

•
•
•

A Distance Education Course in Experimentation, Conjecture and Reasoning for Middle-School Teachers.

Steven Dunbar and Heidi Feller

University of Nebraska-Lincoln

Who:

Students: 33 in-service teachers

- 4 teach high school grades
- 14 teach 7th-8th grade
- 6 teach 6th grade
- 6 teach 5th grade
- 1 district coordinator, 1 special ed

Instructors: Steve Dunbar, Heidi Feller, Cheryl Olsen, with assistance from Jim Lewis, Ruth Heaton, David Hartman , Jami Stone, Pari Ford

Where:

- 16 teachers from Lincoln Public Schools
- 11 teachers from ESUs 6-7 in east-central NE
- 6 teachers from ESU 13 in northwestern NE

5 Learning Groups:

- Group I: ESU 6-7, monitored by Steve Dunbar
- Group II: LPS and ESU 6, monitored by Heidi Feller
- Group III: LPS, monitored by Heidi Feller
- Group IV: ESU 13, monitored by Cheryl Olsen
- Group V: LPS and ESU 6, monitored by Steve Dunbar

What: Strategic Objectives

The strategic objectives were two complementary sets of 5 objectives each drawn from the *NAS Adding It Up* and the *NCTM Principles and Standards*.

Aim to meet the mathematical objectives with:

- solving challenging problems
- exploring reasoning and proof
- organizing, recording, and communicating

in the contexts of geometry, number patterns and probability.

How: Distance Learning

- Hybrid (or blended) Model: a beginning two-day workshop followed by course and student-interaction through Blackboard.
- Homework was mailed or faxed.
- Some learning groups met weekly for collaborative learning. For ESU 13 group in northwest NE, meeting was by a PolyCom web camera system.
- Regular quizzes through the EDU testing system using questions from the AMC 8 archives.

Topics Covered

Beginning Workshop and Session A:
Geometry To *Experience ideas in as many ways as possible*, to *Take ideas from one domain and explore them in another* and *Understand simple things deeply*.

1. Pythagorean Theorem
2. The Golden Rectangle
3. The Platonic Solids

Topics Covered

Session B: Number Patterns To learn to *Look for patterns, Find hidden, underlying structure and Understand simple things deeply.*

1. Fibonacci Numbers I
2. Fibonacci Numbers II

Topics Covered

Session C: Probability Probability and statistics enable us to better understand our world, moving us from a vague sense of disordered randomness to a sense of measured proportion. Simple clear cases let us learn principles that we can apply widely.

1. Probability
2. Counting

Topics Covered

Session D: Data and Distributions Lay the foundations for a later course on statistics and research by learning to deal with data and statistics, and look back at the entire course

1. Expected Value
2. Data and Distributions
3. End of course review.

Role of Reasoning and Writing

What happened: Every unit (week to 2 weeks) had a writing assignment:

- to incorporate elementary reasoning and proof,
- to force the students to reflect on the problem-solving process,
- to create a context for group discussion.

Role of Reasoning and Writing

What worked: Explaining concepts to the pesky parent.

What sort of worked: Recognizing counter-examples and theorems from previous course material.

What didn't work: Feedback on the writing

Memorable Problems:

- Side length of dual cube in an octahedron
 - Lefler group built a large scale model with manipulatives
 - Some students talked through problem on the phone
 - Others posted diagrams on the electronic bulletin board
- "82 cent" problem
 - time-consuming
 - lead to classroom discussions and activities

Student Support: Blackboard

- Shawn, March 5: "I don't understand what is being asked in the second part of the question: "Adapt the methods used in this section to figure out that the quotient of consecutive Fibonacci numbers approaches (the golden ratio) to discover the exact number that their quotient approaches as the numbers get larger"?"
- Virginia, March 5: "I took it to mean that, like in previous problems, we should find the ratio of a term to the previous term and see what number these ratios approach. For example find F_3/F_2 ...I hope that makes sense, I don't know how to type it in any better on here."

Student Support: Polycom

Janet: "Polycom was a great for the ESU people to be able to have support for our class. First of all we met every Thursday. Anyone who could be there was there. Michelle had people from the ESU technology set everything up for us. All we had to do was turn on our equipment and we were set. We discussed problems or questions and then just went through homework one by one with someone volunteering to tell what they got. If we did not agree or someone was confused we worked through the problem. Through discussion we were able to understand different approaches and help each other

Student Support: Groups

Vicki: "The Lefler group was the most beneficial thing for me because I made connections with other teachers who taught the same subject. These teachers were understanding of our differences and the differences in our backgrounds. . . . So we bounced ideas off each other, taught each other when necessary and everyone was very patient. . . . It was never the same people that needed help so none of use felt like failures."

Anne: "... one of the strengths of the group was that it was voluntary . . . The best part of the Lefler group was the good time we had working through problems. There was incredible professionalism and good humor."

A Fact of Life about Distance Ed

- The students in the course are teachers, coaches, parents, first-time parents, citizens, and newly-weds, as well as students.
- The course does not always take first priority.
- Their lives affect their ability to meet with other students, and to study for the course.

Dealing with Isolated Students

- Hard to tell when students became isolated, except in a couple of cases where the students told us directly.
- Homework quality and quantity started declining.
- Feelings of being overwhelmed, over-committed, inadequately prepared, "everyone else knows more, I'm holding them back"
- Heidi emailed each separately to re-establish communication. She met with each individually, provided background information, individual assistance.

Distance learning problems

- mathematical notation,
- expressing geometric ideas through words,
- telegraphic, superficial nature of internet communication works against carefully explaining in great detail
- not being able to gauge by facial expression, body language,
- manipulatives were important, but impossible to convey through DL.

Uneven background knowledge

- Knowledge about triangle geometry
- Knowledge of quadratic formula and radicals
- Conceptual misunderstanding about expected value
- Conceptual misunderstanding of converse and contrapositive
- Conceptual misunderstanding of "For all x , Property P holds"
- Conceptual misunderstanding of the role of counter-examples.

New view of distance education

Use distance education tools for collaboration that enable students to learn from each other.

- Organize and consolidate mathematical thinking through communication
- Communicate mathematical thinking coherently and clearly to peers
- Analyze and evaluate the mathematical thinking and strategies of others
- Use the language of mathematics to express mathematical ideas precisely.

Changes to Make in the Course

- More background material at beginning workshop to cover gaps. (Quadratic formula, triangle geometry, radicals, notation (subscripts, functions))
- More intentional group work built around the model of the LPS Lefler Group and the ESU 13 Polycom group.
- More moderated discussions on Blackboard: One group posts mathematical reasoning, having another group comment on and critique the posting.
- Differences: Cohort 2 will have more experience working together, more background on geometry, algebra, probability, statistics.