CONJECTURE

Learning objects are influencing content and pedagogy in Mathematics classrooms at all levels

How will we recognise the evidence of the change?
What did a 1950s Mathematics classroom look like?

Do we have a shared view?

AAMT (1992) National Statement Kit
Looking into a 1950s Mathematics classroom …

- Physical appearance
  - Desks in rows, floor boards, photo of Queen, print of an Australian landscape
  - Blackboard
  - The door closed

- Classroom resources
  - [Sec] Textbooks, logarithm tables for students, slide rules
  - [Prim] Few manipulatives [MAB, counters, counting frames]
  - Chalk for the teacher, blackboard protractor, compasses, etc

- Curriculum and assessment
  - Centrally-prescribed curriculum
  - External assessment in secondary schools, weekly tests
Looking into a 1950s Mathematics classroom … [continued]

• Pedagogy
  • ‘Chalk and talk’ teaching, certainly in secondary schools
  • Drill and practice
    • ‘Open your textbook to p.53 Ex 7B and do the left-hand column’
    • Teacher is the ‘custodian’ of the answers

• Interactions
  • Teacher - students
    • Teacher asks question, students answer
    • Some individual help for students
  • Student - student
    • In pairs, but little or no group work and discussion
    • The silent classroom
What changes 30 years on? … the 1980s

What do we see?

Do we have a common view?
The 1980s Mathematics classroom

- Physical appearance
  - Open plan classrooms, desks in clusters, carpet on floors, student work displayed on walls
  - Whiteboard, OHP, access to a TV for schools programs

- Classroom resources
  - Textbooks, worksheets and spirit masters ... greater variety
  - Calculators have appeared, computer labs for visits by Maths classes if not being used for computer studies and keyboarding (typing) classes ... some Maths software packages
  - More manipulatives and greater variety

- Curriculum and assessment
  - Centrally-prescribed curriculum
  - External assessment, system monitoring of literacy and numeracy
The 1980s Mathematics classroom [continued]

• Pedagogy
  • Pre *A National Statement on Mathematics for Australian Schools*
  • Still some ‘white board marker and talk’ teaching, but classrooms becoming less formal
  • Emerging emphasis on problem solving, use of calculators, computers … the emergence of AAMT as a catalyst for change
  • Impact of RIME (Vic) and MCTP (Curriculum Corp) in expanding teachers’ pedagogical repertoire

• Interactions
  • Teacher - student, student - student
    • Teachers seeking to engage students in more discussions
    • Discussion in pairs, group work
    • Noisier, more animated classrooms
The 1990s gave us …

National Statements, Curriculum Profiles

and National Numeracy Benchmarks
A National Statement on Mathematics for Australian Schools

- The scope of the Mathematics curriculum
  - Attitudes and appreciations
  - Mathematical inquiry
  - Choosing and using mathematics
  - Space
  - Number
  - Measurement
  - Chance and data
  - Algebra

Mathematics - a curriculum profile for Australian schools

- The strands
  - Working mathematically
  - Space
  - Number
  - Measurement
  - Chance and data
  - Algebra
Schools On-line Curriculum Content Initiative [2001-6]

- Creating a pool of on-line digital resources in agreed priority areas of the curriculum to be used freely by teachers in Australian and New Zealand schools.

- Priority areas
  - Science
  - Mathematics and numeracy Prep to 9
  - Languages other than English
  - Literacy
  - Studies of Australia
  - Innovation, enterprise and creativity
Mathematics and numeracy P - 9

- **Project 1**  Counting and quantifying
- **Project 2**  Representing and visualising
- **Project 3**  Variation, transformation and change
- **Project 4**  Uncertainty and predictability

The brief is not to cover the entire curriculum, rather to
- focus on ideas teachers find difficult to teach and manage related learning materials in the classroom
- take full advantage of the medium
So what are these things called learning objects …

- **Learning objects** …
  - are ‘chunks’ of digital material (for example, graphics, text, audio, interactive tools, video) designed to engage and motivate student learning
  - enable students, individually and collaboratively, to work with complex content and ideas in new and dynamic ways … manipulate and experiment with variables, test conjectures, solve problems, make decisions, reflect on the learning
  - contain scaffolded learning tasks, providing students feedback on their learning
Let’s look at some Mathematics learning objects …

• Some questions to think about …
  • Is the content important?
  • Is the content being presented in an engaging way?
  • When using this learning object, what do you think the role of the teacher would be? Does the teacher have a different role?
  • What is the medium offering to the learning experience?
  • Do you think the learning object will enhance student learning outcomes?
A menu of learning objects …

• **Project 1**: Counting and quantifying
  • The part-adder and The multiplier
  • The vile vendor
  • Musical number patterns

• **Project 2**: Representing and visualising
  • Wishball
  • Shape maker
  • Photo hunt and Building site

• **Project 3**: Variation, transformation and change
  • Biscuit factory
  • Circus towers

• **Project 4**: Uncertainty and predictability
  • Random or not
  • Dice duels
Reflections …

• Do you think that the learning objects deal with important mathematical content and ideas?

• Did you find the content and contexts engaging?

• Does the integration of learning objects into a Mathematics classroom change the role of the teacher? In what ways?

• What are the learning objects offering the learner?

• Do you think the learning objects will enhance student learning outcomes?
Beyond 2000 …

What are we seeing in Mathematics classrooms?

• Physical appearance
  • Variety of classroom layouts and configurations, flexible-use carpeted spaces, desks and tables
  • Brighter appearance, open-door classrooms

• Classroom resources
  • Textbooks, worksheets, manipulatives and expendable resources
  • Calculators, more computers in classrooms (usually networked)
  • Computer labs … learning objects

• Curriculum and assessment
  • A broader Mathematics curriculum freed up by *National Statement*
  • External assessment, system monitoring of literacy and numeracy, national reporting imperatives
Beyond 2000 …

What are we seeing in Mathematics classrooms?

• Pedagogy
  • Less ‘chalk and talk’
  • Teachers making informed choices about resource selection
  • Teachers more conscious of students’ individual needs and preferred learning styles
  • Discussion of alternative strategies and methods
  • Students engaged in mathematical activity … working mathematically

• Interactions
  • Students interacting with each other, with computers, with the teacher
  • Discussions stimulated by hands-on materials and learning objects
  • Students posing their own questions and testing conjectures
Conjecture: Learning objects are influencing content and pedagogy in Mathematics classrooms at all levels

What’s the evidence?

• When students react positively, teachers take notice …
  • Students are finding the learning objects engaging, and they are engaging with the mathematical content and ideas
  • Students are responding positively to the feedback provided by the learning objects, the opportunity set their own pace
• Teachers have long recognised the importance of discussion … learning objects are providing a focus and context for teacher-student and student-student discussions
• Learning objects are providing a skeleton around which teachers are planning to teach some mathematical ideas they have been reluctant to tackle
• There is evidence that student learning outcomes are enhanced
A splendid vision for 2006 and beyond

• Teacher time
  Teachers having the time to ensure that their selection of available teaching and learning resources - including learning objects - is informed and appropriate to the needs of students

• Classroom access to computers
  Mathematics teachers have sufficient access to in-classroom computers to allow integration of learning objects into the day-to-day program, eliminating the need to pre-book and visit computer labs

• Frustrations are overcome
  • Teachers and students have easy access to learning objects
  • Technical issues, such as speed and networking, are resolved
Mathematics learning objects
... ICT influencing content and pedagogy