Goals and Content

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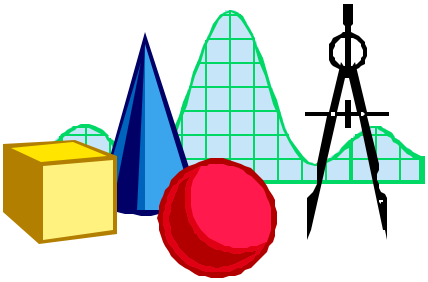

Goals and Content Group Overview

Content choices, balancing theory with computation, the diversity of the students in first year courses, and the future role of calculus lead to fundamental questions concerning the intellectual goals of a mathematics curriculum. Over the past two decades, developing students to learn how to learn on their own has become accepted as central to the set of curriculum goals. Although not identical in meaning, the phrases "life long learner", "learning to think", "mental discipline", and "learning the mathematical thought process" are used as synonyms for learning how to learn. The consensus on this goal does not extend to ways in which to address it. Members of the Goals and Content Group offered responses that covered the spectrum from maintaining the status quo to replacing calculus with a program focusing on inquiry and modeling.

With respect to the choice of content, Laurette Foster, David Lomen, and Paul Zorn express satisfaction with the content in the present (reformed) calculus texts. Jeff Froyd questions why very little of the mathematics developed in this century is found in core courses. He suggests using the question: "To what degree does topic X increase the capacity of a graduate to learn and create?" rather than the statement "Any graduate must know topic X." as the filter for determining content. Don Small would have the choice of content be heavily influenced by the needs of down-stream courses saying mathematics is basically a process, not a collection of topics. For him the primary concern is not content, but how to develop students to become competent, confident, and creative problem solvers.

The theoretical versus conceptual debate contrasts the pre-calculus reform (prior to 1985) thinking to the calculus reform thinking. Paul Zorn characterizes the positions in this debate as the *math way* – emphasizing limits as the major "primitive" and the *science way* – emphasizing rates of change as the major "primitive." Jim Lightbourne provides a nice historical account of the calculus reform movement and parallels it with the present reform taking place in physics and engineering. He notes that the lack of communication and cooperation between departments restricts the effectiveness of the reform efforts in mathematics, physics, and engineering. John Dossey relates the recommendations in the National Council of Teachers Principles and Standards (1998) to the reform in undergraduate mathematics. He focuses on the importance of realigning teacher education programs to prepare future teachers to implement the reform efforts.

Modeling and applications should be the curriculum according to Don Small who argues that the present calculus umbrella for the undergraduate mathematics program be replaced with one that emphasizes *inquiry* and *modeling*. Rates of change, accumulation, transformation, and approximation are important ideas in the projected program, however they will arise in connection with modeling realistic situations rather than from studying topics in a calculus course. An important aspect of the projected modeling program is the integration of data analysis, probability, and discrete mathematics with the continuous mathematics, as the situations being modeled rarely fall into our artificial curriculum categories. Another important aspect is that a modeling program is inherently

interdisciplinary because real world situations are interdisciplinary. Thus interdisciplinary cooperation is built into a core program of modeling rather than being an "add on ."

Student growth needs to be accounted for in curriculum planning, it is too important to be left to chance. Frank Giordano identifies learning how to learn, communications, mathematical sophistication, modeling, technology, connectivity, and history of mathematics as the important components of student growth. He offers a set of content objectives for a two-year integrated program that encourages progressive student growth in each of these categories. Laurette Foster emphasizes that "knowing your students" has become more important as courses have become multifacted and greater importance is attached to student growth.

The understanding and meaning of *High Standards* courses has changed from preparation for real analysis to ones that focus on deeper modeling experiences, open-ended projects, inquiry, and the ability to apply mathematics in interdisciplinary settings. Jeff Froyd suggests changing from the practice of insisting on a thorough understanding of prerequisite topics before introducing the next topic to a program that orders ideas around questions to be attacked. He states "The processes in which students participate can be as important or more important than the ideas that are presented to the students."