HEA SENIOR FELLOWSHIP

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I. INTRODUCTION

I have been at the front (and back) of the classroom teaching Mathematics for 16 years. In that time, I have found that my role as a Mathematician has evolved into a delicate balance of research, teaching, mentorship and public engagement, and in the past five years, leadership. In this context, my professional responsibilities have included

1. Teaching undergraduate courses at all levels, ranging from small group settings to large lecture theatres; delivering specialized postgraduate lectures,
2. Organizing mentorship activities for women in mathematics/physics and delivering public engagement lectures,
3. Personally directing and enabling staff to direct externally funded research-led undergraduate projects,
4. Chairing a two-term sequence of modules, Calculus I and II, developing curriculum and coordinating 20 staff, part-time lecturers and postgraduate instructors,
5. Training and mentoring postgraduates and new/junior staff in subject-specific teaching practices and professional development
6. Serving as Academic Lead on a working group tasked to develop department-wide policy recommendations on student experience.

Below, I reflect on those aspects of my teaching practice which have been consistently effective for a variety of environments and participants (1). I then discuss how my philosophy of integrating research with training and mentorship of undergraduate and postgraduate students has evolved as a result of my responsibilities (2, 3). This, in turn, has influenced the practice of my colleagues and shaped my engagement and outreach activities (3). I have selected two case studies which highlight my ability to develop high-quality resources for learning (students) and layered structures for teaching (staff) which broadly integrate both my practice and philosophy (4, 5, 6).

II. TEACHING PRACTICE

I have extensive experience in the classroom/lecture hall, having taught over 26 modules in the past 7 years alone, from first-year classrooms of 5 students to final-year lecture halls of 200 students with tutorials supported by academics and postgraduates. Naturally, I have experimented with various teaching styles, including technology-based content delivery, traditional boardwork, flipped classrooms, small groups, and vertically-integrated training of undergraduates and postgraduates. Nonetheless, I have found myself converging on a small but seemingly universal set of fundamental principles, described briefly below.

Personality. On the first day of lecture, I always give a quiz, asking students to explain their motivation for taking the module and to tell me something about themselves which I wouldn't find on the class roster. I do the same, describing my professional background and what I found interesting about the subject as a student. This "mutual introduction" develops an immediate relationship between student and instructor and helps me keep things fresh each term with "inside jokes" from the (inevitable) funny quiz responses. More importantly, the quiz allows me to tailor my lectures according to students' career stages and interests (V1). For instance, in a second-year engineering class, I may follow an abstract discussion on implicit differentiation with examples demonstrating use of the method to describe trajectories of electric and magnetic fields; starting with simple equations students can graph by hand, I increase difficulty in each example, finishing with a real-world simulation (K4). Such personalisation can provide context for abstract ideas while expanding students' perceptions of being personal stakeholders in their own education. In a recent module evaluation, I was pleased to see my efforts having an immediate effect: "Dr. Beheshti [...] has influenced me greatly though its only been 4 weeks!" and "Excellent, clear, engaging and motivating, her teaching skills are very good and she really makes you feel the subject" (K5).

Motivation. Beyond lecture inspiration lies the transition from classroom engagement to committed self-study. I use two mechanisms in class to facilitate this. The first is to introduce new concepts using "teaser" diagrams. For instance, to introduce the notion of area, I draw a sequence of figures of increasing complexity, explicitly labeled "motivation" and describe what is known for each figure until we reach the last one, for which nothing is known at the start of lecture. This provides an immediate visual anchor and creates a case for embarking on the pertinent results of the day. After completing a theoretical component, I will pose the question "why do we care?" which is typically greeted with nodding heads or smiles. This creates a chance to close the loop on the motivating diagram by suggesting a concrete calculation for the most complex figure to be done at home, hinting at its use in subsequent weeks (A1, K1).

The second method I employ is using a Plan for the Week to encourage discipline between lectures. After performing staff observations while at Rutgers University, I decided to start including my lecture outline as a checklist on the board (A5). I find this put students in "learning mode" from the start of the period and notice that they are willing to concentrate for longer intervals when we are ticking boxes as milestones are completed. I follow up by sending my (in)famous Friday Email, reminding students what we have covered and what to expect in the coming week. Students at all levels have expressed appreciation for this simple summary, and how they have used it to devise study plans and stay motivated (A4).

