WORKSHOP REPORT

Maths Support provision through embedded classes at LSBU

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Abstract

The present report summarises the communications presented at the **sigma** Network event on 'Maths Support through Embedded Classes' held at London South Bank University (LSBU). Two keynote speakers Professor Jon Warwick, from the LSBU Business School and Dr Lesley Roberts, Head of Skills for Learning, contributed valuable presentations. They outlined how maths support went through various stages and demonstrated the experience of embedded classes at LSBU. Five other delegates communicated their experiences of Maths Support through an embedded approach in their respective institutions.

Keywords: Maths support, embedded classes, learning development.

1. Introduction

As a part of the Centre for Research Informed Teaching (CRIT), Skills for Learning hosted the **sigma** network event on the theme of 'Maths Support through Embedded Classes' at London South Bank University. Participants have been involved in the mathematics learning support in Higher Education; most of them came from South-East England. Professor Shân Wareing, Pro Vice Chancellor (Education & Student Experience) opened the event and Dr Saranne Weller, Head of CRIT, welcomed the attendees and highlighted the importance of the service provided in helping students improve their learning experience.

Support in Mathematics and Statistics at LSBU is provided across the whole University to both undergraduate and postgraduate students. The support covers a range of topics such as Numeracy skills, General Maths, Advanced Maths for Engineering, Quantitative Methods for Business, Psychometric tests, Statistics and Research Methods. The delivery makes use of four different learning formats: workshops, one-to-one consultations, drop-in sessions and embedded classes.

Mathematics and statistics support centres in many universities are actively developing learning programmes that go beyond the traditional drop-in or one-to-one formats. They closely collaborate with faculties and departments to put in place 'embedded' support to meet the needs of specific courses and to reach larger groups of students.

Both keynote speakers Professor Jon Warwick, from the Business School and Dr Lesley Roberts, Head of Skills for Learning, commented how maths support went through various stages and exposed the experience of embedded classes at LSBU. Five further communications were presented by the delegates from University of Bath, Brunel University, Middlesex University and University of East London, followed by discussion. Participants were pleased to share their respective experiences on support provision through an embedded approach.

2. Keynote speakers

2.1. Jon Warwick, Professor of Educational Development in the Mathematical Sciences. Mathematics Support Experiences at London South Bank University.

Professor Jon Warwick gave the first plenary lecture; he described some of the work conducted within the School of Business supporting students who have to study mathematics as non-specialists. In his introduction, he focused on the challenges facing the teaching of mathematics in universities, a task made more difficult by intakes of students of mixed mathematical abilities. It is recognised that poor educational experiences in mathematics learning and poor contextualisation of the mathematics taught contributes significantly to this problem. The teaching of mathematics is a real challenge recognised by employers who complain about graduates' weaknesses in mathematical skills, lack of competency and confidence.

Engagement. Using his extensive experience in teaching mathematics at LSBU, Warwick has developed a teaching model which relies on knowledge acquisition, understanding, assessment and engagement. It is a cyclical model in which the student engagement acts as a feedback to the learning process. The model also takes into account parameters such as mathematical anxiety and self-efficacy. Mathematical anxiety is defined as a feeling of tension that hinders the manipulation of numbers and impedes the solutions of mathematical problems across a wide range of life and academic situations. This anxiety has the potential to cause a student to lose self-confidence in the subject of mathematics. Mathematical self-efficacy is defined as a person's judgement of their capabilities to organise and execute courses of actions that are required to attain specific types of performances. Self-efficacy of an individual is believed to be influenced by a number of factors such as previous success or failure in mathematical performance, comparison with peers' performance, received comments from persons in position of authority such as teachers, parents, and psychological pre-disposition that may give rise to feelings of anxiety and tension.

