Southwest Hub Meeting: New Technologies in Mathematics Support

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Summary

- Background
- The whole picture
- A little theory
- Examples of new technologies in maths support
- **sigma**'s investigations in new technologies
- Conclusions

Background

- What is mathematics support?
- Why is it needed?
- What is **sigma**?
- What are new technologies?
- Why are they important?

What is Mathematics Support?

Definition

Collective term for additional, supplementary teaching & learning provision in mathematics & statistics

Common forms

1. Bridging courses
2. Computer-aided learning
3. Diagnostic testing
4. Drop-in centres / workshops
5. Numeracy classes
6. Paper-based open learning materials
7. Peer study support
8. Tutoring
9. Videos
10. Websites (may include types 2, 6 and 9)

Over 50% of UK HEIs offer some form of maths support (Beveridge, 1997; Perkin & Croft, 2004)

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Why Mathematics Support?

- Rapid decline in maths skills of HE entry students (see below)
- Massive increase in student numbers
- Professional graduate standards ⇒ fairly constant assumed entry mathematical knowledge
- Wider cohort diversity (WP & internationalisation)

⇒ Traditional (curriculum based) teaching methods alone are ineffective in addressing these requirements, even with good teaching practices, c.f. Recommendation 3.1 (Roberts, 2004)

Entry Year	1991	2001
A-Level Grade	N	B
Av. Diagnostic Test Score	34.4	33.8

A-Level grade vs. mark on static maths diagnostic test, source: (Lawson, 2003)

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What is sigma?

- One of 74 Centres for (not 'of') Excellence in Teaching & Learning (CETLs)
- Aim of CETL scheme: promote 'beacons' of good practice in the UK HE sector
- £4.5m funding from HEFCE
- Award based on existing good practice at Coventry & Loughborough
- Running from 2005 to 2010
- **sigma** is probably the most active CETL in disseminating and promoting its activities for the benefit of the rest of the UK HE sector

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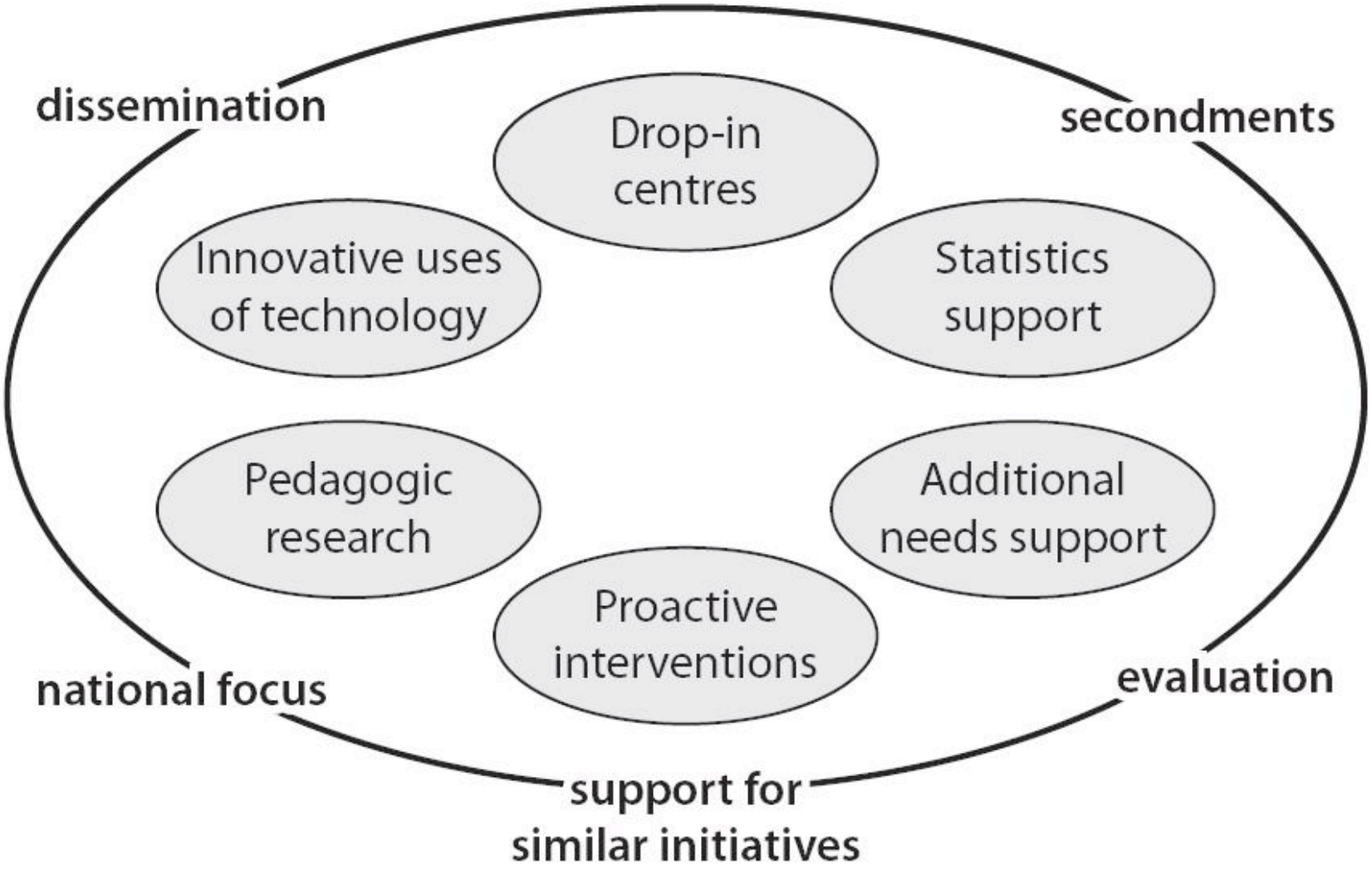
sigma activities



