



The Development of Mathematics Resources

Subject Area: Maths and Statistics

Project Partners: Dublin City University, Institute of Technology Carlow, National University of Ireland Maynooth.

Project Coordinators:

Ciarán Mac an Bhaird, National University of Ireland Maynooth. ciaran.macanbhaird@nuim.ie

Ann O'Shea, National University of Ireland Maynooth. ann.oshea@nuim.ie

Resource handle in NDLR repository:

<http://hdl.handle.net/10633/29649> <http://hdl.handle.net/10633/29650>

Abstract

In this paper we give a brief overview of the ongoing development of Re-usable Learning Objects in mathematics and statistics at the National University of Ireland Maynooth. We focus on the materials that are being developed in collaboration with other third level institutions and supported by the NDLR. We briefly discuss how the topics were selected, the type of resources being developed, the technologies being used and how the resources can be integrated with the wide range of existing materials available. The resources are designed to complement, not replace traditional methods of teaching.

Introduction

The National University of Ireland Maynooth (NUIM) has approximately 5800 undergraduates, 950 of which are taking mathematics modules and a significant number of other students encounter mathematical topics in subjects such as Finance, Sociology, or Psychology etc. There are well documented problems in mathematics education and the reasons for the increase in the numbers of students coming to study service mathematics at third level with high levels of mathematical deficiencies are commonly investigated (Curriculum and Examinations Board, 1986, Lynch et al., 2003). One response to these issues at third level is the growth in the area of mathematics support provision (Gill et al., 2008, Perkin & Croft, 2004).

The Department of Mathematics and Statistics at NUIM has many recently established supports in place to help students if they experience difficulties, for example, we run a successful Mathematics Support Centre (MSC). The main service the MSC provides is a drop-in centre. Research by Mac an Bhaird et al. (2009) shows that first year students at NUIM who avail of mathematics support services have a greater chance of succeeding in examinations than those who do not. This is especially true for students who are deemed at-risk of failing.

The MSC decided to pilot the use of technology and electronic resources for a number of reasons. The initial reason was that our centre is extremely busy and sometimes students are

not able to avail of all the help that they need. Employing online resources means that the students can have access to suitable support material 24 hours a day and do not have to be on campus to access it. We also wish to cater for students with different learning styles and have found that technology has great potential in this area. A full and detailed analysis of role of technology in mathematics support at NUIM is contained in Mac an Bhaird & O'Shea (2011).

Technology is being widely embraced and incorporated in mathematics education and this is well described (OECD, 2005, Macdonald et al., 2001, Suanpang et al., 2003). It is important to stress that the development of these resources should be seen as a complement to existing teaching methods and supports, not simply as a more economical way of teaching. Samuels (2007) asserts that educational purpose and pedagogy should be the driving force behind the use of new technology. The negative effects of a lack of a personal contact between students and teachers involved in the learning process are described by Truluck (2007). This highlights the importance of combining online resources with face-to-face supports.

It is clear that the implementation of technology use in education is a very complex issue, however we believe that technology has a vital role to play in the future of mathematics education. The NDLR funding has allowed us to begin to develop suitable materials in order to provide this support.

Development of Resources and Collaboration

There are a wide range of mathematics resources already in existence so it is crucial that we do not reproduce resources unnecessarily. Prior to starting the NDLR projects, we held discussions with our partners Dr. Eabhnat Ní Fhloinn, DCU and Damien Raftery, IT Carlow, to identify areas in mathematics that students (particularly first years) are having difficulty with. We then searched for existing suitable and freely available resources. It is important to note that there are many different learning styles and learning needs, and using a variety of appropriate presentation methods is essential. We identified areas where we felt that additional material and/or alternative methods of presentation were appropriate. The main areas we selected were Limits, and Sequences and Series. To a lesser extent we are also working on Linear Algebra and Data Analysis.

When searching for existing resources we checked a number of excellent websites such as www.mathcentre.ac.uk, <http://www.justmathtutoring.com/> and <http://www.khanacademy.org/> to name but a few. The majority of the mathematical community freely shares any electronic resources they develop. One example of this is the FETLAR project (<http://www.fetlar.bham.ac.uk/>) which aims to enable the open sharing of educational resources. This is quite similar in certain aspects to the NDLR. Engelbrecht & Harding (2005) also include an extensive list of existing website and online resources.

The next main decision was picking the most appropriate resource type and suitable technologies to use. We had further discussions with our partners and attended a number of showcase events such as the NDLR Fest (<http://www.ndlr.ie/resource/resourcesndlrfest>) and the MSTL Conference (<http://elearn.itcarlow.ie/MSSTL10.htm>). We witnessed the wide range and

quality of work that is already being carried out with technology. We decided to produce resources as videos, podcasts and pdf handouts as these could be easily distributed and used. The podcasts are developed using Audacity (<http://audacity.sourceforge.net/>). There are two video formats, one set is recorded using a standard camera and the second set are screencasts using Screenr (<http://screenr.com/>). The pdf handouts are produced using the mathematics software LaTeX (<http://www.latex-project.org/>). The Centre for Teaching and Learning at NUIM and the NDLR provided appropriate training where required. The people involved in the production of the material at NUIM are Dr. Ciarán Mac an Bhaird, Peter Mulligan, Dr. Ann O'Shea and Dr. Lars Pforte, all members of the Department of Mathematics and Statistics and associated with the MSC.