Changing attitudes. Warwick stressed the importance of taking into account these concepts of mathematical anxiety and self-efficacy in any meaningful endeavour of teaching mathematics. These factors are intimately linked to achievements in mathematics, and modules requiring substantial mathematical input. They will impact employability, improve wider career and occupational prospects and will also feed into academic institutions' performance and standing.

Assessment. Student evaluation constitutes an important stage in Warwick's cyclical learning model. Assessments and feedbacks are used with the aim of furthering student's progress and development. The objective is to allow the student to demonstrate mastery in the subject. Mastery is defined by improvement rather than outcome, sustained learning effort and satisfaction gained from hard work and gradual learning.

Mastery entails encouragement of 'risk taking' in the classroom which is conceived as a safe environment where it is acceptable to make mistakes and learn from them. It is also predicated on knowing the students' backgrounds, capabilities and anxieties early in the academic year so that specific help can be provided to address any issues that hinder students' progress.

Support processes. The learning model requires support processes to be put in place in order to explore students' expectations, enhance self-efficacy and reduce anxiety. The aim is to foster a belief that skills can be nurtured and developed through regular and developmental feedback, encouragement for peer interaction, teamwork and continuous personal development outside the classroom. To make independent learning possible academic institutions should provide electronic resources and specific online help.

Figure 1: Participants at the Maths Support through embedded classes event

Implementation of teaching models. Professor Warwick suggested two models of support that have been implemented with first year undergraduate students (Warwick, 2008 and 2010). Then he summarised some interesting results achieved through these two support models implemented within Business school.

Model 1: Embedded support tutorials

1. Support sessions were timetabled i.e. not optional;
2. Once a mathematics 'driving test' was passed, attendance at support sessions no longer required;
3. Driving tests could be attempted without penalty until passed.

Model 2: In-curriculum support

1. Students worked in small groups, compared and discussed problems and worked with their dedicated tutor;
2. Teaching activities were designed around the Kolb learning cycle;
3. Feedback was constant from peers and tutor;
4. Sessions included theory, worked examples, practice questions and reflections on progress;
5. Completion of a portfolio demonstrating professional competency skills;
6. A richly populated VLE.

The outcomes achieved are summarised below:

- Since implementation the average pass rate increased from just below 60% to 86%;
- 86% of students rated the quality of the module as 'acceptable' or better, with corresponding figures of 86% for the quality of lectures, and 83% for the difficulty of assessment;

- As a crude measure of engagement, 70% said the module held their attention over the year;
- Impact was sustained with evaluation regularly meeting university KPI's for progression (70%) with student feedback scores above sector norms.

The speaker ended his presentation by posing a series of questions for further discussion (subsequently considered by the audience during the last session of the event).

2.2. Dr Lesley Roberts, Head of Skills for Learning. Embedded Learning at London South Bank University.

Dr Roberts' presentation covered the embedded learning at LSBU. She started her talk by briefly describing the role of the Skills for Learning team in supporting learning at LSBU. The service is based on a centralised learning development structure providing support in Academic skills & English and Maths. The support is provided through four different formats namely drop-in sessions, workshops, one-to-one consultations and embedded classes. The following key points were then addressed.

Embedded teaching at LSBU takes place through timetabled classes and seems to fit with the discipline specific approach (i.e. it is tailored to the discipline the student is studying). The embedded lessons are planned in close collaboration with the modules leaders and are delivered at critical times in the course of the modules to produce maximum learning impact.

Roberts raised the following question: Why embed? Embedded learning is a form of "*Opt-out rather than opt-in*" approach (Thomson, 2012). All the students, whether vulnerable or able, benefit from the provided support. This approach is a mainstream one, targets all students and thus avoids some of the stigmatising effects of other forms of remedial learning.

In mainstream embedded classes, it is assumed that the students are not broken. The emphasis here is on motivating and encouraging them to take ownership of their education. Classes provide a learning context enabling students to apply academic practices to their specific subject and assessments as opposed to a bolt-on generic 'skills' class. Beach (2003) states that skills may not be transferable unless the dots are joined or a bridge has been built. By providing embedded classes, impediments to learning and transferring previous skills acquired in different contexts to the students' current learning condition can be investigated and remedied to break with what Roberts called the "*non-transferability of transferable skills*".

