

The State of Transitional Math Courses

Dorin Dumitraşcu
Northern Arizona University

Andrew Pyzdek
University of Arizona

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Question. How do the departments around the country approach the course which bridges the gap between lower level, computationally focused, math classes and upper level, proof based, math classes?

What have we done?

- surveyed the catalogs of a diverse group of universities across the country, and summarized the findings in a webpage
- surveyed the literature
- contacted professors that taught the course
- Andrew wrote a report

1. Course catalogs

The transitional math course is not standardized by any means. Naming conventions and coursework vary from department to department.

Main course content: logic, sets, functions, and relations.

Names: Formal Mathematical Reasoning and Writing (UA); Mathematical Structures (ASU); Foundations of Mathematics (NAU); Fundamentals of Advanced Mathematics (U Akron); Logic, Sets, and Proofs (Bucknell); Foundations of Mathematics (Southeast Missouri SU); Introduction to Analysis etc.

Some departments offer a course called Discrete Mathematics, that often can replace an intro to proofs class in terms of requirements, if both types of classes are offered.

2. The literature

[1] Susanna S. Epp, *The role of logic in teaching proof*, American Mathematical Monthly **110** (2003), 886–899.

[2] Susanna S. Epp, *The use of logic in teaching proof*, in Discrete Mathematics Resource Guide, ed. B. Hopkins, MAA publications, to appear.

[3] Robert C. Moore, *Making the transition to formal proof*, Educational Studies in Mathematics **27** (1994), 249–266.

[4] Judith A. Palagallo and William A. Blue, *Analyzing the Value of a Transitional Mathematics Course*, in Assessment Practices in Undergraduate Mathematics, MAA Notes #49, 1999, 64–67.

- Epp's papers [1] and [2] support the teaching of logic in a proof oriented course and supply insight on how best to teach logic. She is at DePaul University.
- Moore's paper [3] is based on studies made at the University of Georgia in 1989. Three major sources of students' difficulties:
 - (a) concept understanding
 - (b) mathematical language and notation
 - (c) getting started on a proof

These difficulties are discussed in terms of a concept understanding scheme — concept definition, concept image, and concept usage.

- The paper of Palagallo and Blue [4] reports on the effects of the course Fundamentals of Advanced Mathematics (FOAM) on the upper level algebra and analysis courses. At the University of Akron.

3. A personal view point: Dan Madden

Very little time spent on logic as a subject unto itself.

Covers the topology of the real numbers, but not much cardinality.

Follows a top down approach. Begins with properties of the real numbers, and takes a step back and covers logic and sets after some time. This allows him to use mathematical examples when approaching logic. Ultimately, the initial material is revisited with the new tools, and covered again in a small fraction of the time.

Evaluating the success of the class: the proof of the Heine-Borel theorem to test the abilities of his students. “I make the students come in one at a time and present the difficult part of that proof, in a presentation...” “Most people would be quite shocked to find out that just about everyone in the class who truly attempts this process succeeds. They master this proof without much trouble.”

3. A personal view point: Fred Stevenson

Very little time spent on logic as a subject unto itself.

Covers cardinality, but not much topology of the real numbers.

Prefers and uses non-mathematical examples to show that, in order to prove something, one must be able to present a compelling and correct argument. Sets rules and boundaries for what is considered a proper proof, but he allows students to explore the concept first.

Less detail oriented; gives weight to the importance of elegance in proof.

General agreements about Mathematical Reasoning and Writing at UA

- the class is among the most difficult in a students career.
- grades are generally lower in this class than in either upper or lower division math courses
- some students are dissuaded from the major by the class
- in the exit interviews held by the university of their graduating seniors, students regularly state that the course was both the most difficult and most important course in their mathematical work