



MathILy-Er 2015 Final Report

Preface

This was the first year of MathILy-Er, and with the exception of some host site issues we had to deal with over the first few days, everything went very smoothly. Our students were awesome, everyone got along fabulously, and we covered a tremendous amount of mathematics.

Program Preparations

Promotions

Emails: MathILy-Er was announced in mid-February to the MathILy Advisory Amalgam, the SPMPs directors, the Art of Problem Solving founder, MathILy 2013 and 2014 participants, the MathILy interested-parties newsletter list, the 94–98 NExT List, about 50 Math Circles across the country, and about 10 other individuals.

Webpage hits: From the time of MathILy-Er’s announcement, MathILy-Er-specific pages accounted for 12–15% of traffic on mathily.org.

Impacts: About 60% of MathILy-Er participants found out about {MathILy, MathILy-Er} from a list, 40% from a web search, 33% from a parent/guardian, and 6% from a teacher. No one mentioned seeing a flier.

Applications

Statistics: Sixty-one of the 128 completed applications were forwarded for MathILy-Er consideration, and of those 26 were admitted and 15 attended. That’s an admissions rate of 43% and a yield of 58%.

Percentage 2015	Short Forms	Not-as-Short Forms	EARs	admitted	attending
Female	36%	39%	39%	38%	40%
East Asian	36%	34%	34%	31%	27%
South Asian	15%	10%	10%	8%	7%
Latin@	6%	5%	3%	0%	0%
Other of color	2%	2%	1%	0%	0%

Financial Aid: The Mathematical Staircase, Inc. Board allocated \$10,000 from cash reserves for financial aid purposes. We awarded \$6725 in need-based financial aid to MathILy-Er participants; some admitted students who did not participate in MathILy-Er also qualified for financial aid.

Personnel

Academic: There was one Lead Instructor, Dr. Jonah Ostroff (University of Washington, Ph.D. Brandeis University 2013), and one Apprentice Instructor, Dr. Alice Mark (Arizona State University, Ph.D. University of Texas at Austin 2015). A second Apprentice Instructor, Nate Harman (grad student, MIT), was present during the third week to teach additional Week of Chaos classes.

Administrative: The Director was Dr. Jonah Ostroff. The excellent {MathILy, MathILy-Er} Minion was Madison Stuart (Smith College B.A. 2006 in Mathematics and German; graduate work in information science at the University of Michigan). The Protector and Responder in the MathILy-Er Environment (PRiME) was Ashley Corkill (undergraduate, University of Arizona).

Student Demographics:

States represented by MathILy-Er students, from west to east: California, Texas, Minnesota, Missouri, Wisconsin, Illinois, Virginia, New York, New Jersey, Massachusetts.

Countries outside the United States, from west to east if you start in the right place: Ukraine, Canada.

Gender breakdown: 6 females, 9 males.

Ages: There were four 14-year-olds; six 15-year-olds; four 16-year-olds, two of whom turned 17 during the program; and one 17-year-old.

Academic background: Five students had already taken calculus.

What Happened at MathILy-Er 2015?

Academics

Classes: Each weekday we had 4 hours of morning class, 1 hour of Daily Gather, and 3 hours of evening problem session, for at least 8 contact hours per day (not including mathematical conversations held outside of class). Weekends varied, but Saturdays usually consisted of 4 hours of morning class and 2 hours of life seminar.

The basic curricular structure was two weeks of core curriculum, called Root Class (after the root of a graph theoretic tree, and after the idea that the material strengthens student grounding much as the roots of a tree do), followed by one week of short topical classes, called the Week of Chaos, followed by two weeks of focused-topic class, called Branch Class (after branches of mathematics, and after the idea that tree branches grow from a strong trunk nourished by roots).

Root Class: All fifteen students were in the same Root class, taught by Jonah and Alice. The material in the Root Class included matrix algebra and ring theory, enumerative combinatorics, graph theory, and combinatorial game theory. All of this material was treated with full proofs given by the students.