Structure. Creating a bespoke, organised learning environment encourages disciplined independent thinking. With fine-tuning of module structure, I try to assist students in identifying and refining effective habits. Students' strategies for learning and studying can differ widely (V1); setting up an online learning environment with layers of resources can enable students to become better independent learners (K3). For example, in spring 2014, I used the QMUL online learning platform, QMPlus, to post lecture notes, practice exercises, and supplementary materials (detailed proofs, additional reading, etc.) for my 200-student Complex Variables module. I did not assume students would discover each of these layers on their own, so I described each posted component and the purpose it served. By communicating my rationale for each resource, I found that students were more willing to engage with different aspects of the module: practice exercises labeled "to help you with reading your notes" prompted many students to ask questions on the lecture notes during office hours, for instance (A3).

Example: A Flipped Classroom in General Relativity. The above three teaching and learning principles need not impose a top-down approach. In Spring 2014, I was asked to teach the Senior Honours Seminar at Rutgers University. I decided to run the module in my own research area, but as a flipped-classroom (A1, K1). Combining structure and motivation, teams of 3-4 students would present new material each week, having been coached by me both one-on-one and in groups, for content and exposition; I also posted weekly exercises for everyone to attempt and discuss with me during office hours, held at a table in the Student Union cafe. My rationale was that the relaxed venue would encourage students to discuss problems with each other under my guidance, ask questions about material they were personally interested in, or just stop by to eat lunch and hear about whatever problem I was working on that week (A4). It is worth noting that the same subgroup of 4 students who regularly attended these hours have gone on to doctoral programmes in either mathematics or physics (Brown Univ., Univ. of Maryland, UCLA, CERN) (V4). In retrospect, this style of office hours could work equally well for a traditional lecturing scheme. Our module culminated in a mini-symposium consisting of two research-level lectures in Mathematical Relativity by invited staff (K2, V3).

The most significant observation I made that semester was that the few students for whom English was a second language struggled with the flipped classroom format; understandably, they found presentations considerably more stressful than their native colleagues. I learned about the linguistic challenges of knowledge construction in mathematics (see, e.g., [1] and [2]) to create a coaching environment in which these students could develop confidence and presentation skills as much as mathematical concepts (A3, V2). I was fortunate to have a group of students who were self-motivated, extremely hardworking and socially gentle; the level of collegiality I witnessed watching those students teach each other as I sat in the back of the classroom was a strong reminder for me not to interfere too quickly to help a struggling presenter. I am undecided if I would set up the presentations differently if I were to run such a module again (K2).

III. RESEARCH-TEACHING LINKAGES

My professional practice is built around a belief that there is room for learning open problems at all stages. It has been both natural and enjoyable to incorporate research-led mentorship of masters and doctoral students into my general research programme (K1). Last year, I trained Erasmus Plus scholar M. Venanzi (Univ. of Rome, Sapienza) through

my most current investigation on relativistic fluids; she is now a doctoral candidate in Physics at Southampton. I have just published a paper with postgraduate E. Gasperin (QMUL) on accretion disks in astrophysics, studied using intedisciplinary tools; our line of enquiry is independent from his thesis work (under J. Valiente Kroon) and allows for training in valuable secondary skills. My recent leadership roles, however, have been shaped more dramatically through my involvement with REUs, described below.

A. Research Experiences for Undergraduates (REUs): Guiding Students and Staff

The National Science Foundation has funded Research Experience for Undergraduates (REUs) at US institutions for decades, stating that it is "one of the most effective avenues for attracting students to and retaining them in science and engineering, and for preparing them for careers in these fields" (V3, V4) [3]. The Math REU at Rutgers is a competitive summer research programme in which 1-2 undergraduates undertake 9 weeks of intensive study through high-quality interaction with an Academic on his/her ongoing research programme. This REU is linked with a site-wide programme through the Center for Discrete Mathematics and Computer Science (DIMACS), which provides complementary support through guest lectures, supplementary training (online research, mathematical typesetting, etc.) group activities and recreational events. Following the philosophy of connecting my research with students' interests, I actively participated in the Rutgers Maths-DIMACS REU in several capacities.

Maths-DIMACS REU Participation. I served on the Rutgers Maths REU committee for three years and assumed a leadership role in pairing students with funding and potential research supervisors. To my knowledge, at least three of the students whom I recruited into REU projects with fellow staff members have continued on to doctoral studies in Mathematics (at UCLA, Ohio State and Rutgers). I delivered a set of six guest lectures to the Math-DIMACS REU cohort of 30 students on Symplectic Geometry and Hamiltonian Dynamics in 2012; In the exit surveys of that year, a student mentioned these lectures as one of her favourite parts of the summer. I subsequently delivered lectures on Combinatorics of Water Waves (2013) and Minimal Surfaces (2014).

