Supporting postgraduate taught students through tailored maths workshops and Q&A sessions

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Abstract

Maths Support at the University of Aberdeen was established in 2012, and has been offered to all students, whatever their discipline and level ever since. Early on, interest was raised amongst the postgraduate population, which represents about 20% of the whole student population at the University of Aberdeen. Maths Support for postgraduate students, however, will necessarily take different shapes to Maths Support for undergraduates. Their time constraints are different; their timetable is often very full, with little opportunity to fit in potential extra sessions for Maths Support during the semester; they need to clarify their maths queries early in order to be able to keep up with the pace of study. In addition, a significant proportion of postgraduate students are mature students, coming back to study a Masters a number of years after completing their first degree, who may also be part-time, having to balance between study, work and family life. This paper will discuss the range of tailored Maths Support services developed at the University of Aberdeen for postgraduate students (PGTs) on Business, Engineering and Geosciences Masters programmes. Student and staff feedback on the usefulness of the service, gathered anecdotally, will also be presented.

Keywords: Mathematics support, university mathematics, postgraduate studies.

1. Introduction

Maths Support was established at the University of Aberdeen in August 2012. The post of Academic Skills Adviser (mathematics) was created as a 50% full time equivalent post, in the Student Learning Service. The remit of the post holder is to work with students from all levels of study, and all disciplines, but support is provided for maths only, and not for statistics.

There are no dedicated teaching spaces for Maths Support, and the Maths Adviser has a shared office, therefore, in order to accommodate for time and space constraints, a variety of delivery modes have been developed (Richard, 2016):

- One-to-one bookable appointments;
- Questions & answers sessions and workshops for specific courses;
- Online resources accessible through the VLE;
- Drop-in sessions at the University Library prior to the exams;

Maths Support is advertised to students via lecture visits at the start of term, emails, announcements on the VLE (Blackboard), campus plasma screen displays, and social media (Twitter, Facebook).

Postgraduate students showed interest in accessing Maths Support as early as 2012, however, they also raised concerns about their ability to use and make the most of the service. Anecdotal conversations with the students highlighted a number of factors specific to these cohorts.

Masters programmes run over a year for full time students, with two taught semesters, and a third semester for the project and dissertation. As a result, many of these programmes operate a very busy timetable, with little spare time to use Maths Support. A number of PGT students will be mature

students with a family, possibly have a part-time job to generate income and cover for tuition fees and living costs, putting additional pressure on their availabilities.

The pace of teaching in the programmes can also be rapid, with the course progressing quickly to further topics. Consequently, it is important to offer Maths Support early in the year, to ensure that students have sufficiently consolidated the fundamental maths topics required for the understanding of their courses.

A significant proportion of students at the University of Aberdeen are postgraduate: 20% in 2016-17 and 21% in 2017-18. Yet, only 9% of students using Maths Support bookable appointments and drop-ins were PGTs in 2016-17 and 16% in 2017-18. This indicates that bookable appointments and drop-ins may not be the most suitable to offer to PGTs, possibly because of the factors highlighted above. Figures 1(a)-(c) show the number of appointments and drop-in visits by PGTs, in academic years 2015-16, 2016-17 and 2017-18. The largest numbers are recorded for PGT's in the Business School (Bus), with lower numbers recorded for PGTs in the School of Geosciences (Geo Sc) and the School of Engineering (Eng). In particular, in 2017-18, no PGT students from the School of Geosciences visited Maths Support, but 1 PGT student from the School of Natural and Computing Sciences (N&Comp Sc) and 1 PGT student from the School of Social Sciences (Soc Sc) did.

Some PGTs are seeking Maths Support because they have low-level maths qualifications (GCSE/National 5 Level qualifications) and need to gain confidence and practise to overcome the maths required in their degree. Other Postgraduate students, however, do have high-level maths qualifications (BSc, BEng), however, they return to studies after a number of years in the work place. Not only have these students forgotten some of their maths knowledge, but they are also no longer used to the formality of academic maths (notation, formal calculations, proof reasoning). This situation is becoming more prominent at the University of Aberdeen, due to the current economic climate of the Oil and Gas Industry, with a high number of staff registering on a Masters programme after being made redundant.