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What are new technologies?

- Virtual learning environments:
  - Computer assisted assessment
  - Reusable learning objects
- Communications technologies (e.g. Audio-Video-Text software)
- Mathematics & statistics software environments, e.g. integrated dynamic geometry & computer algebra systems
- Mobile devices
- Web 2.0 and social networking
- Serious games
- Personalisation

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Why are they important?

- Reflect current social practices and preferences of contemporary learners ⇒ have the potential to engage learners where traditional teaching methods are becoming inadequate
- Can overcome some of the social limitations of traditional methods (e.g. can assist peer learning or overcome embarrassment in feedback)
- Some smart technologies have the potential of enhancing teaching
- Might make teaching more efficient & economical

⇒ Specific aim of **sigma**: to take risks in new technologies in maths support on behalf of the UK HE sector

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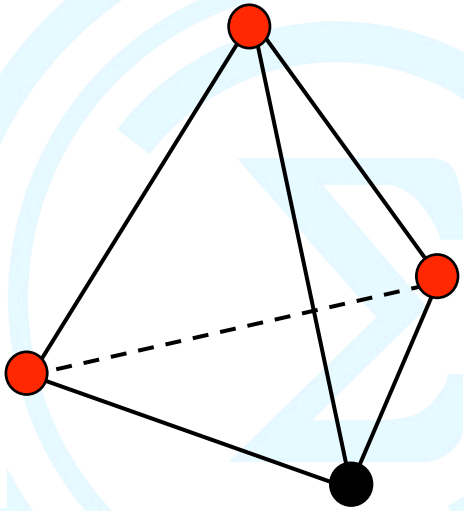
The whole picture: excellence in HE mathematics teaching

Innovative uses of technology in mathematics teaching, e.g. classroom communication systems



Mathematics support, e.g. statistics advisory services

Innovative teaching methods, e.g. problem-based learning (PBL)

Conventional teaching methods, i.e. lecture/tutorial

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Excellence in conventional maths teaching:

- E.g. contextualised staff development by MSOR

Innovative teaching methods in HE maths:

- Mainly individual enthusiasts (PBL becoming popular)
- Some coordination in the 1990s, e.g. (Houston, 1994), MathsSkills project (Hull)

Innovative uses of technology in mathematics teaching:

- Similar to innovative teaching methods
- Increased general use of VLEs – but what for?
- Too much emphasis on new technology rather than pedagogy & evaluation (Kirkwood & Price, 2005)

Pressure on institutions to move away from conventional teaching methods, e.g. Faculty of Engineering & Computing at Coventry's change of pedagogy to Activity Led Learning

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A little theory

1. Prensky's digital natives
2. Hartley's model of 3 different social uses of technology
3. The Web 2.0 paradigm shift
4. Convergence between new learning and new technology
5. Learning in the 21st Century & mobile learning
6. Feasibility of mobile connectivity
7. Theory of engagement

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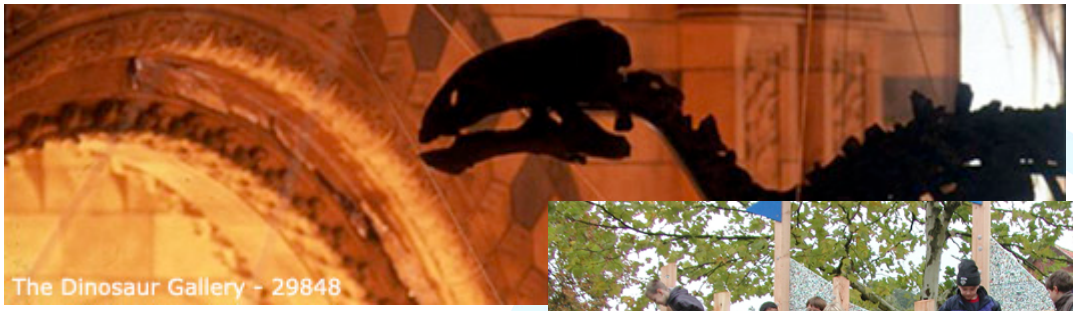
Theory 1: Prensky's digital natives

It is now clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's students think and process information fundamentally differently from their predecessors. These differences go far further and deeper than most educators suspect or realize.

(Prensky, 2001)

Theory 2: 3 different social uses of technology (Hartley, 2007)



The museum

The playground

The refuge

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Collision of learning spaces

The Museum:
Formal, public, controlled
Institutional world of control and individual assessment

e.g. Virtual Learning Environments

e.g. Facebook

The Playground:
Collaborative, informal, exploratory
The world of facilitation and enquiry

e.g. iPod

The Refuge:
Personal, private and exclusive

E-learning: "the new fight in the playground"

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Theory 3: The Web 2.0 paradigm shift (O'Reilly, 2005)

- Not a software package – a different way of thinking about the internet
- Emerged from '.com' bubble bursting in 2001: wrong business model
- **Web 1.0** = software packages, information control, isolated, non-participatory, publishing, release versions
- **Web 2.0** = free internet services, user control of data, radical trust, collaborative, continuous improvement, cost-effective scalability, exploits the 'long tail' of small websites: 'architecture of participation'

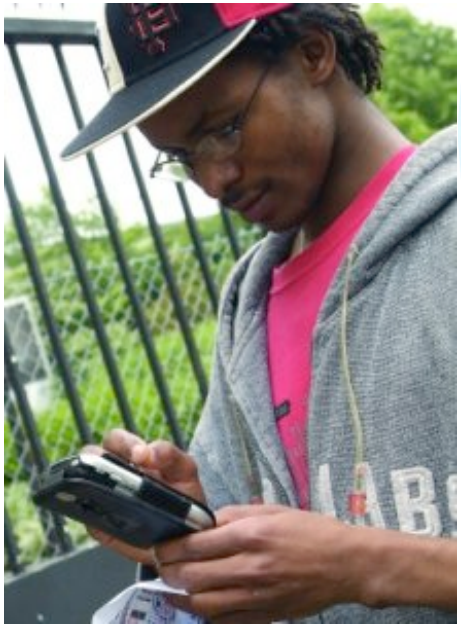
Theory 4: Convergence between new learning and new technology (Sharples Et Al., 2007)

New Learning	New Technology
Personalised	Personal
Learner centred	User centred
Situated	Mobile
Collaborative	Networked
Ubiquitous	Ubiquitous
Lifelong	Durable (?)

