eSUM Project

Lead site

1. Contact details for project leader.
   Dr Antony Maciocia
   School of Mathematics
   University of Edinburgh
   James Clark Maxwell Building
   Kings Buildings
   Mayfield Road
   Edinburgh
   EH9 3JZ
tel 0131 650 5994
fax 0131 650 6553
e-mail A.Maciocia@ed.ac.uk

2. Details of other members of the project team.
   Manolis Mavrikis, School of Mathematics. M.Mavrikis@ed.ac.uk
   Professor Cliff Beevers OBE
   Nora Mogey, SCROLLA, Media and Learning Technology Service,
   Nora.Mogey@ed.ac.uk

3. Summary of the relevant skills and experience these staff will bring to
   the project. (see also attached cvs)
   Antony Maciocia is current manager of the Edinburgh University
   funded COSMaP\(^1\) project which aims to add subject context to
   mathematical e-learning material. He managed the SHEFC funded RSI
   project MathPool and was a member of the SUMSMAN\(^2\) Project.
   Professor Cliff Beevers OBE currently leading the SCROLLA\(^3\) project
   in Heriot-Watt. He has a long and distinguished career in Computer
   Aided Learning in Mathematics including the CALM\(^4\) project. He will be
   contracted to Edinburgh University if funded by this grant.
   Manolis Mavrikis is currently writing the WALLIS\(^5\) system which is a
   web based mathematical learning environment which is built on AI
   technology. He is also involved in a JISC funded QTI\(^6\) project to develop
   standards for Mathematical e-learning material.
   Nora Mogey is manager of the e-learning Services in Edinburgh
   University with experience of setting up university wide VLEs.

Collaboration

---
\(^1\) Contextual On-line Solution of the Mathematics Problem
\(^2\) Scottish Universities Mathematics and Statistics using the Metropolitan Area Network
\(^3\) Scottish Centre for On-line Learning and Assessment
\(^4\) Computer Aided Learning in Mathematics
\(^5\) Web-based Assistant for Learning; on-Line Intelligent System
\(^6\) Question and Test Interoperability
4. Contact details for each partner higher/further education institution.

Heriot-Watt University

**Helen Ashton**, is a lecturer in the School of Mathematical and Computer Sciences part of whose remit is developing an appropriate infrastructure for e-learning within the School. She is also involved with the PASS-IT project in investigating the delivery of NABS’ online in Scottish schools. [h.s.ashton@hw.ac.uk](mailto:h.s.ashton@hw.ac.uk)

**Professor Ken Brown**, Ken Brown has 34 years of teaching experience in university at all levels; he has served on the Mathematics Panel of the Scottish Examinations Board and on the Examinations Board itself; he has acted as setter and moderator for CSYS examination papers. He has been involved in previous e-learning projects participating in the IMPACT project at Heriot-Watt and authoring a module as part of the UK wide MATHWISE programme. [k.j.brown@hw.ac.uk](mailto:k.j.brown@hw.ac.uk)

**Martin Youngson**, a lecturer in mathematics, has been involved with e-learning and e-assessment for over a decade. He was a coauthor of Interactive Past Papers and has carried out research on whether e-assessment can be used in some Scottish Qualifications Authority examinations, most recently as part of the PASS-IT project. [m.a.youngson@hw.ac.uk](mailto:m.a.youngson@hw.ac.uk)

University of Glasgow

**Nick Hill** is the Head of the Department of Mathematics at Glasgow University and has initiated the introduction of computer-aided learning and assessment for Level 1 Mathematics teaching. He is keen to commit departmental funds to the success of this project. [n.a.hill@maths.gla.ac.uk](mailto:n.a.hill@maths.gla.ac.uk)

**Neil Dickson** pioneered group project work for Junior Honours Mathematics as Glasgow University and is now leading the group responsible for the introduction of computer-aided learning and assessment in the Department of Mathematics. [nkD@maths.gla.ac.uk](mailto:nkD@maths.gla.ac.uk)

University of Paisley

**Neil Pitcher**, School of Engineering and Science, (see enclosed cv) [neil.pitcher@paisley.ac.uk](mailto:neil.pitcher@paisley.ac.uk)

5. Details of their role in the partnership.

Heriot-Watt University: Heriot-Watt will pilot the use of materials in both its service and honours courses and help to provide exemplars for use by other institutions. One learning technologist will be based here to train staff and help with the local pilot projects.