Undergraduate mentorship. I personally supervised two undergraduate research students, working broadly under "Geometry of Differential Equations." With student M. Boemo, we examined applications of knot theory to DNA topology, a burgeoning research area at the interface of Mathematics and Biology. This year, he finished a doctorate in Physics and commenced a postdoc in the Pathology Department, both at Oxford University. My second student, M. Geis studied analytical dynamics, and connections between minimal surfaces and complex analysis; he is currently a Mathematics Ph.D. candidate at Northwestern University.

Research-Led Mathematics Education. My REU experiences served as a springboard for engaging in conversations with researchers and educators about research-led teaching. In 2013, I attended the prestigious Institute for Advanced Study(IAS)-Park City Mathematics Institute, a three-week summer session for school teachers, mathematics education researchers, undergraduate college faculty, undergraduate students, postgraduates and mathematics researchers (A5, V4). In addition to lectures specific to each group, daily activities were designed to create meaningful interactions, many focusing on broadening participation in STEM fields[4]. A participant in the Research in Mathematics Program on Geometric Analysis, I was invited to deliver a lecture to the Undergraduate Faculty Program on funding and delivering research-based teaching (K6, V3).

B. Broadening Participation & Public Practice

Witnessing the effects of broadening participation in STEM research to a diverse and talented student pool through REUs motivated me to become involved with the Princeton-IAS Program for Women and Mathematics, for promising female undergraduates (V2). For two years, I served as panelist and co-chair for sessions on topics ranging from successful navigation of graduate school and grants to work-life balance (K1). It was only after moving to the UK that I became more interested in examining the policy side of such programmes.

Women in Mathematics. I am a longstanding member of the Association for Women in Mathematics and currently serve on the School Athena Swan Committee at QMUL. Last autumn, I decided to become a delegate at an Inside Government event on "Successfully Integrating Women into STEM" in order to better understand the UK STEM policy landscape (V4). Experts and practitioners from all sectors exchanged information on a range of policies and

the meeting served to confirm my belief in the importance of soft-skills mentorship, childcare support, and secondary training (e.g., unconscious bias) (K6) [5], [6].

Public Engagement. I remain firmly grounded in my opinions on policy through two general public engagement events each year. In the past two years, I was a faculty speaker for the QMUL Maths Society Lecture series and had the pleasure of participating with local physicists, actors, and comedians in an event known as StoryCollider. This led to an invitation to chair a sold-out session at the Royal Institution, hosting the famous science writer John Gribbin. It was months later that I discovered how these three events were received: I was totally surprised by my students revealing that they had recorded part of my Maths Society talk on their phones, listened to the StoryCollider podcasts and watched the RI videos online! Their "confessions" changed the way I thought about bringing more expository and historical aspects of my public presentations back to the classroom (A3, K3)

IV. DISTINCTIONS

It is my belief that my practice of research-led teaching has had significant impact on the departments in which I have worked; I mention two distinctions which I believe support my claims (A2, K5).

University of Massachusetts Distinguished Teaching Award. I had the privilege of receiving this award in 2008, bestowed upon two people in the institution each year through a rigorous nomination and vetting procedure. "The purpose of the Distinguished Teaching Award (DTA) program, a feature of the UMass Amherst campus for over 30 years, is to honor exemplary teaching at the highest institutional level. Both faculty and graduate students, nominated by students or alumni, are eligible for this highly-competitive award. DTA winners receive a monetary prize and are recognized at both the Undergraduate and Graduate Commencements."

Nominations at QMUL. In the past two years at QMUL, I have been a nominee for Teacher of the Year, the Innovative Teaching Award and the Student Experience and Education Awards. For the latter nomination, the Director of Taught Programmes, Professor Thomas Prellberg noted "Shabnam has shown herself to be an excellent lecturer, which is evidenced by both Module Evaluation Questionnaires and Peer Observation. Her teaching on MTH5103 Complex Variables has been exemplary, achieving both high attendance and high satisfaction, with average ratings in each(!) question above 3.97. [...] In summary, Shabnams contributions to teaching development and delivery have been truly outstanding."

With the privilege of these awards and nominations comes the responsibility of leading in the identification and exchange of best practices, when appropriate. Culmination of my professional experiences point directly to my main leadership roles, my two case studies: creating PGR/Staff Training programmes at Rutgers and at QMUL, and being selected as Academic Lead on the Student Experience Working Group at QMUL.

V. CASE STUDY I: CALCULUS CHAIR & TA-STAFF TRAINING

I have been active in discipline-specific training of junior staff and postgraduates since 2011. Last year, I was tasked to conceive and deliver a postgraduate training programme for the School of Mathematics at QMUL, largely based on the experience I developed while Calculus Chair at Rutgers. The case study is in three parts: chairing at Rutgers, developing a new programme at Queen Mary, and a forward-looking comparison of the two models.

