Bringing Undergraduate Research into the Mathematics Classroom

ACMS 2011, Westmont College, Stephen Lovett

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The Problem

Levels of Undergraduate Research
Reasons for Undergraduate Research

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Can we adjust teaching practices in math classes to fix these problems?
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5. Results obtained in a group project or a team competition.
6. Problem solving.
Reasons for Undergraduate Research
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Maybe we cannot solve all of these in the classroom setting but why not try.
Investigative Projects

A new form of assignment with these parameters:
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- Two to three projects per semester.
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A new form of assignment with these parameters:

- Two to three projects per semester.
- Teams of 2 to 3, not more, not less.
- Give at least two weeks.
- Counts for a sizeable portion of the course grade.
- Offer a variety of topics; students are encouraged to modify or add questions.
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Assessing Student Projects

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I give detailed feedback in each of those categories.
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I give detailed feedback in each of those categories.

Sometimes I offer a rewrite.
Guidelines for Project Questions

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- Always have some form of open-ended aspect (some more; some less).
- May be guided, like some textbook projects.
- Some projects may not have clear cut solutions.
Specific Project Questions

1. Calculus II: Project 1; Project 2; Project 3; Project 4
2. Linear Algebra: Project 1; Project 2
3. Differential Equations: Project 1
4. Modern Algebra: Project 1; Project 2
Specific Student Work

- Differential Equations: Population Dynamics and War
- Modern Algebra:  
  When Does $x^2 + 1 \equiv 0 \pmod{n}$ Have Roots?
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- Linear Algebra: Dating Habits of Wheaties
- Calculus 2: Parametric Curves and Art
- (Mentored Student Research)
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New theorems proved, (At least) one article published, some interesting results...
What Students Have Learned

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Students can learn different things at different levels.

1. That math problems are not just exercises.
2. How to write a math paper: prose, organization, LaTeX,…
3. How to think creatively and reflectively using math.
4. How to find real data.
What Students Have Learned

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1. That math problems are not just exercises.

2. How to write a math paper: prose, organization, LaTeX, ...

3. How to think creatively and reflectively using math.

4. How to find real data.

5. How to find what other people have already done.
A Few Additional Benefits
Students sometimes continue working on their project afterwards.
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Projects produce many ongoing math conversations.
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3. I get rich material for when I write letters of recommendation.
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3. I get rich material for when I write letters of recommendation.
4. The projects begin to offer students a research experience.
5. It’s exciting!