Over the past 6 years, some specific material has been designed and delivered to PGTs at the University in order to best answer the specific needs and constraints of these students. These projects have been developed in close collaboration with staff in three Schools of the University: the Business School, the School of Geosciences and the School of Engineering.
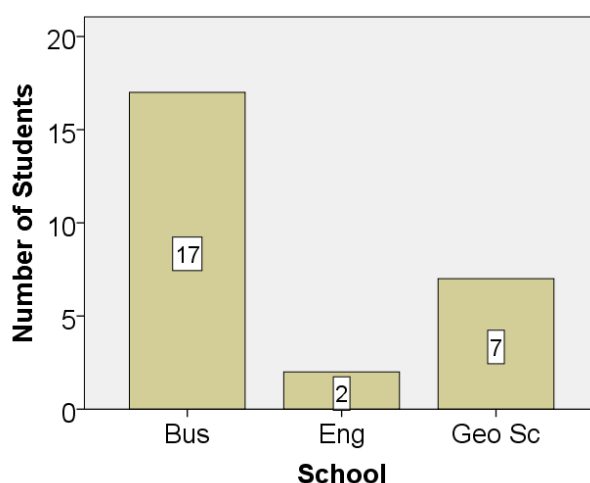

Figure 1(a): Number of PGT sessions (bookable appointments and drop-in sessions) in 2015-16
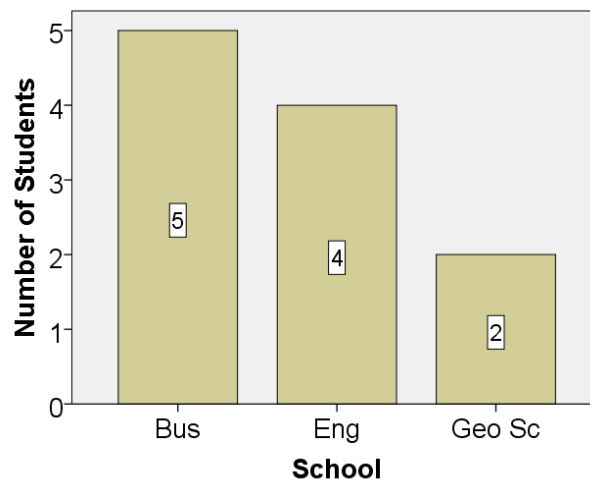
Figure 1(b): Number of PGT sessions (bookable appointments and drop-in sessions) 2016-17
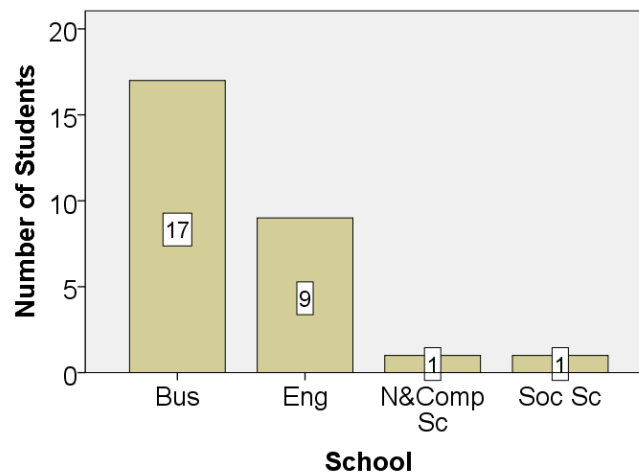

Figure 1(c): Number of PGT sessions (bookable appointments and drop-in sessions) in 2017-18

2. Masters programmes in the Business School

The Business School at the University of Aberdeen offers four MSc Programmes (MSc Petroleum Energy Economics and Finance (PEEF), MSc Accountancy and Finance (AF), MSc Finance and Investment Management (FIM) and MSc Finance and Real Estate (FRE)) for which there is a maths and statistics course, the Quantitative Methods course. The maths section of this course is taught over the first five weeks of the semester and covers three main topics:

- Optimisation of functions of one variable;
- Optimisation of functions of two variables;
- Lagrange optimisation method for constraint optimisation.

The students on the four different programmes have a wide range of maths qualifications, from GCSE/National 5 level qualifications to University level qualifications. Students with the highest maths qualifications tend to be the students on the PEEF and FRE programmes, while students with lower maths qualifications tend to be those on the AF and FIM programmes.

