Teaching Calculus Through History, Intuition, Exploration and Development (HIED)

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Our backgrounds and perspectives

We come at the challenge of teaching calculus with the advantage(?) of several perspectives:

• Math professor

• Administrative
  - Department Chair
  - College Dean
  - Provost/Vice Chancellor for Academic Affairs
  - Interim Chancellor

• Author
Student characteristics:

- Widely varying levels of preparation
- Broad array of objectives and expectations
- Accustomed to learning in many different ways and in many different environments
- Intuition, curiosity, ever greater need for active participation and instant feedback
“H” for History

• Introduce topics with the historical desire for and subsequent development of the subject

• Link the historical context with the contemporary use and continued development of the subject

• Make use of the classical calculus problems and the personal stories associated with them

• As appropriate, assign group history projects
“I” for Intuition

• Build on the natural intuition and curiosity of students; blend conversational style with precision and depth, leaving the student unaware of the transition

• Develop intuition while introducing new topics, before developing rigorous calculation skills

• Encourage focused and disciplined thinking through disciplined and linear exposition

• Employ flipped learning as appropriate
“E” for Exploration

• Exploratory projects develop insight, challenge students, and directly connect the subject to everyday life

• Group projects and peer learning, again as appropriate

• Exploration develops learning beyond rote memorization of formulas/procedures; facilitates discovery of the beauty and depth of Calculus

• Technology usage: 1. Technology as a problem solving tool, 2. Technology as an investigative tool
“D” for Development

• Teaching methods include interactive lecture, discussion, and student presentations.

• Examples and exercises range from skill-building "drill-and-practice" to more challenging guided exploratory exercises that allow students to discover applications and principles on their own.

• Group and peer learning, again as appropriate.

• Instant feedback instructional software is immensely useful.
Summary

The tools and techniques of “HIED” can be effectively employed to reach the goal of student success in calculus – the proper balance is a matter of personal taste.
Summary, continued

- Introduce topics with historical and social context.
- Use the natural intuition and curiosity of students whenever possible, especially in a group format.
- Math is a human endeavor – employ conversation, and introduce rigor as a distinguishing feature of mathematics. Allow students to explore – through guided exercises, individual or group projects, and technology use. Have students teach students.
- Use smart tutoring software to foster participation and provide instant feedback.
Questions and Comments