Roberts highlighted the experience gained by the Skills for Learning department from a pilot programme covering 39 modules spread across the seven Schools of the University. The support included targeting low performing modules and the extent of the intervention varied from 1 to 5 sessions. Approximately 1,700 individual students were involved with 2,685 registered attendances.

The results of the pilot showed first attempt pass rates for the year 2015/16 improved by an average of 10.76%. On average, modules with one support session produced an improvement of 3.95% whereas support of two or more sessions improved the results by an average of 21.7%. In the case of low performing targeted classes, the first attempt pass rate improved by an average of 53%.

Maths support poses a particular conundrum as far as embedding is concerned. Embedding classes for modules where maths is not the primary content is not problematic. This is easily done for modules, which require drug calculations, or the statistics needed for final year empirical projects. It is when maths is the primary content such as in engineering subjects where the

problem arises. Typically two situations arise, either to take the 'broken' students approach or to teach a whole module. In other words, either to provide a curative response, or to substitute the module lecturer. As the current role and mission of Skills for Learning do not allow the luxury to implement either option, we tend to opt for a compromise solution. It is that neither these options are mainstream Learning Development, because the first option is remedial and the second is simply not Learning Development. For instance, teaching a couple of topics and running revision classes on the topics that the students find most difficult.

In conclusion, Roberts asked the audience to reflect on the two following important questions:

- Is there a role for embedding in modules where maths is taught as the primary content?
- Are there different approaches that could mark out embedded maths learning development from traditional module teaching?

3. Contributed presentations

3.1. Cheryl Voake-Jones, MASH Coordinator and Teaching Fellow. Embedded Support at the University of Bath.

Cheryl Voake-Jones began her presentation by giving a brief overview of MASH, the mathematics and statistics help and advice service at the University of Bath. Support includes drop-in sessions (some of them peer led), Statistics Advisory Service (SAS) appointments, and embedded sessions in three Faculties (Engineering, Social Sciences and Science) and School of Management.

In the main content of the talk, Cheryl recounted candidly on her experiences of providing embedded sessions on a variety of courses. Her first example was teaching statistics (including SPSS labs) on a Biology and Biochemistry core module where the content was determined by the module staff. There were three sessions in Year 1 followed by a refresher session in Year 2 and in Year 3. Other examples followed including key skill sessions for Year 1 Chemistry students, statistics and Excel for MSc students in the School of Management, and for the Sport and Exercise programme, and bespoke sessions for final year Management and Economics students on graduate numeracy assessment. MASH were asked to teach first year Civil Engineering students weekly compulsory maths classes to individuals who had obtained low scores in a diagnostic test. Here the content was determined jointly between Faculty staff and MASH staff.

A 'one size fits all' approach certainly does not work for embedded support. It is not just the content that varies by department or programme, but also the background knowledge of the students, staff expectations, student expectations, mode of delivery and time available to cover material.

Whilst describing these examples Cheryl discussed the issues that have arisen along the way, as well as the benefits. Departments can be demanding beyond the resources of MASH with staff-time limited and demand for sessions clustering around particular times of year. Is assessment part of the deal? If it isn't, do you know how the students will be assessed? Making teaching materials discipline-specific can be very time-consuming but is worthwhile. Another issue is that sometimes you can inherit teaching materials not of own choosing, what do you do if you are not happy with the quality of the materials? Additionally, course staff can have unrealistic expectations of what can be covered in one session and it is not always clear on the level of students and assumed knowledge. These issues need to investigated and resolved with the aid of the department. Cheryl emphasised the need for timely delivery in relation to a course structure to ensure material taught is experienced as helpful by students.