In close collaboration with the staff teaching on the Quantitative Methods course, a programme of two workshops has been created for students. The first workshop covers some basic Algebra that students will need for the course:

- solving systems of equations;
- factorising quadratics;
- rules of powers;
- exponential and logarithm functions.

These topics are not taught specifically to students in the Quantitative Methods course. The second workshop covers:

- differentiation and partial differentiation;
- optimisation of functions one and two variables;
- Lagrange optimisation method.

Students are taught these topics by the teaching staff as well. Sessions are a mixture of teaching and practise, and all exercises are set in the context of Business Studies (Mavron and Phillips, 2007; Renshaw and Ireland, 2012).

The workshops were first delivered at the beginning of the academic year 2013-2014, and have been run annually ever since. Students are split in three groups: two groups for the AF and FIM programmes and one group for the PEEF and FRE programmes. This allows instructors to work with groups of a manageable size, as well as to work with students of similar expected maths abilities. Workshops are delivered over the second, third and fourth week of the teaching semester.

Over the past three academic years (2015-2016, 2016-2017, 2017-2018) the average workshop attendance was 22 per group for the three groups, and the average total number of PGTs over the four programmes was 117. Many more students attend the workshops than those using bookable appointments and drop-ins. Figures 2(a)-(b) show attendance to the workshops across the three academic years.
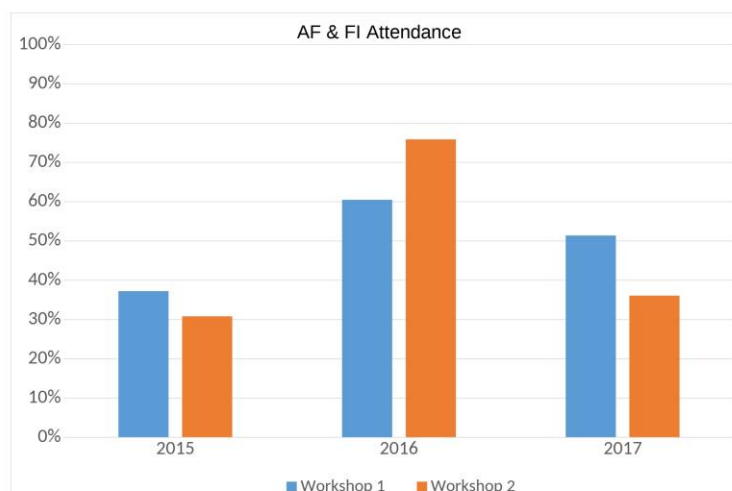

Figure 2(a): Attendance at workshops, as a percentage of the group total, for AF & FI programmes
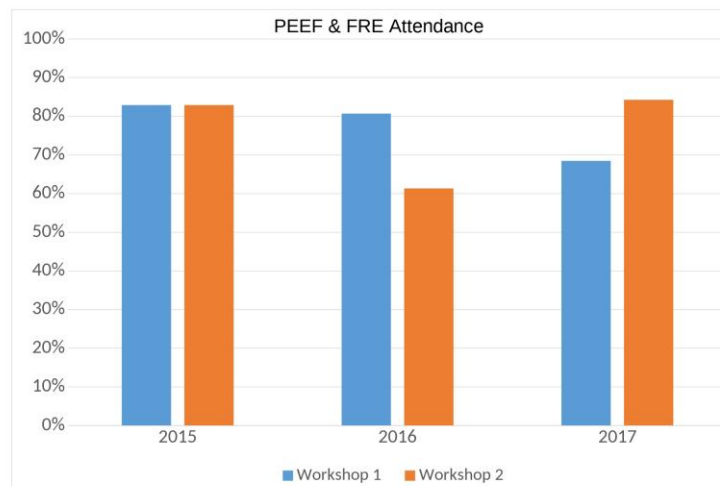
Figure 2(b): Attendance at workshops, as a percentage of the group total, PEEF & FRE programmes

Last academic year (2017-2018), some students commented that, in the sessions for AF and FIM, a number of students attended that did not experience difficulties with the maths topics. This was possibly due to the fact that the workshops were timetabled in the students' VLE timetable, resulting in students thinking that there were mandatory sessions, in spite of numerous messages from all staff. As a consequence, the students who had real difficulties with the maths component felt overwhelmed and intimidated. To respond to this, additional very small drop-ins were organised for those students (no more than five students), and from this academic year (2018-2019), maths workshops will no longer appear in the students' timetables.