University of Glasgow: The University of Glasgow will play an auxiliary role in the development of the project and will pilot the e-learning material in Level 1 Mathematics classes, integrating it fully into the Mathematics syllabuses. This is a substantial commitment involving teaching to about 1,000 students.
University of Paisley: Advisory role via Neil and a consumer of the resources within currently running courses. Paisley will be a minor partner in this project.

6. Contact details of other partners
SQA, Head of CAA provision at SQA, martyn.ware@sqa.org.uk
LTS, t.liversedge@ltscotland.com

7. Details of their role in the partnership.
The role will be limited to representation on our steering group.
Martyn Ware: Provide a link to the school interface
T. Liversedge: Involvement with the PASS-IT programme in schools

**Description of the project**

8. State the aims of objectives of the project.
This project is concerned with how to effect pedagogical changes in the delivery of Mathematics to university students. Mathematics stands out as a special subject in e-learning because of the difficulty in rendering and inputting mathematical expressions: none of the VLEs or generic e-learning tools can handle this satisfactorily as yet. It is also special in a Scottish context because it is a prerequisite for a large number of 4 year degrees and the entry conditions differ from the rest of the UK. Add to this the well documented “Mathematics Problem” and we see a strong need to have the support this project would provide.

The eSUM project will initiate a network providing advice and assistance to set up and embed e-learning in mathematics courses. The emphasis, at least initially, will be placed on the school and FE to HE interface promoting e-learning to target the Mathematics Problem. We will provide Scotland wide curricula and mappings to school syllabuses (a useful service independent of e-learning) and to already established e-learning software. This will enable staff to integrate the material easily in their courses and relate this to what was seen at school.

The project will be based in the universities of Edinburgh and Heriot-Watt with explicit participation from the Universities of Glasgow and Paisley. This will be a true collaboration; each contributing a variety of skills to the team: Edinburgh is developing a system called WALLIS via the COSMaP project which aims to tackle the Mathematics Problem in first year service mathematics by adding subject context layers on to an intelligent tutoring system; Glasgow is making changes to its first year mathematics teaching to integrate CAL and will be used to pilot our systems: this represents a key transformation in their provision embracing e-learning; Heriot-Watt has a long history of using e-learning software including computer assessment and would like to extend this to other aspects of e-learning – they will provide a vital source of expertise; Paisley has used e-learning via the Methwise system and will
be used as a client for our services to test usability as well as supplying valuable additional experience.

Although setting up e-learning resources and embedding them in the curriculum in the four participating institutions will be an initial goal, an important aim is to set up a Scotland wide network of advice centres linked through a series of web pages. This will consist of key staff contacts with expertise in using various software systems in their teaching as well as workshops open to Scottish HE (and beyond). We will maintain close links with the SQA, Schools, LTS, LTSN, JISC and other interested parties. We will also give help and advice on interoperability and usability issues.

The team, based in the two principal institutions will be pro-active in seeking out staff to inform, help and engage in e-learning activities. This will include all Mathematics departments across Scotland. We will seek to build on the SUMSMAN project which collated data on usage, opinions and skills related to e-learning as well as on curricular issues. There is evidence in the principal institutions that the university management is serious about engaging in transformational change to embed e-learning in their mathematics teaching provision and in the other two participating institutions, commitment is strong at the faculty level. In Edinburgh, the Principal has set up a fund to support the development of e-learning modules and there is a similar scheme in Glasgow.

- We will define a core syllabus across Service Mathematics /Honours Mathematics at years 1 and 2 in Scottish Universities;
- building on the SUMSMAN work in this area;
- support this core syllabus with existing CAA/CAL resources and web site;
- help with usability audits of e-learning material and systems;
- help with setting up pilot schemes and integrating the material into current provision;
- provide brokerage to other universities in e-learning provision: seek out best practice and give advice and service in interoperability issues;
- provide technical and pedagogical support if necessary and appropriate including setting up servers.

9. **What problem is the project aiming to solve?**
- Help with the School/university interface. e-learning, and especially computer aided learning tools are being used increasingly in schools and there is an expectation from the students to use such systems. We will, wherever appropriate, encourage the use of the SCHOLAR look and feel to make this transition more seamless.
- The Mathematics problem: the observed decline in mathematical abilities of school leavers. This results in a diverse and inhomogeneous class with a variety of, often, elementary problems.