⇒ Importance of mobile learning

Theory 5: Learning in the 21st Century

- In the 1990s challenge was to provide PC labs
- Locus of learning is changing very quickly – away from the lab/ classroom/lecture theatre



- Advances in mobile and ubiquitous computing – create ways to go beyond 'traditional e-learning'
- Challenge now is to establish an integrated approach to learning environments – both real and virtual

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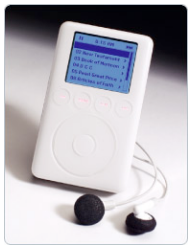
Mobile & wireless devices

laptops

mobile phones

digital camcorders



MP3 & MP4 players, e.g. iPods

Classroom communic-ation systems

tablet PCs

portable DVD players

digital voice recorders

electronic paper e.g. Sony Librie

smartphones

Ultra Mobile PCs

PDAs

games consoles e.g. Sony PSP

Need for platform stand-ards, e.g. MID, Java

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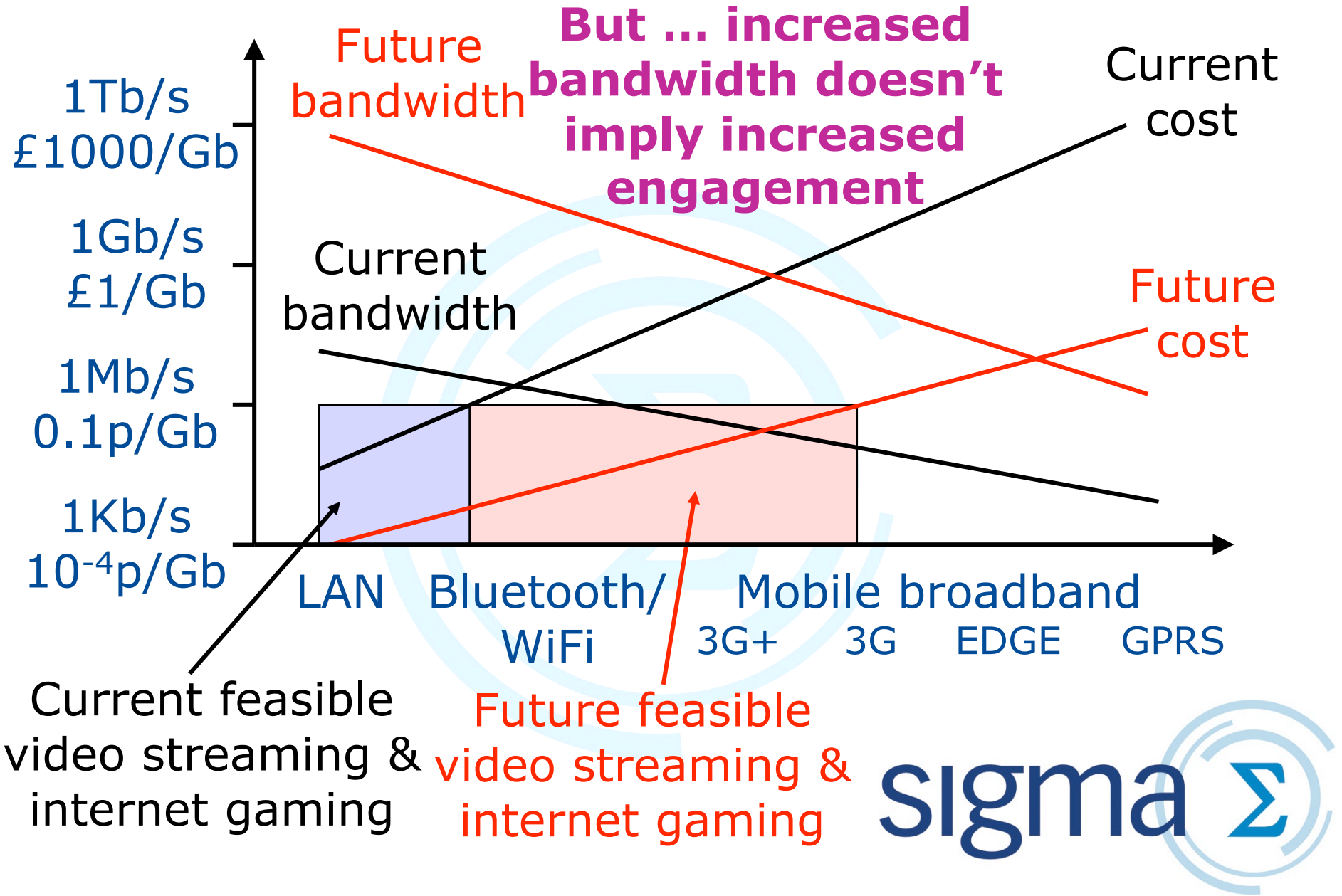
Theory 6: Feasibility of mobile connectivity



