Symbolic Algebra in the Classroom: Discuss, Demonstrate, or Do?

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Disclaimer

This presentation is designed to raise more questions than it answers. My intent is to relate a few of the lessons I have learned while using Maple.

Since each of us comes to this workshop from a different environment and with different expectations, we may all respond differently to the situations I will describe.

I welcome (brief) comments and discussion during the talk, and hope to provide time at the end for more detailed interaction.

Background Information

Current Status

- Assistant Professor of Mathematics (1 year to tenure decision)
- Lilly Teaching Fellow (1994–1995)
- Maple Ambassador (1995–present)

CAS Experience

- graduate student (Carnegie Mellon, 1984–1989)
- research (Purdue, 1989–1991; South Carolina, 1991–present)
- teaching (South Carolina, 1994–present)

Including Symbolic Algebra in the Classroom

- Out-of-Class Labs
- In-Class Usage
  - Discuss
  - Demonstrate
  - Do

Discuss

There are computer packages that can assist with the calculations we are discussing. Please see the handout for a sample session.

Discuss

- requires no special classroom arrangements
- fits easily into traditional lecture format
- very safe – no surprises or hardware problems
- passive participation – second-hand account of session
- minimal transfer of skill/knowledge

Demonstrate

I am now starting the computer algebra program called Maple. With this program you will be able to see how the computer can be used to help with the calculations involved in this problem. A complete transcript of this demonstration is provided on the handout.

Demonstrate

- requires minimal, but non-trivial, hardware
- transition between lecture and demonstration takes time
- Murphy's Law
- passive participation – exposure to CAS is only as a spectator
- minimal transfer of skill/knowledge

Do

In this course we will make frequent – almost daily – use of a computer algebra system. The power of the CAS comes from its ability to manipulate mathematical expressions – not just numbers.

To begin, you will learn how to create plots of functions and do other basic operations. Our usage will then expand to support the new material that we encounter during the semester. The CAS can be used for all homework and exams.

In addition to the computers in this classroom, the CAS is available on almost any public computer on campus. In addition, a copy of the Student Edition can be purchased (for a PC or Mac) for under \$100.

Do

- special hardware needed in classroom
- restructuring of presentation is required
- $\left(e^{\text{Murphy's Law}}\right)^n$
- active participation
- students acquire a skill for future use

Additional Issues to Consider

- course planning
- CAS reliability
- information transfer
- computing background
- introduction of CAS to students
- academic honesty

Course Planning

- identify rationale for including CAS in course
- level of expertise expected of students
- modifications to course content
- preparation of materials
- discuss your plans/needs with computer support
- test-run your activity from student perspective

CAS Reliability

- no CAS can solve all problems
- distinguish CAS and user errors
- do you know the limits of safe usage?
- how will you explain these to students?
- friendliness of error messages

Information Transfer

- server and network reliability
- software compatibility
- surprises due to customization of account
- need to have a contingency for any situation

Computer Background

- it is true that today's students do have some background *using* computers, but very little of that seems to be devoted to "programming"
- in fact, some students seem to have been turned off to the use of computers in educational settings
- scientific expressions (parentheses, exponentials, powers)
- functional notation (expression, function)
- CAS syntax (case sensitive, omit termination character, interface)

Introduction to CAS

- assume no prior knowledge of CAS
- devote (at least) first week to CAS – review OK, but no new content
- can neither overwhelm students nor waste time
- students need to know this is required – exams, grade
- problem resolution – system messages and on-line help
- student access to computers and CAS expert

Academic Honesty

- access to class files during exams
- illegal use of e-mail during exams
- copying from the screen of another student

Supporting Documents

- course documents
- Lilly report
- Delay Equations
- Maple Technical Newsletter article
- World-Wide Web (URL: `http://www.math.sc.edu/~meade/`)