Flipped format number theory class

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Jargon disentanglement

▶ Flipped class. Instead of listening to lectures in class and doing problems at home, students ingest learning material (text, online notes and videos) on their own time and spend class time working and presenting problems, workshopping proofs, group work, etc.

▶ Inquiry-based learning (IBL). Students exposed to essentially no lecture material. Instructors guide students through the theory via well-chosen sequence of problems. Closely associated with R. L. Moore (Moore Method): “That student is taught the best who is told the least.”

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Motivation

Mathematics is an activity. To get good at an activity one needs to train. Some activities require personal trainers.

Frustrated with results of a previous number theory course. Lectures were well-received (good attendance, much head nodding and smiles), exam performance and written work was disappointing.

Main goal of the course was more to teach students how to read and write mathematical arguments. Had in mind a sort of proof-writing workshop.

Classroom conditions: small class, whiteboard.
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Mechanics

Learning material: textbook, online video lectures and lecture notes.

In-class problems. Around 4 homework problems assigned for each class session ahead of time.

Weekly careful write-ups of 1-2 problems.

Grading: 20% (in-class) + 25% (write-up) + 25% (midterm) + 30% (final).
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▶ Homework collected, graded quickly on ✓ ± scale. Returned to students with their comments.
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- Each week 1 or 2 more difficult problems written up carefully.
- Graded on scale of 1 to 4.
  1. Minimal progress
  2. Partial explanation, but major gaps in argument
  3. Minor technical error or missing minor details
  4. Correct and clear

Write-ups must be typed and submitted electronically as a PDF.

Students encouraged to use LaTeX. ShareLatex is an excellent resource; allows students to write and compile online without having to install any software.

First write-up assignment was only mandatory LaTeX assignment. Thereafter every student used LaTeX to typeset write-ups.
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Feedback: from instructors

Format allows for near continuous assessment of how the students are doing.

Observed clear improvement in presentations and write-ups over the semester for nearly all students. (Steve's section seems to have had a more significant "hump" to get over.)

In my section there was never a problem getting people to volunteer to present. Both genders equally represented.

Exam scores were higher. Midterm average was 83, final average was 85.

Teaching course, preparing course materials, collaborating with Steve—all of these made this one of the most enjoyable teaching experiences I've had.

From Steve: overall experience very positive; students who remained enrolled made more progress than usual; instructor must be flexible; plans to use these techniques in future courses.
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- Class was a lot of work.
- In-class activities and write-ups effective in teaching proof writing and problem solving.
- Video lectures of questionable worth. Not a replacement for traditional lectures. Online lecture notes, which were simply the scripts of the videos, are ranked higher in usefulness.
- Do not seem to prefer a flipped format to a conventional format, but...
- Perhaps think that other math courses should be run in flipped format.
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Questions

- Are video lectures necessary?
- More generally, which if any of the learning materials (text, lecture notes, video) do we need? Would IBL approach be more effective?
- More group work in class?
- What other courses could be run like this?
- How does class size effect success of flipped format?
- What do we do with all the course materials we’ve produced?