Theory 7: Engagement (Fredricks Et Al, 2004)

Behavioural - type of conduct, degree of involvement in learning and academic tasks, and degree of participation related activities

Cognitive - psychological investment in learning or cognition and strategic learning

Emotional - affective reaction to academic activities

Examples of new technologies in maths support: 1. Video podcasts via the mathtutor website

- 15 short clips currently available
- Impact?

Examples of new technologies in maths support: 2. Nintendo DS with nursing students

- Problems with numeracy
- High anxiety

Advantages of Nintendo DS:

- Wide demographics for recreational gaming (e.g. cooking, brain training)
- Can develop contextualised resources (e.g. drug calculations with graphics using Flash)

Institutions currently using them:

- Coventry
- Suffolk

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Examples of new technologies in maths support: 3. FETLAR

- Finding Electronic Teaching, Learning & Assessment Resources
- A JISC/HEA Open Education Resources project – outputs to be made freely available to all
- 12 month Project from 1/05/09
- Main focus: reuse of e-assessment objects
- Aims:
  - Collect mathematics e-resources
  - Technical work to assemble them
  - Try out & evaluate resources in the 'real' curriculum

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FETLAR resources offered

Institution	Resource	Description
Anglia Ruskin University	NuMBerS	Resources for numerical methods for the biosciences
Coventry University	Just the Maths	Modularised resources for foundation level and first year degree level courses
Glasgow Caledonian University*	CALMAT	Computer Aided Learning in MAThematics software suite for GCSE, A-level and first year university students
Leeds University	Maths Solutions	Short video clips of solutions to a series of maths problems known to challenge students
Loughborough University	mathcentre & mathtutor	Around 900 learning objects to help students who have difficulty at the transition to HE
Nottingham Trent University	METAL	A variety of resources to support mathematics for economics
Newcastle University	DIAGNOSYS	A knowledge-based test of basic mathematical skill

