Provide meaningful cognitive and metacognitive gains; and
- Nurture healthy and informed perceptions of mathematics, mathematical ways of thinking, and the ongoing impact of mathematics not only on STEM fields but also on the liberal arts and humanities.

DAoM provides a wealth of resources for mathematics faculty to help realize this vision in their MLA courses:

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a library of 10 inquiry-based learning (IBL) guides, extensive teacher resources, and many professional development opportunities. These tools enable faculty to transform their classrooms to be responsive to current research on learning (e.g., National Academy Press's *How People Learn*), and the needs and interests of MLA students, without enormous start-up costs or restructuring.

Connecting with MLA Audiences

Connecting mathematics to the disciplinary interests of MLA students has a profound impact on their interest level and motivation. Sample connections from DAoM guides include the following:

- Maypole-weaving patterns, salsa steps, and fractal music in *DAoM - Music and Dance*
- String art and fractals in *DAoM - Calculus*
- Perspective drawing, projections, cross sections, and 3D printing in *DAoM - Geometry*
- Sudoku, CAT scan puzzles, and Rubik's cubes in *DAoM - Puzzles and Games*
- Spirograph, Riemann's hypothesis, and ancient aperiodic tilings in *DAoM - Patterns*
- Paradigm shifts, paradox, burdens of proof, and Gödel's theorem in *DAoM - Truth, Reasoning, Certainty, and Proof*

DAoM supports deep mathematical connections with many areas, helping us meet the challenges laid out by CUPM and others:

College students study the best paintings, the most glorious music, the most influential philosophy,



and the greatest literature of all time. Mathematics departments can compete on that elevated playing field by offering and making accessible to all students intriguing and powerful mathematical ideas. . . . Indeed, these courses [MLA] should be developed and offered with the philosophy that the mathematical component of every student's education will contain some of the most profound and useful ideas that the student learns in college. (CUPM, 2004, p. 28)

Open-Source Curriculum Material

Each of the 10 volumes that make up the Discovering the Art of Mathematics library is available as a free, downloadable PDF file at our webpage, <http://artofmathematics.westfield.ma.edu/>. To date, this includes more than 1,000 pages of curriculum materials.

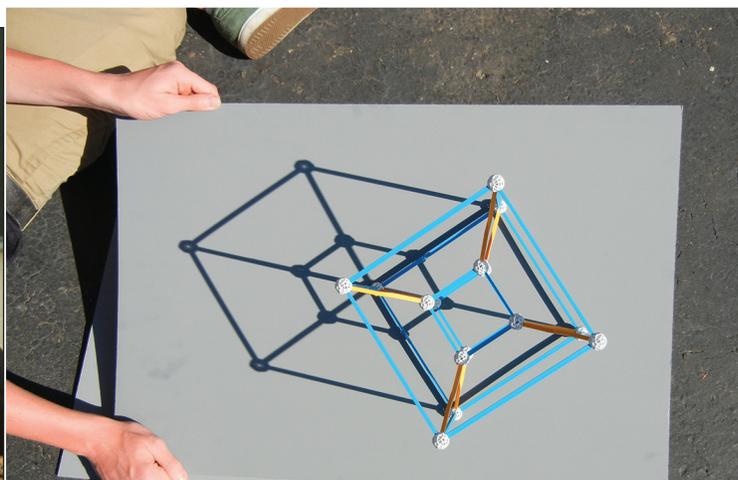
When finished, each volume will provide enough content for at least a semester-long MLA course. Currently, four volumes are complete and ready to beta test, four are nearly complete and ready to beta test with support, and two volumes are in progress, each with several chapters ready to beta test.

Active Student Involvement

The need for more active involvement of mathematics students in the learning process is well documented. Many MLA students' fields revolve naturally around active involvement—think of what our art, dance, and music students routinely do. In addition to being drawn to the cultural, aesthetic, and humanistic elements from



On p. 17 and above: Students' original anamorphic artwork.



Above: Exploring different projections.

the DAoM content, involvement occurs through the use of inquiry-based learning. The curriculum materials that make up DAoM flip the typical lecture dynamic by being built on guided-discovery investigations. Questions, tasks, experiments, constructions, data collection, and discussion prompts replace transcribed lectures and worked-out sample problems followed by banks of routine exercises. To appreciate the transformative impact this has on MLA classrooms, examine the vignette, student journals, and videos available online at <http://artofmathematics.westfield.ma.edu/MLAClassroom.html>.

Relinquishing control of the center stage in your classroom may seem intimidating. But the low-cost, low-risk DAoM curriculum materials provide a practical way to experiment doing just that. Try it: Choose one content area currently included in your MLA course—perhaps large numbers, exponents, or patterns. Find a chapter or section on this in our topic index (<http://artofmathematics.westfield.ma.edu/TopicMatrix.html>). It's easy to use these inquiry-based materials as a replacement unit to flip just a few classes. For many, this small start is the beginning of a transformative approach to teaching and learning.

Navigating New Territory

If you need help, a wealth of resources is available

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through DAoM. DAoM is featured in the 2013 PREP IBL Workshop in June (<http://www.iblworkshop.org/home.html>) and at the Legacy of R. L. Moore Conference, also in June (<http://legacyrlmoore.org/events.html>). In collaboration with AMATYC, DAoM offers two-day, traveling IBL workshops that will come to your institution (<http://artofmathematics.westfield.ma.edu/pd/>).

For those already more experienced in IBL or MLA, we invite your participation. DAoM has opportunities for reviewers and beta-testers for the volumes in our curriculum series.

Finally, senior DAoM project staff are guest editing a special edition of the journal *PRIMUS* on inquiry-based learning in MLA. Please look for this edition of *PRIMUS* in mid-2014. 🌐

The Discovering the Art of Mathematics project team is Julian F. Fleron, Philip K. Hotchkiss, Volker Ecke, and Christine von Renesse. The four are colleagues at Westfield State University, the oldest coeducational teachers college in the country, founded in 1838 by Horace Mann. The team can be contacted at artofmathematics@westfield.ma.edu. All project information and resources are online at <http://artofmathematics.westfield.ma.edu/>. Originally supported by a gift from Harry Lucas and a phase 1 NSF CCLI grant, DAoM is in its fifth year, supported through 2016 by a Type 2 NSF TUES grant.