A. Course Chairing Calculus at Rutgers University

At Rutgers University, the first-year module sequence Calculus I and II is comprised of nearly 1000 students attending two lectures per week, taught by staff and postgraduates in sections of 30 to 100 students. There is also a workshop period directed by a postgraduate teaching assistant (TA) and an undergraduate "peer mentor," in which students work in small groups solving challenging applications in physics and engineering as a gateway to research-level problems [7]; TAs and peer mentors facilitate discussion and assist in construction of formal arguments, with emphasis placed on process and clarity of communication.

Naturally, coordinating such a large-scale operation has its challenges: instructor teaching experience ranges from first-time TAs to experienced part-time lecturers to new postdoctoral associates and junior full-time academic staff; consequently, students' experiences can greatly vary. One duty of the Chair is to ensure all students receive uniform mastery of the core knowledge required for success in their subsequent modules. This in turn requires creation of appropriate resources and guidance for both students and instructional staff.

Creation of module resources. Three tasks I accomplished as Calculus Chair were creation of a new module website, construction of a test bank and an overhaul of the workshop question archive, used by instructors and TAs on a weekly basis. The first two tasks aimed to successfully streamline the syllabus, exercise and lecture schedules, providing a uniform but flexible set of teaching resources [8]. Practice materials were pooled and the test bank ensured comparable exam difficulty across the various sections of the module, ensuring a uniform experience for students in different sections and fair preparation for the common final exam. Having received its first update in nearly a decade, improvements to the workshop archive were largely due to enthusiastic participation in the postgraduate TA seminar, described below. The revitalization had an immediate impact on the quality of experience of the incoming students (including less possibility for cheating), and the secondary benefit of creating a new sense of ownership among everyone involved in the module. As evidence of its success, I mention that the website, teaching resources and workshop archive are still in place and appear to be in use and self-renewing each semester.

As a yearly lecturer for two of the larger 100-student sections of the module, I was also implementing my own changes. As such, I was able to realistically engage with instructional staff, noting what worked (and what didn't) in practice and delivery, and adjusting for subsequent terms accordingly. To determine if I was achieving the desired outcome of simplifying the teaching structure and uniformizing student experience, I regularly held informal "check-in" meetings with colleagues and students not in my own sections. The results were largely positive: students felt more confident and better prepared for their midterms and finals; this was also confirmed using the final marks distribution statistics compared across sections. The structure I set up also dispelled the impression that there were "easy professors" vs. "hard professors" for the module. Furthermore, staff were extremely happy with having easily accessible tools at their disposal each week for lecture preparation and spent more time interacting with their students during tutorials and office hours.

Postgraduate and Staff Training. Of personal interest and pride was the Calculus TA Seminar. Initiated during my first year as Chair in 2011, I held group meetings with junior staff and postgraduates to discuss difficulties faced by workshop-style tutorials, devise effective teaching strategies, and improve overall learning aspects of the module; I decided to assume this mentorship role because I recalled my own training in graduate school involving only seeking help when there was a problem. I dovetailed my own classroom observations and critiques of PGR/staff teaching with the established Departmental first-year TA training, at which I was a guest panelist each spring.

Given that I trained postgraduates at Rutgers for 3 years, I was touched find I was one of 5 nominees for a mentorship prize from the Rutgers AMS Graduate Student Chapter. Nominations are given to individuals "whose instructing, mentoring and/or advising of [postgraduate] students in mathematics is outstanding and remarkable in preparing future

researchers and scholars [...] and constitutes a significant contribution to graduate education and training." I was particularly humbled to be amongst four tenured faculty who had directed PhD students at Rutgers for decades.

B. Bespoke Teaching and Learning at QMUL

Part of my duties since arriving at QMUL has been to use my Rutgers experience to conceive and execute a similar scheme in the School of Mathematics. After identifying key constraints such as module format, postgraduates teaching contracts, and staffing, I realised that a simple modification of my workshop model would not be appropriate.