* **Note**: Informal permission not yet received

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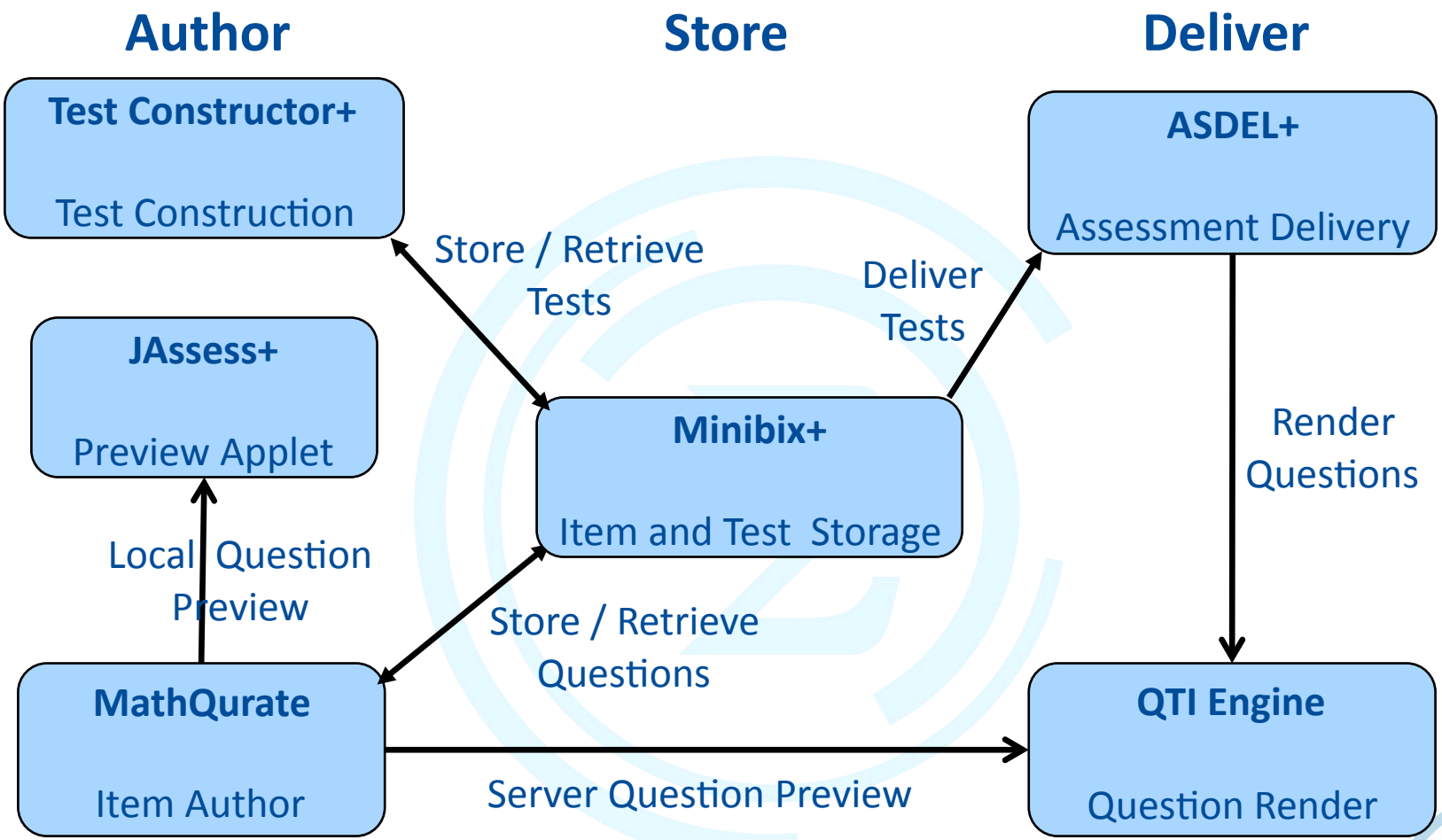
E-Assessment in FETLAR builds on MathAssess tools



QTI compliant ⇒ 'future proof'

