

Department of Mathematical Sciences
Indiana University South Bend
General syllabi for the T-courses for Elementary Education majors
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Course descriptions

MATH-T 101 Mathematics for Elementary Teachers I (3 cr.) P: MATH-M 014 or equivalent, or Level 3 on mathematics placement examination. The foundations of arithmetic, including elements of set theory, numeration systems, operations, fractions and elementary number theory. Emphasis is on explaining, illustrating, and communicating mathematical ideas. Does not satisfy liberal arts and sciences general education requirement. I, II, S

MATH-T 102 Mathematics for Elementary Teachers II (3 cr.) P: C or higher in MATH-T 101. Integers, rational and real numbers, equations, and inequalities, functions and graphs, measurement concepts, problem-solving, elementary combinatorics, probability, and statistics. Emphasis is on applying problem-solving strategies in a variety of mathematical situations. Does not satisfy liberal arts and sciences general education requirement. I, II, S

MATH-T 103 Mathematics for Elementary Teachers III (3 cr.) P: C or higher in MATH-T 101. Topics include analysis and measurement of two- and three-dimensional figures; congruent and similar triangles, compass and straight-edge constructions. Emphasis is on the transition from visual and informal reasoning to formal reasoning about geometric objects and relationships. Does not satisfy liberal arts and sciences general education requirement. I, II, S

Textbook used

Mathematics for Elementary Teachers by Musser, Burger, and Peterson (8th edition), published by John Wiley and Sons (2008). Note that this book has been used at IUSB in various versions since at least 1992.

Specific content by textbook chapter in each course

- T101: Chapters 2 - 7, except 2.4. Also, section 4.3 is optional, and some instructors include also Appendix Topic 2 (clock arithmetic)
- T102: Chapter 1, Section 2.4, Chapters 8 - 11, Section 13.1
- T103: Chapters 12 - 14, with additional material from Chapters 15 and 16 at the discretion of the instructor

Professional licensing standards

Courses are designed to meet the mathematics content standards for K – 8 teachers, as required by the Indiana Professional Standards Board. See:

<http://www.doe.in.gov/dps/standards/MathematicsContStds.html>

Variation by instructor

Although these courses have common syllabi, and course coordination is required in the Department of Mathematical Sciences, teaching methodology used varies. All instructors place emphasis on understanding children's thinking about mathematics and include class work or writing assignments that encourage analysis of mathematical concepts and how students understand these concepts.

Evaluation typically includes 2 or 3 exams during the semester plus a comprehensive final. Some instructors collect the daily homework and/or give weekly quizzes. In T102, some instructors assign problem-solving portfolios.

All elementary education majors must achieve a grade of C or better in each course to gain admission to the teacher education program.

Guiding principles for the T-courses

Instructors have found the following summary from the book *Adding it up* to be helpful in designing assignments, assessing student work, and in reflection on their teaching.

What is mathematical proficiency?

Mathematical proficiency can be visualized as a rope with intertwined strands, each strand signifying one of its aspects. The five interwoven and interdependent strands of mathematical proficiency are:

- *conceptual understanding* - comprehension of mathematical concepts, operations, and relations
- *procedural fluency* - skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- *strategic competence* - ability to formulate, represent, and solve mathematical problems
- *adaptive reasoning* - capacity for logical thought, reflection, explanation, and justification
- *productive disposition* - habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy.

This is the vision of the authors of *Adding it up: helping children learn mathematics*, a report published in 2001 by the National Research Council. It is a result of a broad review and analysis

of the research on teaching and learning mathematics. The authors argue convincingly that all strands of mathematical proficiency must be developed throughout an individual's education, and that by developing all strands it becomes more feasible to develop any one.

The report is about elementary mathematics (pre-Algebra). However, the ideas can be extended to any domain of mathematics, and thinking about what the mathematically proficient student brings to a study of other mathematics topics gives a coherent view of long term mathematical education.

Here is some additional descriptive detail from the report.

Students with *conceptual understanding*:

- see mathematics as coherent and connected, not a collection of isolated facts
- understand why a mathematical idea is important, and when it is useful
- retain more, because ideas can be re-constructed when forgotten
- monitor their thinking by asking themselves whether things “make sense”
- can often verbalize their thinking, but not always
- can represent mathematical situations in more than one way
- can apply their knowledge in a broad variety of situations
- learn more easily because they can use connections to ideas already understood

Students with *procedural fluency*:

- know procedures and when it is appropriate to use them
- find it easier to develop conceptual understanding, because conceptual understanding has its root in actions that can be repeated successfully
- can put into action what they understand conceptually
- are ready to analyze their procedures, which supports conceptual understanding
- can make use of conceptual understanding to modify or adapt procedures they understand, thus building more procedural fluency

Students with *strategic competence*:

- can both solve routine problems and attack non-routine problems
- may come up with several approaches to solving a single problem, and see the relationships among the approaches
- are motivated to understand concepts because problems present the need to know
- are motivated to become more fluent procedurally so that more effective modes of problem solving can be used.

Students who engage in *adaptive reasoning*:

- think logically about the relationships between concepts and situations
- use both formal and informal explanations
- focus on justifying their work
- exploit visualizations, patterns, analogies and metaphors
- can begin to learn to do this as early as 4 or 5 years old

Students with *productive dispositions*:

- see mathematics as useful and worthwhile
- see mathematics as reasonable and as something that makes sense
- see that steady effort in studying mathematics pays off
- see themselves as an effective mathematical thinker and doer
- are confident in their abilities to learn mathematics

The book *Adding it up* can be found on-line at
<http://www.nap.edu/openbook.php?isbn=0309069955>

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