Pilot Project: Complex Variables MTH5103. Having an enrollment of 200 students and 6 tutorial sessions, I used my Complex Variables module to pilot a subset of the Rutgers workshop techniques in spring 2015 and 2016. I chose to engage with learning and teaching aspects of the module simultaneously. On the learning side, I created concrete module materials including typeset lecture notes and weekly companion exercise sets. I reworked the tutorial and homework formats entirely with two objectives: to encourage students to discuss challenging exercises amongst themselves and to have those discussions culminate in clearly written solutions explaining their reasoning. To accomplish this, students formed small groups in tutorials and unseen exercises were distributed. With the assistance of the tutorial instructor/TA moving from group to group, students worked together to outline their ideas for each problem, returning home to write their complete solutions later in the week. I decided to settle on individual submissions, holding each student accountable for articulating their rationale in their own words. Problem sets contained exercises of varying difficulty to aid students in distinguishing routine calculations, exam material, and challenge problems.

On the teaching side, the changes in practice was accompanied by regular meetings with the 6 postgraduates assigned to the module to discuss the ideas behind this practice, troubleshoot their issues and devise strategies for running their tutorials. I completed observations of each postgraduate and provided continued support during the term. I also trained the postgraduates in giving both formative and summative feedback on the submissions, based 5 points for mathematical correctness and 5 for clearly articulated reasoning. The first student feedback I received on these changes appeared on my midterm evaluations, including: "The module is well organised and Dr. Beheshti is such a good lecturer I was literally looking forward to her lectures," "Problem Sets are challenging and thought-provoking but not exhaustingly difficult," and "Course brought to life by Dr. Beheshti [...] Tutorial format is very helpful, and encourages clear understanding, should be adopted for other modules."

I am further encouraged to refine the ideas I employed, as it has influenced the practice of my colleagues. In my nomination for the QMUL Student Experience and Education Award, the School's Director of Taught Programmes wrote "Shabnam has been the driving force behind the introduction of group work into the Schools exercise classes. In AY 2014/15 the School trialled several different methods to give formative assessment (mini-tests, peer-marking, group work, etc.). Shabnams model of encouraging students to work together in small groups and 'lab report-style submissions received excellent feedback and formed the blueprint for the exercise class regime from this academic year [2015/16] on."

It is worth mentioning that postgraduates who were informally trained in the groupwork method by me in 2015 volunteered to be my TAs in the subsequent year, noting that they felt valued, useful, and stimulated during the tutorials; this forms a clear contrast with the traditional exercise session models in which tutors stand at the front and wait for questions from the (often silent) class. Next time, I would make an effort to visit with lead staff members and TAs of the module in advance of the term to reinforce the groupwork/writeup model and ensure that students have a similar learning experience across all tutorials.

Postgraduate Training & Mentorship Programme. In the 2015/16 Academic Year, I went beyond the Complex Variables pilot to create a broader PGR Training & Mentorship Programme, open to all postgraduates in the School. Guided by the philosophy that students can prepare for (and create) the variety of responsibilities they will encounter at their next career stage, the seminar involved both TA training and professional mentorship.

The first term focused on best practices specific to the effective and clear communication of mathematical concepts. To create an opportunity for expanded discussion around certain topics, I provided research literature in mathematics and STEM education and proposed possible projects (e.g., [9], [10], [11]). For example, on the topic of "Technology in the Classroom" I suggested a project to create an animated graphic sequence demonstrating that integrals represent areas. The benefits are twofold: first, the project creates a concrete accomplishment for the postgraduate to include on

his/her CV. Second, as more postgraduates complete these projects, it populates a repository of animations accessible for use during lectures and tutorials by all instructors, from any classroom computer on campus [12].

The second term of the programme addressed development of a well-rounded academic portfolio, balancing excellent teaching with world-class research. Sessions were intended to build important secondary relationships within the School and were prioritized based on addressing needs and interests of the postgraduates. Consequently, I developed a healthy working relationship with the PGR students: I have already written a teaching reference for one of the participants of the seminar, enabled a postgraduate to take advantage of an Athena Swan funding opportunity to attend a conference with childcare support, and facilitated another postgraduate to become the QM-WISE Maths Ambassador.

The PGR Training Programme has now had its first full-year run and has been formally recognised by the Queen Mary CAPD and Doctoral Studies programme through the Skills Points Database. Furthermore, in my nomination for the Student Experience and Education Awards, it was remarked that "[...] Shabnam is leading the design and delivery of a new training and mentorship programme for PhD students. This was noted at the recent Periodic Review meeting, where the Panel commended the introduction of bi-weekly training meetings to provide support for students in their teaching, academic and professional development."

C. Looking Ahead: Staff and (UG/PG) Students in Conversation

Facilitating independent thinking through structured groupwork in Complex Variables was motivated by the successful Rutgers model, however the predetermined QMUL marking scheme for the module (90% final exam) disincentivized some students from fully participating in the process [13], [14]. With appropriate training in both teaching and marking, the workshop tutorials and submissions provide a high-quality source of formative and summative feedback for the student. Moreover, my change in approach was not met with resistance by students in the module. In fact, they valued the merits of clear, communicative mathematical writing (e.g., student wrote "[...] emphasis is placed on explanation of steps rather than just computation of answers."). As such I believe it could be used as a source of information and evidence for changes to module structure or more broadly, School policy.