Teaching staff, as well as students, have expressed the wish that the workshops be delivered earlier, possibly during Fresher's Week, as preparation for the course. Unfortunately, this is not easy to set up for this cohort of PGTs, as many students are overseas students who often are not able to come early due to visa issues, and sometimes are not even able to arrive after term has started. However, this was successfully implemented for a different cohort of students, namely, Postgraduates in the School of Geosciences.

3. Masters programmes in the School of Geosciences

In 2013, a small group of Postgraduate students in the School of Geosciences accessed Maths Support. These students had very little spare time, with lectures timetabled daily from 9 am - 12 pm and 2 pm – 5 pm, and thus could only attend Maths Support over lunch time. They had GSCE/National 5 maths qualifications, and had not done any formal maths since then. Therefore, they felt quite rusty, and had to get quickly familiar with a wide range of mathematical notations and topics which they had never encountered before: from calculating angles in radians rather than degrees, to studying partial differential equations.

Subsequently, discussions were held with staff in the School of Geosciences, and a Maths Induction course was devised, to be delivered to students during Fresher's week, prior to teaching commencing. The School of Geosciences offers four MSc programmes, enrolling students with different maths qualifications, and covering different maths topics:

- Integrated Petroleum Geophysics (IPG): students on this programme hold GCSE/National 5 maths qualifications, and the programme will require them to do some geometry, trigonometry, algebra and differential calculus;

- Reservoir Engineering (RE) and Geophysics (GP): students on this programme hold A Level or Higher maths qualifications, and must have completed at least a Level 1 University maths course. The two programmes will require students to do some geometry, trigonometry, algebra, and differential and integral calculus;
- Oil and Gas Enterprise Management (OGEM): students on this programme hold GCSE/National 5 maths qualifications, and will be required to do some geometry, trigonometry, and algebra.

The Maths Refresher course runs over two days, with three taught and practise sessions, and one question-answer session. The course is not mandatory, not assessed in any way, and the aim is to give students a first exposure to the kind of maths they will work with in their courses. The first two sessions are intended for all four programmes and cover:

- Algebra: Linear Equations and Straight Line, Quadratics and Parabola, Exponents, Exponential & Logarithm;
- Trigonometry: Radians and Angle Properties, Trigonometric Functions and Identities, Wave Functions.

The third session covers: Differentiation of Functions of one Variable and Graphs of Functions, Partial Differentiation, and Integration, and is intended for all programmes except OGEM. All sessions are a mixture of teaching and practise, all exercises being written in the context of Geology as much as possible (Waltham, 2000; Ferguson, 1988). During the last session, students have the opportunity to ask further questions, or get help with any tutorial exercises not covered during classes.

The course was first delivered in September 2015, and has been delivered every year since. The average attendance over the past three academic years at sessions was 35 where the average over all four programmes was 71 students. Figure 3 shows the breakdown of attendance over the past three academic years for each session: as for PGTs in the Business School, the number of students attending the Maths Refresher Course largely surpasses the number of students using bookable appointments and drop-ins.
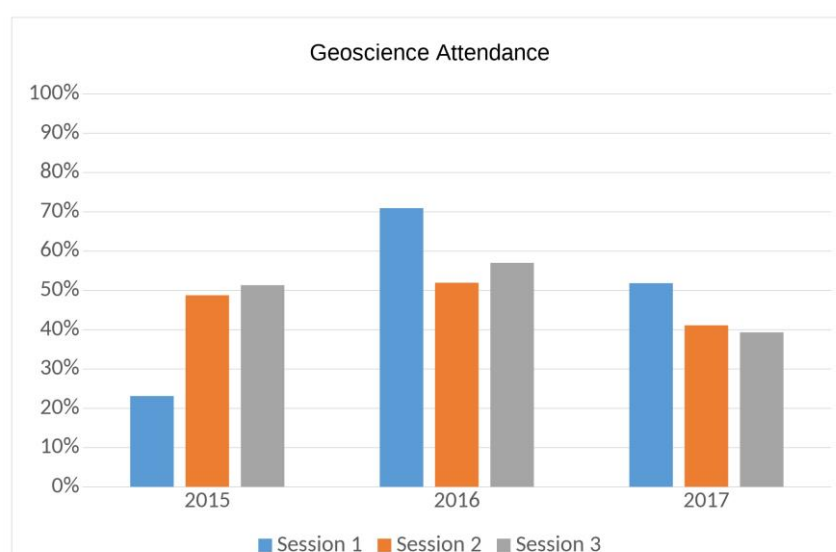