3.2. Mohamed Mehbali, Learning Development Adviser for Mathematics, Skills for Learning. Maths Support through Embedded Classes at London South Bank University.

Mehbali's presentation revolved around one aspect of the maths support provision at LSBU, namely embedded classes. He started by giving a brief description of the role of Skills for Leaning department which is part of the Centre for Research Informed Teaching at LSBU. The service is dedicated to helping students develop their learning skills particularly in two areas: Mathematics, English and Academic skills. Mr Mehbali who leads the Maths Support team, talked about his experience in embedded classes and how to run them in such a way as to maximise benefit to all the students attending these sessions. He then focused on two case studies of embedded learning, one concerning first year Nursing students, and the other, second year Product Design Engineering students.

Case Study 1. Mehbali collaborated with course directors from the Health & Social Care School (HSC) to deliver embedded lessons in drug dosage calculations to the first year nursing students. He worked with the module leaders to select the topics to be covered. The embedded lessons were then incorporated into the learning modules and the students' attendance of them was monitored.

The Head of Maths Support planned the sessions and specified the required resources such as staff, time, rooms, learning materials and announcements via Moodle (Virtual Learning Environment). The teaching sessions were delivered over six consecutive weeks and focussed on drug dosage calculations.

The lessons were interspersed with tasks designed to test students' progress and to allow formative assessment to be made on the performance of each student. At the end of each session, homework tasks were set to consolidate the educational experience and promote independent learning.

As the course leader wanted an assessment to be carried out, the Maths Support team developed an online assessment tool (namely Kahoot activity) for this purpose. The students were asked to complete a test paper then they logged on to the Kahoot website (https://kahoot.com) through their smartphones or tablets. Next, they were required to enter their individual answers one by one using their devices. A detailed report on the students' responses was subsequently generated. The students engaged with the activity and valued the prompt feedback on their performance. Gibbs and Simpson stressed how the provision of feedback can affect student learning behaviour (Gibbs and Simpson, 2004).

The Maths Support staff are not directly involved in the summative assessment but do contribute to the summative process. The team is heavily involved in the formative assessment through providing feedback on students' learning. Formative assessment and feedback are crucial for students to learn effectively (Black, 1998 & 2003). The assessment experience was shared with other lecturers in the HSC School. After the examination results, the course leader forwarded some feedback: "*Thank you for your support of the students' numeracy education. The pass mark was high for all groups at above 98% which is brilliant."*

Case Study 2. A similar embedded learning experience was repeated with second year Product Design Engineering students. A collaborative approach was adapted to encourage group-work and to stimulate cooperation. Students learn better when they work together and interact with their peers (Race, 2009). Six timetabled embedded lessons were delivered to the students over 3 weeks. Three topics were covered (Algebra, Differentiation & Integration).

Key outcomes were:

- High attendance rate (87%);
- Students engaged and interacted well with the lessons having realised their importance to their course;
- Students showed interest by asking to have their homework checked;
- After the lessons, students made regular visits to Skills for Learning willing to further improve their mathematical skills.

An evaluation questionnaire was produced and handed to the students to be filled in to record their experience and feedback. The results were communicated to the course leaders.

The following remarks can be made on the embedded lessons.

- Positive feedback from students, on their evaluation form;
- After the embedded sessions, more students became regular visitors to the Skills for Learning department for extra help;
- Partnerships established with module leaders.

In conclusion, the speaker mentioned that embedded classes:

- May contribute to effective teaching, in reference to Biggs who challenged traditional methods of teaching and suggested seven characteristics of effective teaching contexts (Biggs and Tang, 2011);
- Have a wide impact on students;
- Enable us to effectively support more students;
- Offer an opportunity for building partnerships with module leaders.

Figure 2: David Bowers providing details on the sigma network

3.3. Lois Rollings, Maths, Statistics & Numeracy (MSN) Lecturer at Middlesex University. Embedding Maths Support – Some Thoughts.