Week of Chaos: Students indicated which of 25 potential topics they would be excited to learn about. Instructors compiled these favorites into a set of ten courses. The courses offered were as follows: Convex Geometry and Polyhedra; Cryptography, Number Theory, and Modular Arithmetic; Fibonacci Numbers and Linear Recurrences; Generating Functions; Euclidean and Non-Euclidean Geometry; A Tour of Turing; Integral Quadratic Forms; Liskers... in Spaaaaaaace! (topological graph theory); Cardinal and Ordinal Numbers; and Methods of Proof. Each student was placed into five of these classes according to their expressed preferences. A majority of these classes used combinatorial and graph theoretic material from the core curriculum.

Branch Class: There was one Branch class, on the topic of mathematical politics: social choice procedures, apportionment, weighted voting systems, and fair division. The instructors were pleased by the students' progress, especially in the area of social choice and fair division.

Pedagogy: All classes were conducted through inquiry-based learning, with students writing on the board throughout most of the morning class, and almost zero time spent with instructors presenting at the front of the room.

Feedback: Students received feedback in several ways. Class presentations were met with instant verbal feedback from instructors and students, both for mathematical correctness and style. Students received written comments on the work they handed in at the end of each problem session, always within 24 hours. Near the end of Root and Branch classes, students wrote self-evaluations on their progress at MathILy-Er. Finally, instructors conducted 5-20 minute interviews with each student at three separate points during the summer to give feedback and advice.

Daily Gathers: Each instructor gave several Daily Gathers. The Daily Gather time slot was occasionally used for other activities, such as a Sage tutorial, a mathematics spelling bee, and Math Movie Night. The remaining Daily Gathers were interactive presentations given by visiting mathematicians and math-adjacent professionals. Some visitors were local (from the University of Oregon), and the rest traveled from elsewhere on the west coast: Seattle, Tacoma, Salem, and Los Angeles.

Extracurriculars

Life Seminars: Three Life Seminars were held on weekend afternoons. Each of these was an unstructured two-hour period where students could ask the staff about applying and going to college, work as a mathematician, and general practical matters of life and adulthood.

Other program-wide activities: At the end of the first week, students and staff explored the nearby Alton Baker Park. Other activities included a day-long trip to downtown Eugene and a celebration of National Ice Cream Day.

Non-program-wide activities: A few students regularly used the indoor pool at the University of Oregon. The nearby Willamette River was a popular swimming destination on weekends, and the sand volleyball court saw by the dorm saw occasional use as well.

Some students played foosball in the dormitory basement, and a large variety of board and card games were often held in the lounge. A few students practiced musical instruments, and others watched movies in the lounge.

Administrative matters:

Facilities at the University of Oregon: Students and staff generally liked the UO campus, but found our particular dormitory and classroom to be lacking in a few ways. Neither building was air conditioned, and the dorm rooms and bathrooms offered minimal privacy. On the other hand, the campus itself was beautiful and its location in Eugene was ideal.

Eugene: The staff and students felt that Eugene was an excellent location for the program. There were a lot of options for food and recreation, but the town was small enough that students could safely leave campus in groups for shopping or eating. However, travel to Eugene was expensive and inconvenient for most participants and visitors.

Post-Processing

Post-program staff meeting: On Saturday evening, the staff met to discuss various aspects of the summer.

We were very happy with how the Root curriculum worked out, even though we didn't use much of it in Branch. We did note that the Euler characteristic would have been a useful topic to cover before the Week of Chaos, but it is unclear how to treat it without overlapping too much with the MathILy curriculum.

Collectively, we felt that the students showed a promising amount of growth, and that many would be ready to attend MathILy should they apply in the following summer.

Finances summary:

The total MathILy-Er income was from student fees: \$62,358.

Administrative expenses (insurance, fliers, etc.) totaled approximately \$2070.

Total wages (instructors, PRiME, Minion, Directors) were approximately \$18,670.

Travel costs (Daily Gather speakers, instructors, students to/from airport) were approximately \$2920.

Program expenses (supplies, program social activities) were approximately \$1740.

The charge from University of Oregon was approximately \$32,880 for food, housing, classroom rental, and copying costs.

Thus, the total expenses are approximately \$58,280.

Income was slightly higher than expenditures because of two students who were admitted in June, at which point we were unable to hire a second Apprentice Instructor.