---

9 Learning and Teaching Scotland
Again, e-learning provides a way to help with this; by targeting the particular needs of an individual student and providing more directed motivation (as provided by the COSMaP project).

- There are growing pressures to use e-learning both from students and from management.
- the need to provide e-learning Staff development for lecturers to help them get a foot on the e-learning ladder.
- the need to make efficiency gains by fostering collaboration across the sector in Scotland and adopting emerging interoperability standards for learning objects (such as provided by QTI).

Benefits for the lead institution and its learners

10. State how aspects of learning and teaching will be conducted in a new way.
- Use diagnosis for self reflection and educational planning
- Re-purpose SCHOLAR for Service/Honours delivery
- Adopt the policy of NAB delivery as used in Scottish school education
- Use of immediate and intelligent feedback, both to teachers and students. This builds on work in both Heriot-Watt and Edinburgh Universities.
- Students will have access to asynchronous systems to provide “just in time” on-line tutorial support with self-diagnosis and formative assessments to help them stay in touch with course material.

11. Describe how these new processes will yield measurable benefits to the institution and its learners
- Aid retention and progression
- Better experience for teacher/learner: students will be able to engage in a larger number of activities without significantly increasing staff time.
- Economies of scale especially in “remedial” teaching and in advice shop
- Build on a solid core

Benefits for the sector(s)

12. Describe the way in which the project will benefit the Scottish further and/or higher education sector(s), including your plans for dissemination of the project outcomes.
- Central service of advice and talks,
- e-learning Exemplars available on-line with links to digital object repositories containing suitable mathematical material.
- Provide core syllabuses and mappings to commonly used CAL systems such as CALMAT as well as pooled material.
- Help and advice on setting up servers if required
- Information will be disseminated through a seminar/workshop series within Scotland, information sent out via the HoDoMS list, the HE Academy subject centre, the mathematics and statistical societies (EMS, LMS, IMS and RSS). We will also set up web pages linked to LTSN (and its replacement).
13. Set out separately the potential benefits for:

14. **Partner institutions directly involved in the project**
   - Address the Service Mathematics problem,
   - try out different testing regimes for module completion for example, CAA to test minimum competency and synoptic exam at end of course to measure higher order skills.
   - Demonstrate to staff not already engaged in e-learning its benefits.
   - University of Glasgow: development of new CAA/CAL schemes for Level 1 Mathematics, leading to more effective and better-targeted use of academic staff teaching time.

15. **Other institutions and bodies not directly involved in the project**
   - Provide a model for the way forward including core syllabuses, interoperability standards, usability information, course exemplars, access to a network of practitioners, access to distance courses residing on central servers.
   - CPD provision for staff in e-learning.

**Evidence of demand/feasibility**

16. **Give details of any research conducted to establish the feasibility of the new approach.** (This might be a market analysis of the existing student base (in order to identify groups of students for whom re-engineering might be most appropriate). It could also involve an analysis of the business processes associated with educational programmes (in order to identify processes likely to yield achievable, cost-effective benefits through re-engineering). If the project will adopt a new model of learning, to what extent is this based on educational research?)
   - The Mathematics Problem is well documented in England and Wales but is still very relevant here and represents one of the biggest threats to our undergraduate programmes in the physical sciences.
   - When specifically asked about e-learning, and especially CAL software, students frequently respond “of course, we expected to use this sort of stuff”.
   - NAB delivery in school is proving successful.
   - Educational principles such as those embodied in Bloom’s taxonomy in general and Smith et al for a Mathematics specific variant are becoming more widely implemented in degree programme objectives.

**Evidence of commitment**

17. **Describe the extent to which the institution is committed to engaging in this transformational process as part of its strategic development.**
   - Edinburgh University has funded a large project (COSMaP) to help tackle the maths problem in the university science school. WALLIS is the underlying intelligent tutoring system and this was also developed
at Edinburgh. The university has given a strong steer, pushed by a highly pro-active Principal, to staff to employ e-learning.

- Continues the HW approach adopted in CALM/Mathwise/SCHOLAR for example.
- Builds on SCROLLA collaboration across Edinburgh/Heriot-Watt/Glasgow

18. Provide evidence that the process of change is consistent with, and embedded in, institutional strategies.

- Edinburgh University has set up a substantial e-learning fund to help with development of e-learning materials and promotes e-learning through MALTS (media and learning technology service)
- This approach has been central at HW for two decades.
- Glasgow University is also promoting e-learning development through an internal fund.