Lois Rollings reflected on embedding maths support in her presentation and wanted to share some thoughts with the audience. Lois stressed the importance of communication between the stakeholders involved in the support provision. If embedded sessions are going to be successful then good communication between all those involved such as maths support tutors, lecturers, their respective managers and the students themselves, is vital. She reported that problems could arise if managers are speaking to each other without adequately informing staff and vice versa.

The speaker added that the maths support tutor and course lecturer need to be clear about the expected content and timing of a session as well as what can be expected of the students. For the MSN tutor, having access to the course resources available on the virtual learning environment (VLE) site can be extremely useful as it can then be seen what else students have covered and the style of the lecturer, and maybe more.

Rollings noted that it is also important to ensure that what is requested is feasible – MSN tutors can only be in one place at a time, and their overall workload limits need to be observed. MSN tutors also need a reasonable notice to prepare sessions.

Rollings remarked that students needed to recognise that an embedded session is relevant to their course – and preferably will be assessed in some way. The session also needs to be at the right time, so that the content will be needed in the near future.

Rollings concluded the presentation by posing two questions:

- What about students taking maths courses? Perhaps they need 'attached' rather than embedded sessions.
- Does maths need a different model from academic writing?

3.4. Inna Namestnikova, Academic Skills Adviser - Mathematics and Numeracy. Brunel Educational Excellence Centre. Academic Skills at Brunel at University – A Short Overview of the Service.

The Academic Skills (ASK) service provides support to Brunel students on academic skills, maths and numeracy, statistics and SPSS. The ASK also coordinates Peer-Assisted Learning (PAL) schemes at Brunel which during 2016/17 have been operating in Computer Science, Maths, Occupational Therapy, Business Studies, Civil Engineering and Mechanical and Aerospace Engineering. ASK is part of the Brunel Educational Excellence Centre (BEEC).

ASK offers drop-in sessions, one-to-one appointments, central workshops, in-school workshops and run several special events throughout the academic year, e.g. ASK week, Undergraduate dissertation week and Maths Café. Four full time members of the team are responsible for academic skills support and two members of team are full time advisors responsible for maths and statistics support. Some lecturers and PhD students are also employed on a part time basis to assist the team.

Academic skills and SPSS support. The ASK team has been running many embedded classes around the university. The pilot project was for this was in Politics, History and Law students. At the moment they deliver sessions for many departments such as social sciences, sport science, maths and engineering etc. There is a similar situation with statistics and SPSS support. Upon staff request, they run embedded sessions to help students with using SPSS for statistical analysis in their studies and final year projects.

Maths and numeracy support. In the past, ASK focused only on core maths and numeracy support but in recent years it was decided to try running some embedded maths and numeracy revision sessions. They delivered such sessions for computer science (level 1 and 2), sport science (level 1 and 2), bioscience (level 1) and economics (masters' level). All these sessions were timetabled and not optional. By running these sessions, they definitely increased the number of students using their service and were able to advertise it.

However, all of these sessions (except master level) were for large groups of students (more then 100) with a wide range of ability in maths and numeracy skills. This variation in knowledge level sometimes made it simply impossible to keep all students engaged and active during these sessions and to work with them in an effective way.

ASK repeated these sessions for several academic years, but it was eventually decided to stop doing so. Students were advised to attend the one-to-one service and use subject related materials developed and placed on Blackboard (Virtual Learning Environment).

In recent years, they have only run timetabled revision sessions for level 2 maths students to help them to prepare for their mid-term test but these sessions are not compulsory and were attended only by students who feel they need the support being offered (usually about 40 - 70 students). This year they also offered an additional online session, which was attended by 14 students.

ASK recorded around 700 student visits (224 unique student visits) to the Maths Café this year, which is the main event during the revision and exam period. At the same time, they have been looking for ways to encourage students to work throughout the academic year and not to leave maths preparation and revision until the last moment. ASK try to help them to develop the skills they need to learn independently and thrive academically, whatever their level or subject.