An unexpected success of the PGR Training Programme was the discussion panel. Speakers, both academic and professional services staff at various career stages were invited to discuss their insights on communicating and writing mathematics, career trajectories and outreach opportunities. Not only did the postgraduates request having another panel next year, but the participating academics initiated discussion on teaching practice amongst staff which I believe would not have otherwise occurred. Building on this experience, I believe by involving more staff in the tutorial observations and training sessions, the PGR Training Programme could create a creative mutual forum for exchanging approaches and philosophies, and change the teaching and learning culture of the School overall.

My experiences in teaching undergraduates, training postgraduates and staff and mentorship of students at all levels recently culminated in being selected to lead in the development of a School strategy document on identifying and delivering a positive student experience. This will be the second case study.

VI. CASE STUDY II: ACADEMIC LEAD, STUDENT EXPERIENCE WORKING GROUP

At the beginning of 2015-2016 academic year, the Queen Mary School of Mathematics established three working groups: Employability, Student Recruitment and Student Experience. Academic leads for the first two working groups were a Senior Lecturer and the Director of Taught Programmes, respectively; I was selected by the Head of School, Professor Boris Khoruzhenko, to lead the third working group. Each working group was comprised of 3-4 academics and 1-2 professional services staff with rank and experience pertinent to the theme of the group. Our working group was convened to identify the primary challenges and main areas of deficiency facing the School with regards to a positive undergraduate student experience, providing suggestions and implementation guidelines for addressing these deficiencies. We were asked to deliver a strategy document within 5 months.

I believed that broad remit of student experience required a balanced perspective and immediately solicited the Education Manager to serve as co-chair. Our Working Group also had UG and PGT representatives who participated fully in the decision-making process. Not only did this result in a more holistic approach in collecting and analysing data, it also provided key insights in creation of the strategy document; I was particularly pleased to see several of the students' suggestions making it into the final policy document put forward by the School Executive Group. This was the first time I had served on a committee with students and I would likely advocate to have students participate far more frequently in the decision-making process than before this experience [15]. I found out later that my Working Group was the only one to capitalise on the diversity of its participants using a cooperative approach.

A. Collection and Analysis of Data

The working group reviewed data at national level (NSS/PTES), institutional level (QMSS, 2015 First Impressions Survey), and school level (focus groups, open forums, Maths Society, informal conversations), including an extensive 2008 external report on Student Satisfaction, commissioned by the School. The primary challenges, as identified by students, in having a positive student experience within Maths were categorized in terms of teaching quality, course structure, personal development, and student/staff engagement. While a wealth of data was available on student opinions and some institutional data was available on working conditions for Professional Services Staff, I discovered that little information had been systematically collected from Academic staff on their perspectives on the student experience. This proved to be challenging, since many academics were uncomfortable with such imprecisely defined terms (myself included). Nonetheless, we gathered and analyzed data by carrying out personal/email discussions as well as by creating a free-response online survey (e.g. What is the biggest challenge you personally face in providing a positive student experience? How important is peer observation to your teaching practice?).

Contrasting perceptions. It is interesting to contrast the primary challenges identified by the surveyed Academic and Professional Services staff. PS staff identified a positive student experience as one in which the student is provided and engages with a diverse set of opportunities both academically and socially, creating a stimulating and balanced experience; the primary challenges in providing this were believed to be managing student expectations in teaching and advising and overall student/staff engagement. On the other hand, Academic staff identified a positive student experience as one which is both challenging and enjoyable, whilst developing emotional and intellectual independence; they universally felt strongly that it was important for students to feel an excitement for mathematics and to be proactive and curious, a sentiment which I share. Physical and bureaucratic constraints posed the greatest hindrances to delivering a positive undergraduate experience, consuming time and feeding into a lack of engagement.

B. Transforming the School Teaching & Learning Environment

The three personal practices outlined in my RAP seem to optimise my desired outcomes of clear mathematical thinking and writing under the constraint of a good student experience in the classroom, as measured by participation, improvement and independence. I did not, however, view them as universal principles of practice when formulating the School strategy document. My goal as Academic Lead was to obtain a snapshot of the teaching and learning landscape, reflect on the School practices from the perspective of our Working Group and provide recommendations which were realistic uses of staff energy and which accommodated a variety of teaching styles and philosophies.