Most third level institutions use a Virtual Learning Environment (VLE) VLE for material dissemination, NUIM uses Moodle (<http://Moodle.org/>). So lecturers can choose any of the resources that we have developed and upload them to their moodle page for their students to use. However, simply developing the resources and making those available is not sufficient. They should be presented in an appropriate manner to encourage student engagement. The creation of a meaningful learning environment that fosters and supports learning is emphasised in Khan (1997), similar issues are dealt with in Reid and Petocz (2002). We decided to produce the resources in such a fashion so that they can be used and presented collectively as well as individually. To this end we are using Articulate (<http://www.articulate.com/>) to help present the material developed along with existing resources collectively in a coherent and practical fashion. Damien Raftery's presentations using this software were instrumental in our decision to use Articulate.

Evaluation of Resources

The resources were being developed during the academic year 2010-11, so there has been limited opportunity to evaluate them effectively to-date. Some of the videos were uploaded by lecturers to moodle and they were accessed by a significant number of students. Students were encouraged to comment on the videos, typical comments were as follows: *'The videos really helped me get my head around limits! Thank you!'* *'I thought your video on the limits were very good and helped clear up any confusion I had on the limits.'* *'Thanks for putting up the videos on limits - they're great!'* We plan to complete a thorough evaluation of the resources next year when we have a full academic year of usage to report on.

We are optimistic that the evaluation process will be positive, based on the student comments and the high rate of usage. Many papers present evidence of the effectiveness of using technology in mathematics education (Karr et al. 2003; Ruthven & Hennessy 2002). There are a number of papers available on the implementation of technology in mathematics support services but there is little analysis on the effectiveness of these supports. Hibberd et al. (2003) gives a detailed description of how first-year support can be substantially enhanced by the use of web-based learning environments. Samuels (2007) gives a very thorough overview of the reasons why new technologies should be embraced in mathematics support. He also discusses what this electronic support should be and the challenges facing the wider dissemination of such methods.

Future Plans

The most immediate plan is to conduct a thorough analysis of usage and feedback based on a full academic year. This will entail investigating the use of individual resources and the use of the resources when presented as part of a more complete package for students using Articulate. We will continue to promote the materials with colleagues; all the resources are being uploaded to the NDLR website and the MSC website <http://supportcentre.maths.nuim.ie/>. Links to the resources will also be available through the Irish Maths Support Network website <http://supportcentre.maths.nuim.ie/mathsnetwork/>.

We hope to continue to develop additional resources in areas of mathematics where required and as time allows. We want to continue collaborations with other third level institutions and within the NDLR Mathematics and Statistics Service Teaching Community of Practice (<http://www.ndlr.ie/mshe/>).

References

- Curriculum and Examinations Board (1986) *'Mathematics Education: Primary and Junior Cycle Post-Primary'*. Dublin: Stationary Office.
- Engelbrecht, J. & Harding, A. (2005) 'Teaching Undergraduate Mathematics on the Internet', *Educational Studies in Mathematics*, 53, 253-276.
- Gill, O., Johnson, P. & O'Donoghue, J. (2008) *'An audit of mathematics support provision in Irish third level institutions'*. University of Limerick: CEMTL Report.
- Hibberd, S. et al. (2003) 'MELEES- e-support or mayhem?', *MSOR Connections*, 3(3), 29-34.
- Karr, C. et al. (2003) 'Analysis of the effectiveness of online learning in a graduate engineering math course', *The Journal of Interactive Online Learning*, 1(3), 1-8.
- Khan, B.H. (Ed.). (1997) *Web-Based Instruction*. Englewood Cliffs, New Jersey: Educational Technology Publications, Inc.
- Lynch, K. et al. (2003) *Inside Classrooms: a Study of Teaching and Learning*. Dublin: Institute of Public Administration.
- Mac an Bhaird, C., Morgan, T. & O'Shea, A. (2009) 'The impact of the mathematics support centre on the grades of first year students at the National University of Ireland Maynooth', *Teaching Mathematics and its Applications*, 28(3), 117-122.
- Mac an Bhaird, C. & O'Shea, A. (2011) 'The Role of Technology in Mathematics Support: A Pilot Study'. In: Juan, A. et al. eds. *Teaching Mathematics Online: Emergent Technologies and Methodologies*. In Press.
- Macdonald, C.J. et al. (2001) 'The demand-driven learning model: A Framework for web-based learning', *Internet and Higher Education*, 4, 9-30.
- OECD (2005) *E-Learning in Tertiary Education*. Paris: Organisation for economic Co-operation and Development Policy Brief.
- Perkin, G. & Croft, T. (2004) 'Mathematics Support Centres – the extent of current provision', *MSOR Connections*, 4(2), 14-18.
- Reid, A. & Petocz, P. (2002) 'Students' conceptions of statistics: a phenomenographic study', *Journal of Statistics Education*, 10(2). Available from

<http://www.amstat.org/publications/jse/v10n2/reid.html>, [Accessed 22 April, 2011]

Ruthven, K. & Hennessy, S. (2002) 'A practitioner model of the use of computer-based tools and resources to support mathematics teaching and learning', *Educational Studies in Mathematics*, 49, 47-88.

Samuels, P. (2007) 'Mathematics Support and New Technologies', *MSOR Connections*, 7(1), 10-13.

Suanpang, P. et al. (2003). 'Student Attitudes to Learning Business Statistics Online vs. Traditional Methods', *Learning for unknown future*. New Zealand, HERSA, 6–9 July 2003.

Truluck, J. (2007) 'Establishing a mentoring plan for improving retention in online graduate degree programs', *Online Journal of Distance Learning Administration*, 10(1), 1-6.