3.5. Andrea Didier, Head of Academic Skills. Embedding Maths Support at the University of East London (UEL).

Andrea Didier delivered the last presentation of the event. In her introduction, she provided information about her Skillzone team structure, the Learning and Language Support, and its operation over two university campuses. She then focussed on the philosophy of embedding maths support at UEL. The support is open to all students across the University. The team has achieved good results despite facing challenges.

The Learning and Language Support is part of the Library and Learning services and includes:

- Academic Writing and English for Academic Purposes (EAP) tutors;
- Learning Achievement Assistants;
- Maths tutors.

It has a two-strand approach. The first covers the university as a whole. The support is delivered from virtual and physical spaces which are branded "*Maths Space*" in both the Stratford and Docklands campuses. It operates continuously and is accessible online 24 hours a day and 7 days a week throughout the year. The Maths tutors have designed and developed Maths diagnostics assessments for the Business & Law; Health, Sport & Bioscience; Architecture and Computing & Engineering schools.

The second covers embedded provision for a tailored support targeting specific Schools and Programmes on particular topics such as Business & Law; Health, Sport & Bioscience; Architecture, Computing & Engineering. The topics covered are Numeracy, Algebra, Calculus and Statistics. Tailored assessments and learning materials for specific programmes and modules are

currently being developed. Collaboration with lecturers is essential in order to work out and schedule the best times for incorporating these sessions.

The maths tutors ran a successful pilot project for the pre-entry programmes to identify which provision is needed in the main foundation short course. There is ongoing interest for information advice and guidance for outreach programmes such as summer schools and workshops for mature learners, specific workshop sessions on Numeracy and Psychometric Tests for employability enhancement. This results in increased demand on the time of colleagues in the university's schools.

The speaker gave statistics on the numbers of face to face sessions per school. The data presented showed an increased exposure of students to maths through embedded lessons. There is also ongoing work which seeks to develop the best ways of approaching students. Maths support through workshop sessions is more popular than embedded classes for Health, Sport & Bioscience School.

The positive outcomes of embedding Maths support at UEL are summarised as follows:

- Establishing the importance of Maths as a legitimate part of Academic Skills Development;
- Developing relationships and gaining champions within both schools and the service;
- Encouraging the take up of Maths support within numerate and non-numerate subject areas;
- Using internal and external networks for information;
- Growing interest in big data and all things statistical;
- Leveraging the importance of being numerate.

Finally, Andrea mentioned some of the challenges that maths tutors are facing.

- Managing expectations while meeting increased demand for maths support;
- Exploring different modes of delivery/platforms;
- Developing materials for different modes of delivery;
- Remaining agile enough to align with changing institutional priorities

The speaker concluded her talk by setting the following question to the audience: "*How do you measure the impact of your embedded interventions and non-embedded interventions when maths is not the key area being examined?*"

Figure 3: Left to Right - David Bowers (Chair of sigma Network), Lesley Roberts (Keynote speaker), Jon Warwick (Keynote speaker), Mohamed Mehbali (Event organiser).

4. Conclusion

Skills for Learning at LSBU is a centralised structure, which strives to help students develop their Mathematics learning. Mathematics Learning Support is already provided under traditional formats such as one-to-one, drop-in and workshop sessions. The objective sought by organising this **sigma** event is to explore the possibility of offering further support through an embedded classes approach. All participants agreed that Mathematics Learning Support deals with mathematics content knowledge and therefore presented challenges. The agreed suggestion was to contribute to the disciplines where Mathematics is not a major part of the programme but its impact is crucial to students' achievement. The delegates shared their respective experiences and raised some interesting questions for future consideration, for instance:

- How do we see the role of a mathematics support centre?
- What does 'success' look like for those engaged in providing mathematics support?
- How do we measure it?
- How should we deal with diverse student intakes?
- Should one-size fit all?

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