Figure 3: Attendance at the Maths Refresher course, as a percentage of the total of students on 4 MSc programmes for the School of Geosciences

The staff feedback is that the course is useful in preparing students to learn mathematical notation and topics, and that students have been less overwhelmed by the mathematical content of the programmes since the course has been running. No systematic feedback has been collected from students on their perception of the usefulness of the Refresher course. Very few of these students subsequently visit Maths Support during the academic year (seven visits from PGTs in the School of Geosciences in 2015-16, two in 2016-17 and none in 2017-18, see Figures 1(a)-(c)), but anecdotal comments collected at visits indicate that the course does help in tackling the maths content of the programmes.

In 2016, postgraduate students from the School of Engineering started attending the Maths Refresher course for Geoscientists and the Maths Workshops for the Economists. As these sessions were designed neither at the appropriate level, nor in the appropriate context for Engineering, it was decided to organise sessions tailored for the School of Engineering.

4. Masters programmes in the School of Engineering

The first PGT students in the School of Engineering seeking Maths Support were students on the MSc Subsea Engineering programme. In discussion with the programme co-ordinator and the students, three workshops were organised on Calculus, Matrices and Complex Numbers in 2016.

During the course of the semester, students from another programme, MSc Renewable Energies, approached the Maths Adviser, and additional ad-hoc sessions were organised for this cohort. Although the sessions were first delivered as workshops combining teaching and practice, students quickly changed the format to question-answer sessions on their lecture material. Although topics remained unchanged, this ensured that the help provided was most effective, as it was given directly in context.

These sessions were delivered in the following academic year again (2017-2018) to both programmes (three sessions for each programme). Once again, the first workshop was delivered as a lecture (Calculus Refresher), and subsequent sessions were driven by students' questions on their lecture material. Mature students from a third programme, MSc Petroleum Engineering, also approached Maths Support at the beginning of that year, and further Q&A sessions were organised for them (additional three sessions).

Recurrent topics in these sessions were:

- Partial derivative in the context of Thermodynamics;
- Integration in the context of permeability coefficient calculation;
- Numerical methods: Trapezium method and Newton-Raphson method;
- Probability;
- Complex numbers in the context of calculating complex impedance, intensity and potential.

Last academic year, 2017-2018, three students out of a total of six, attended the sessions from the MSc Subsea Engineering, seven students out of 24 from the MSc Renewable Energies and six students out of ten from the MSc Petroleum Engineering. These are much smaller numbers than for the other two Schools, and, in fact, comparable to the number of students making use of appointments and drop-ins. The cohorts are smaller than the cohorts in the Business School and School of Geosciences, and the proportion of students attending Maths Support sessions is also smaller (see Figures 4(a)-(b)), so it may be that less Engineering Postgraduates need Maths Support.

No systematic feedback was collected, but one student explicitly stated that they found the Maths Support sessions very helpful, because they had graduated over a decade ago, and felt that they