The consensus is that there is room for marked improvement in teaching quality and learning materials available to students as well as a desire to raise standards and self-expectations from the cohort. The strategy document submitted

to the School Executive Group included approximately 30 concrete recommendations in changes of practice and/or policy, ranging from simple fixes to more revolutionary restructuring; this was supplemented with data, timelines and resource management. The final document approved by the Head of School Advisory Group included 8 measures under the headings Improved Communication with Students and Improvements in Teaching & Learning, to be put into effect in the 2016/2017 Academic Year. I highlight key suggestions and resulting policy and management changes.

Teaching Quality and Assessment. The current Peer Observation process is a non-reciprocal, randomized staff pairing involving a Peer Observation form with two parts: free response (Lecture aims, observation focus, Observer remarks on strengths, areas of development, etc.) and numerical (audibility, pace, etc. rated from 1=needs improvement to 4=exemplary). We found that the current format of observations does not directly address the variable teaching quality reported by students. The Working Group student representatives confirmed that improvements did not necessarily follow after observations took place; they made concrete suggestions to make the Peer Observation form more specific to the mechanics of teaching found in the student feedback forms: "students look out for the following: [...] continuation from last lecture, proper use of language, good use of board space, demonstration of sound knowledge in subject, appropriate and enough examples, stimulating exercises either in class or to think about at home (especially for students who are doing mathematics out of passion for the subject), allowing time for questions."

Another issue the Peer Observation form does not address is feedback on the online presence and accessibility of resources for student use. Consequently, we proposed that Observers should remark on the creation, quality and maintenance of a module page through an online learning environment such as QMPlus, when pertinent.

Outside of informal discussions, the Peer Observation process also appears to be the primary mode of exchanging teaching practice within the School; we strongly recommended creation of a new forum for sharing best practices.

Policy Change: Peer and Student Observation and Sharing Practice. The School is reviewing the Peer Observation form this Autumn to include feedback on his/her QMPlus page as well as better quality information for the lecturer to use in order to improve. Student feedback forms will be reworked and used more strongly "to enable staff to assemble an improvement plan" for their teaching practice.

The School is further soliciting a volunteer Academic to run regular forums in which staff exchange views on colleagues' teaching and learning activities. Personally, I would like to see this dovetailed with the PGR Training Programme, to create a stronger sense of community and send a clear message on valuing teaching to our postgraduates.

Advising and Personal Development. Students identified the advising relationship as a key area of improvement. In focus groups with students and staff, I noticed a common uncertainty, namely "what should we discuss [besides module selection]?" The Working Group proposed decoupling registration from advising and creation of advisee-advisor "cribsheets." After meting with students in the focus group, my conclusion was that we could empower students to visit their advisors more regularly by posing concrete questions they might not think to ask at various career stages; on the other side, advisors would benefit from knowing the wealth of resources and opportunities available to students' encouraging them to engage with university life. Tensions exist with restructuring wht I would loosely call an "Oxford-Cambridge advising framework," as there is little precedent amongst the Russell Group universities to depart from this practice. With increasing student numbers, however, I believe the current system is not sustainable, especially if we wish to improve the quality of advising.

As the number of uncollected homework submissions and missed advising appointments each term demonstrates, a significant subset of students are not placing a high value on available feedback, viewed by staff as essential to their academic and personal development. The Working Group decided that addressing such disengagement involved clearly setting expectations while maintaining a welcoming environment from the first day. As first steps, we recommended including tips on transitioning to university-level mathematics in the first-year welcome packs and more explicitly alerting students to our expectations in lectures and online.

Policy Change: Restructuring the Advising Process. The School is decoupling bureaucratic responsibilities from the Advisor-Advisee relationship by creating an advising team of PS and Academic Staff, available at drop-in support desks during peak months; students will retain Academic Advisors as contacts with whom they can discuss personal development and obtain references. The School recognises that although the quality of information available has improved, so has the volume. Thus "to improve standards of advice overall," there are plans to update, archive and

streamline the information available to staff and students. Furthermore, School welcome pack this year will include a book on studying Mathematics in university.

Student-Staff Engagement and Longer-Term Strategies. To expect sustained and diverse engagement within the School, I believe it is essential that both students and staff feel they are part of a mathematical community. The challenge appears to be in balancing improvement of intellectual achievement and professional outlook with participation in more professional and personal opportunities–for both students and staff. A concrete suggestion from the Working Group was to identify or create common activities in which staff, undergraduates and postgraduates could participate.