19. State what resources the institution is committing to the project (in terms of funding, staff time and infrastructure).

- Edinburgh University: 20% staff time for two staff members, support via the COSMaP project (£200k over 2 years), office space in the school of mathematics.
- Heriot-Watt: Dr Ashton has recently been appointed to a permanent lecturership in the School of Mathematical and Computer Sciences and 50% of her job remit is to develop the e-learning infrastructure within the School. The University fund (£30K) a Virtual Learning Environment Project in which Prof Brown will participate. Accommodation for a learning technologist.
- Glasgow University: academic staff time in CAL/CAA group: 5% time for 4 staff in Mathematics, office space in Department of Mathematics, general secretarial and IT support.
- Paisley University: 5% staff release time for NP to attend committee meetings.

20. Describe the strategy to ensure that the intended outcome is sustainable, and will result in long-term change in activities beyond the period of external funding. Describe any structural changes which the institution will make to fully embed the project outcomes.

- One objective is to develop a critical mass of staff actively using e-learning to teach mathematics. By promoting standards and providing help at the outset we aim to build up a sufficient level of expertise in each department (and, at least, in the participating institutions which can then be used to provide help to others). The team will actively seek out staff in all institutions to create this body of expertise.
- In the project a number of different approaches to e-learning within mathematics will be developed and evaluated. Information will be disseminated throughout the Scottish Universities about Web-materials and approaches relevant to core syllabus material. We are confident that we can demonstrate the effectiveness of e-learning and help institutions put in place appropriate infrastructure. This should lead to a significant increase in use of e-learning across the
the participating departments are committed to updating their delivery of Level 1 teaching through the use of CAL/CAA. eSUM will be used to bring about the necessary changes which will be incorporated into revised syllabuses and teaching and learning programmes.

Providers of services

21. Where the institution is providing the service(s): have you explored the scope to provide the service more effectively by sub-contracting to specialist outside bodies?
HW have explored this out sourcing possibility but the nature of the service is very specialised: mathematical and tackling a particular problem.

22. If subcontracting is involved, state how the contract(s) will be managed. Not applicable

23. Where the service involves 'home-grown' or open-source solutions: say how this approach will be more reliable and effective than using commercially available products.
- WALLIS (incorporating COSMaP) is designed to tackle the mathematics problem in a Scottish context. It incorporates leading edge technology based on AIED and building on expertise in Edinburgh University informatics.
- SCHOLAR has demonstrated scalability across secondary sector

Sustainability

24. Say how the new approach will be embedded and sustained. See previous answers (especially 20).

25. In what way will the new approach substitute for existing processes or methods of delivery? It will enhance not replace existing provision.

26. How will the new approach be maintained and updated within normal running costs beyond the period of central funding? See previous answers (especially 20). We would hope that the project will have demonstrated the benefits of the use of e-learning in the teaching of mathematics to the extent that the participating institutions will continue to fund the learning technologist positions.

Financial information

27. Set out the budget for the project, in terms of: (see enclosed spreadsheet for details)
28. Staff costs:
   Total: £ 609,779
to include a project manager/technologist, 2 learning technologists and,
staff release

29. **infrastructure (equipment, office space, overheads) costs;**
    (see appended spreadsheet)

30. **service costs (where services are to be purchased from an external provider);**
    None
    and

31. **software licence costs.**
    £ 5000 (We aim to use and promote opensource software wherever possible).

32. **State what level of Council funding is required for the project.**
    £ 509,438

33. **State which costs will be met by the institution(s).**
    £ 100,341 (as listed in 19 above and detailed in the spreadsheet).

34. **Set out a projected profile of expenditure, based on the project plan.**
    See appended spreadsheet.

**Project plan**

35. **Please attach a full project plan, setting out key milestones, outcomes and delivery dates. This should be in the form of a Gantt chart, MS project plan or similar.**
    (see attached Gantt chart)
I certify that this proposal has the support of central institutional management

Signed .......................... (Principal of lead institution)

Signed .......................... (Principals of other participating institutions)

Date .................................

Please return this form by post and send an electronic version to:

David Beards
Learning and Teaching
Scottish Funding Councils for Further & Higher Education
Donaldson House
97 Haymarket Terrace
Edinburgh EH12 5HD
Tel: 0131 313 6520
email: dbeads@sfc.ac.uk

The deadline for receipt of bids is Monday 27 September 2004.