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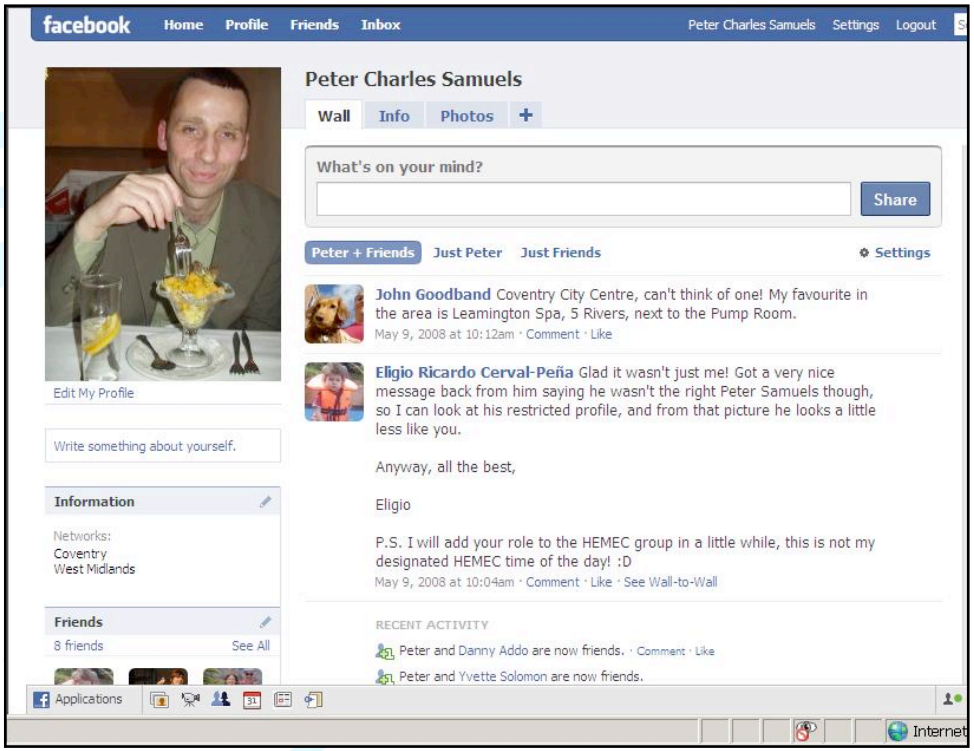
Examples of new technologies in maths support: 4. sigma's experiences with Facebook

- World's most active Social Networking Site
- Familiar technology to 'net generation' students
- Potential effective use in HE: Match social context of learning & Provide peer support



- Used by **sigma** to support maths students at Coventry
- 4 different groups
- Evaluation: interviews & focus groups

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Findings

- Social & physical environment more important factors than the virtual environment (e.g. new drop-in centre, strong student personalities)
- Generally 'low bandwidth' communication – social aspects of learning
- Problems with student ownership when started by staff
- Problems with equality & appropriateness when started by students
- **Solution**: Facebook group based on a student society set up by postgraduate students
- Appears to be more effective with postgraduate students (e.g. HEMEC conference)

sigma's investigations into new technologies

1. Evaluations of new technologies
2. Feasibility of mobile devices for HE maths learning
3. Proof of concept studies
4. Technologies implemented in Proactive Teaching Programme
5. Technologies chosen for further investigation in final year of **sigma**

1. Evaluations of new technologies

- 'Warts and all'
- Emphasis on technical aspects
- 13 evaluations currently available from **sigma** website