Finally, there was a general consensus that the two structures which would have the greatest effect in student-staff engagement needed to be put in place with great care: supporting, not evaluating, struggling lecturers and rewarding committed educators by establishing better measures of student learning.

Policy Change: Calendar of SMS activities. The primary obstacle to student-staff engagement within the School does not appear to be a lack of activities, rather timely dissemination of their logistic details. The School intends to create a publicly viewable community calendar on the Maths webpage and social media for all events: Maths Society, QM Careers, certifications, internships, colloquiua, public lectures, outreach, open days, etc. I believe the calendar will increase visibility of the wealth of daily activities available. This will, in turn, encourage greater involvement.

Policy Suggestion: Reward committed educators. The College has begun putting new promotion mechanisms in place, which partially address the recommendation of rewarding committed educators; the School has committed senior staff time and resources to helping academics with their career progression against the new criteria, noting that advice and support will be available for excellence in teaching. After having examined concrete data and thought deeply about what constitutes a good student experience, I will be interested to see how the new promotion scheme identifies and measures successful teaching and learning outcomes through the lens of career progression.

C. Looking Ahead: Measuring the Effects of Policy Change

A new concept for me in the past year has been to understand and measure what one learns when changing teaching practices on a larger scale than one's own modules. When estimating timescales for the recommendations, I became more aware of the institutional framework in which I was operating. For example, changing modules having a 100% yearly final exams to three in-term exams involves reworking external examining procedures and must be resourced/completed in stages. When thinking at this broader level, a lack of clarity on student experience is one of the most difficult challenges faced by the School when designing and delivering a high-quality undergraduate degree in Mathematics. There is, however no complete "data picture" one may use to create a positive student experience.

Questions which I believe merit further consideration are: do we know what we want the student experience to be and what is worth of delivering this student experience? Conversations and expectations communicated clearly and with mutual respect would benefit the School from all sides. Students would feel empowered to take ownership of their education and future trajectories more fully; staff would be encouraged to actively engage with their modules and advisees, challenging both parties to rethink their notions of what constitutes a "good" student experience.

[1] *The linguistic challenges of mathematics teaching and learning: A research review*, by M. J. Schleppegrell, Reading & Writing Quarterly, 23, 139–159, (2007).

[2] *Supporting the participation of English language learners in mathematical discussions*, by J. N. Moschkovich, For the Learning of Mathematics, 19(1), 11–19 (1999).

[3] see National Science Foundation page on REU cross-programme funding, http://www.nsf.gov/crssprgm/reu/faculty.jsp.

[4] See, e.g., *Racial equity requires teaching elementary school teachers more mathematics* by P. C. Kenschaft, Notices of the AMS, 52(2), 208–212 (2005).

[5] *Laying the Foundations: encouraging girls in science, technology, engineering and mathematics in school*, V. Pittard, Assistant Director Curriculum and Standards, Department for Education, Integrating Women into STEM Conference, Sep 2015.

[6] *Steps to integrate women into high level STEM roles*, L. Giles, Deputy Director, UK Commission for Employment and Skills, Integrating Women into STEM Conference, Sep 2015.

[7] See, *Modelling the journey from elementary word problems to mathematical research* by C. Sangwin, Notices of the AMS, 58(10), 1436–1445 (2011).

[8] "Good teaching, like good research, is multidimensional, difficult and contextual." p.183 of *Developing the Scholarship of Teaching in Higher Education: a discipline-based approach*, by M. Healy, Higher Education Research & Development, 19(2), 169–189 (2000).

[9] *How to Teach Mathematics,* by S. Krantz, American Mathematical Society, 307pp. (1999).

[10] *Writing in the Teaching and Learning of Mathematics,* by J. Meir and T. Rishel, MAA (1998).

[11] *Twelve tips for peer observation of teaching,* by Z. S. Siddiqui et al., Medical Teacher, 29, 297–300 (2007).

[12] See QAA Subject Benchmark Statement: Mathematics, Statistics and Operations Research, May 2015, p.20, Sections 4.9 and 4.10 on Teaching and Learning. http://www.qaa.ac.uk/en/Publications/Documents/SBS-Mathematics-15.pdf.

[13] *Learning to teach in higher education,* by P. Ramsden. London: Routledge (1992).

[14] *Understanding learning and teaching: The experience of higher education,* by M. Prosser and K. Trigwell, Buckingham: Society for Research into Higher Education and Open University Press.

[15] See QAA College Higher Education Toolkit, May 2015, p.48: Enabling students to participate in the design and delivery of programmes. http://www.qaa.ac.uk/en/Publications/Documents/College-Higher-Education-Toolkit-0515.pdf.