could hardly remember any mathematical notions. Maths Support and the School of Engineering are now considering opening Maths Support sessions to all MSc programmes in the School of Engineering (total of 16 programmes).
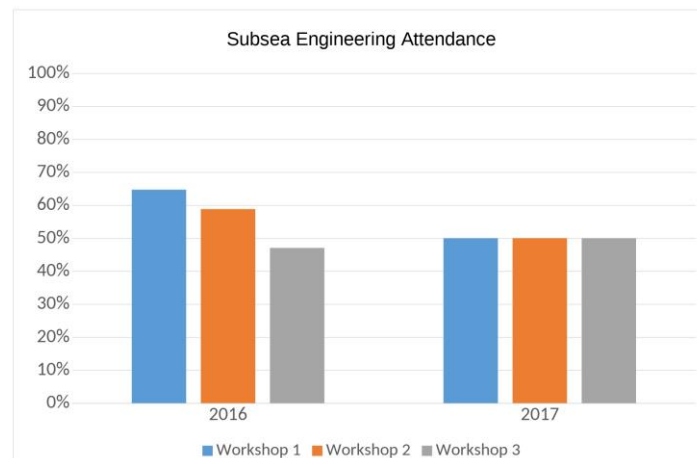

Figure 4(a): Attendance at workshops, as a percentage of the class total, for the MSc Subsea Engineering, School of Engineering.
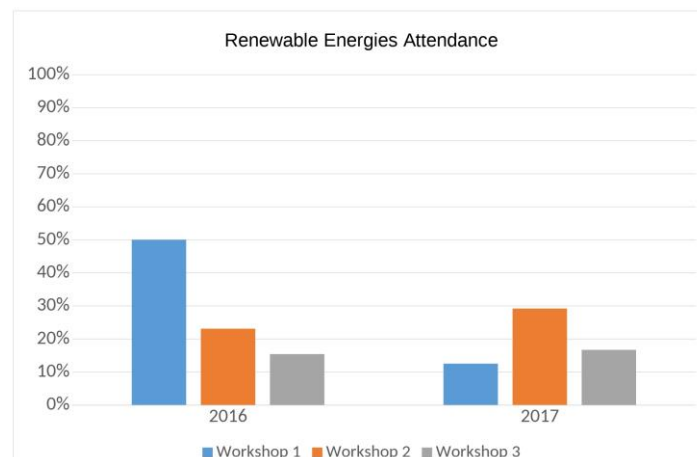

Figure 4(b): Attendance at workshops, as a percentage of the class total, for the MSc Renewable Energies, School of Engineering.

5. Discussion and conclusions

Maths Support at the University of Aberdeen started in 2012, and the remit of the Maths Adviser is to work with all students, at all levels. Given that 20% of the student population consists of Postgraduate students, this should be reflected in the usage of Maths Support. However, during the course of the semester, bookable appointments and drop-in sessions tend to be predominantly utilised by undergraduate students.

Discussions with PGT students have shown that this is perhaps because bookable appointments and revision drop-in sessions are not the most appropriate for this cohort. Consequently, over the

past six years, we have developed Maths Support sessions tailored to each of the three Schools where PGTs have approached the Maths Support service (PGTs in the Business School, the School of Geosciences and in the School of Engineering). Each solution has been designed in response to students' requests, and in collaboration with teaching staff, to ensure that appropriate content was used, and with administrative staff, to ensure that sessions were timetabled appropriately, and advertised efficiently to cohorts.

Over the years, a large number of PGT students from all three Schools have accessed Maths Support only through these sessions, indicating that this may be a more suitable way to address their maths issues. This is particularly true for students in the Business School and the School of Geosciences. A limited number of group sessions are also offered to some specific cohorts of undergraduate students, however, it is interesting to note that, based on experience teaching PGTs, they seem to really enjoy working as a group with the Maths Adviser, and interact with each other as well as with the Maths Adviser. In the School of Engineering, particularly, less PGT students are attending the sessions, and yet, those students attending have taken 'ownership' of the sessions, and have been very proactive in changing the structure of the workshops into Q&A sessions.

The University of Aberdeen has recently opened a number of its postgraduate programmes to online learners, and in particular, all Masters programmes in the School of Engineering. At the moment, Maths Support for these distance learning students is limited to directing them to our online resources located in the university's VLE (Blackboard at the University of Aberdeen). The maths resources contain the handouts of workshops as well as a selection of HELM workbooks (Harrison et al., 2007) and Facts and Formulae leaflets (Richard, 2015). In addition, we are currently investigating how to open face-to-face Maths Support to online students, using Blackboard Collaborate together with Smartboard and Graphic Tablet technologies. However, given that Maths Support is only 0.5 FTE, support for a potentially growing population of off-campus students, who will probably experience challenges particular to their situation, will necessarily have to be limited.

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