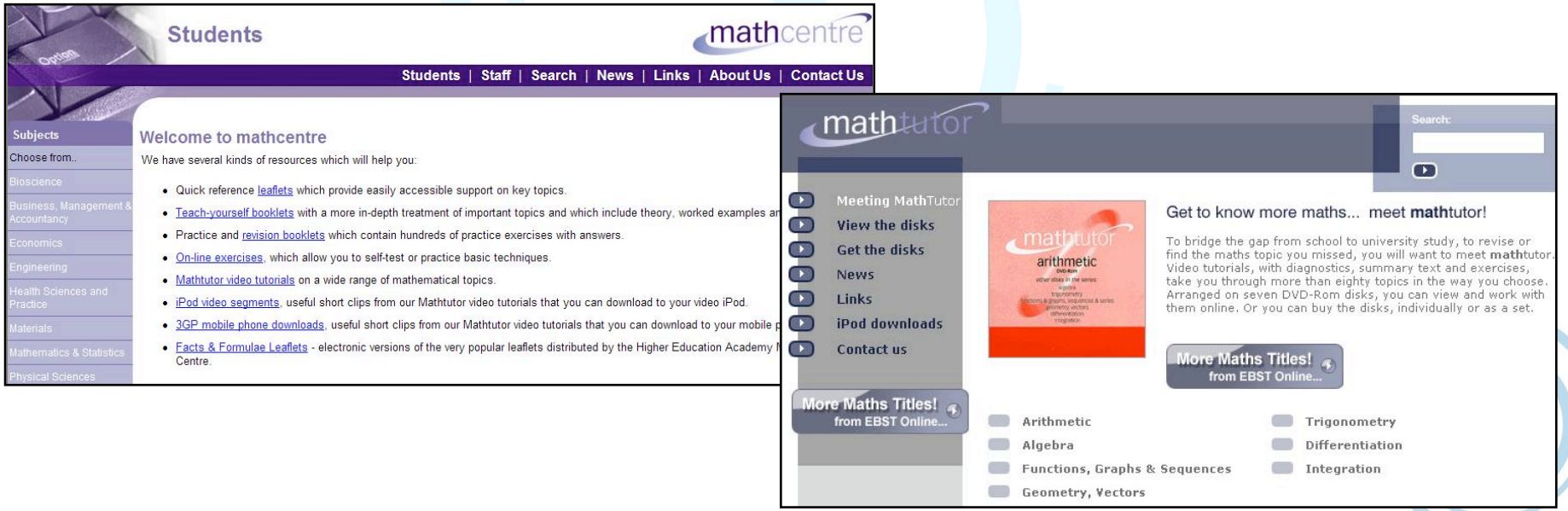
2. Feasibility of mobile devices for HE maths learning (Hu, 2007)

- More pedagogical evaluation of the potential of 8 mobile devices in HE maths learning:
  - Samsung Q1 UMPC
  - Sony Vaio UX UMPC
  - HP iPAQ PDA
  - Sony PSP
  - Apple iPod
  - Nokia N95 smartphone
  - Prada phone
  - Nintendo DS
- Also available from **sigma** website

3. Proof of concept studies (Saunders)

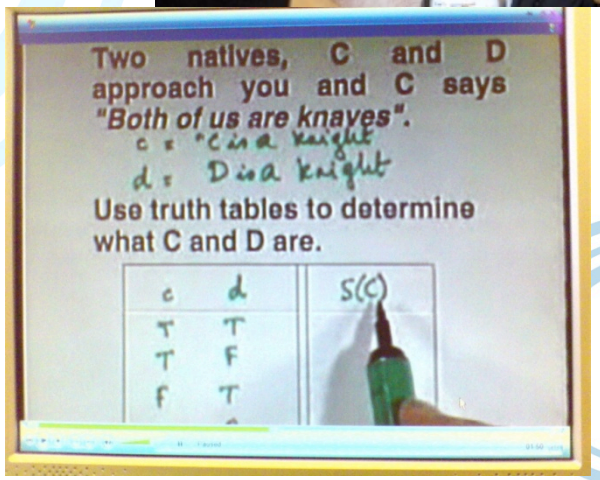
Aim: To investigate implementing mathcentre and mathtutor resources on mobile devices:

- Videos on iPods ✓
- Pdfs on PDAs ×
- E-assessment on PSPs (✓) and Nokia N95s (✓)



4. Technologies used in Proactive Teaching Programme

- Aim of programme: to reduce failure rates in maths modules by targeting 'at risk' students by deploying a support intervention
- Main uses of technology:
  - Classroom Communication Systems with engineering maths (Goodband)
  - Video & online tests to support self-paced learning in discrete mathematics (Samuels)



5. Chosen technologies for further investigation in final year of sigma

1. Classroom communication systems (Robinson & King, Boyle)
2. Elluminate (Audio-Video -Text software)
3. Lego Mindstorms NXT robots
4. Graphics tablets

Also interested in GeoGebra

Conclusions

- Learners are changing and less easily engaged with traditional methods
- Learning is becoming more mobile and ubiquitous
- Technology is becoming smarter
- Importance of theory & pedagogy when using new technologies
- Introduction to some new technologies in maths support and HE maths learning

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Any questions?

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Thank you!

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