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Ri Mathematics Masterclass programme

Impact report for The Clothworkers' Foundation November 2018



Introduction and background

This report presents the impact of the Ri Masterclass programme across its lifetime. The programme would not exist were it not for the generous and on-going support of the Clothworkers' Foundation. We thank them for the support and for the opportunity to demonstrate the positive impact that the Masterclasses have had on students and volunteers alike.

The programme, supported by the Clothworkers' Foundation since 1989, has grown to 68 series, 3,627 students and over 200 speakers. Over 800 volunteers contribute by organising, supervising and helping out at the sessions every year. A total of 66,000 students have engaged in the programme in total over the past 37 years.

Masterclasses can benefit the students by offering an enjoyable extra-curricular experience of mathematics, helping to boost confidence and allow them to experience a positive learning environment in a setting such as a university. Working with other keen mathematics learners who create a positive peer group is often welcomed by Masterclass students.

Educators still struggle to inject inspiring content into the maths curriculum. This element is at the core of the Ri Masterclasses – we excel at creating courses of enriching mathematical workshops that are interactive and challenging for attending students.

Aims & Objectives

The Ri Masterclasses for primary and secondary school students aim to contribute to a positive shift in attitude towards STEM (science, technology, engineering and mathematics) subjects by inspiring and enthusing students, allowing them to investigate a range of ideas and applications. We are meeting the challenge of inspiring and nurturing young scientific and mathematical talent by:

- 1) Providing a free STEM enrichment offer to schools and students
- 2) Providing extended engagement over a course of workshops to engender long-term attitude change and increased confidence
- 3) Providing hands-on, interactive sessions so students play an active role when learning content
- 4) Capturing students at an early and critical age
- 5) Expanding students' knowledge about the multiplicity of STEM disciplines and the diversity of their applications
- 6) Providing diverse and positive role models to champion these fields and careers
- 7) Deepening understanding of jobs and career opportunities
- 8) Encouraging and developing students aptitude and promoting ongoing engagement
- 9) Demonstrating the relevance, excitement and value of STEM subjects in society, identifying real-world applications as they explore the subjects
- 10) Enabling students to meet like-minded peers from different schools, backgrounds and local area.

Impact of Masterclasses

Evaluation

Impact is evaluated at the end of each Masterclass series using student questionnaires and evaluation by Ri staff during visits to the series. The Masterclass team uses the data to monitor quality, addressing issues raised about venue, supervision, delivery of the workshops, etc.

Two extraordinary impact studies have additionally been undertaken:

- In 2008, a nation-wide evaluation was undertaken by Durham University to assess impact. The study demonstrated the high level of impact the Masterclasses had on students
- In 2018, an impact assessment was undertaken by gathering feedback from Masterclass alumni students via an online survey form. The results, presented below and in Appendix I, show that students are still responding in a very similar pattern to those in 2008 (table 1)

Masterclass Alumni impact study

Further impact has been measured via an online survey undertaken by former Masterclass students in September 2018. Sixty-one responses were gathered from the alumni students within 12 hours of the survey being sent out. Full analysis of the survey is presented in Appendix I, and the following results encapsulate the success of the programme (includes data from the 2008 evaluation for comparison):

Question	Alumni Masterclass students 2018	Masterclass students 2008
	% responded positively*	% responded positively
Did you enjoy the Masterclasses?	100%	Not reported
Did your level of confidence change?	70% (Yes, my confidence grew because of the Masterclasses)	72%
Did you value the opportunity to learn in a group of like-minded peers during the sessions?	90%	70%
Did the Masterclasses help you form choices for your future studies?	58%	59%

Table 1: Impact assessment on Masterclass students

*Selected 'Yes, a lot' or 'Yes, a little' from the multiple choice options.

In terms of choices at post-16 education and higher education, 58% of alumni students recorded that Masterclasses affected their choice of post-16 school subjects and 47% recorded that they affected their choice at higher education level.

Overview of research

There are widespread concerns in the UK and abroad that not enough young people are choosing to study STEM subjects after the age of 16 or pursuing STEM-related careers. This limits the aspirations and social mobility of the individuals making these choices as well as impacting negatively on the economy and culture in general [1, 2, 4, 6, 11]. As such, a significant amount of research has taken place into the factors influencing students' decisions. While increasing uptake in STEM subjects post-16 is not one of the

objectives of the Masterclasses, and no individual STEM enrichment activity can be said to have sole influence on a student's decision to further pursue a STEM education or career [13], this research has shown that the core elements of the Masterclass programme significantly affect these choices.

Science Capital

The concept of 'Science Capital' was developed by the ASPIRES project team during a five-year study (2008-13) exploring young people's science and career aspirations in the UK [6]. This work has been further developed by the five-year Enterprising Science project (2013-17), which aimed to understand how young people from all backgrounds engage with science and how their engagement might be supported, as well as being linked to existing models of social and cultural capital [9, 15].

Science capital is a model for viewing all of an individual's science related 'resources' – their connections with science, attitudes, understanding, interests and participation in science-related activities. This has been broken down into eight key areas:

1. Scientific literacy (knowledge and understanding)
2. Science-related attitudes, values and dispositions
3. Knowledge about the transferability of science
4. Science media consumption
5. Participation in out-of-school science learning contexts
6. Family science skills, knowledge and qualifications
7. Knowing people in science-related roles
8. Talking about science in everyday life

Extensive research has shown that the higher a young person's science capital is, the more likely they are to continue to pursue science later in life, have higher aspirations towards science-related careers and to continue with further study [6, 9, 15]. Though the focus is on science, this all applies to the STEM subjects as whole, and is particularly relevant to the Masterclass programme as a series of Masterclasses addresses almost all of the key dimensions of science/STEM capital.

Extended engagement

A Masterclass series provides on average six workshops for each student; each highly interactive workshop in the series focuses on a different topic which the students are able to explore in detail in a collaborative setting. This results in an in-depth, extended interaction with the subject, and alongside the other key aspects of the programme, is in-line with the science capital approach. Extended engagement of this type has been shown to be much more valuable for creating long-term attitude changes in young people compared to one-off events [6, 15]. In particular, series of lessons and other longitudinal learning opportunities which incorporate elements to build science capital result in young people seeing science as more relevant, deepened their appreciation of science, increased their engagement and increased the proportion of young people 'seeing themselves as "sceincey"' [15].

Enjoyment

Given the variety in the programme, students are able to explore topics aligned to their own interests as well as developing new ones, gaining a greater awareness of the subject outside the school classroom. Feedback on each series and from former students shows that enjoyment is one of the most highly rated aspects of the Masterclasses. Enjoyment and interest are key; there is often a correlation between positive informal learning experiences in childhood and a continued interest in adulthood [3]. However, while these factors are an essential pre-cursor to a continued participation in STEM, they are not solely sufficient [6].

Variety of careers

Each Masterclass in a series is delivered by a different workshop leader (usually termed 'speaker') who has based the workshop around their own favourite topic – often something they use in their own work or

research. Speakers come from a variety of backgrounds (typically academia, industry or education) and are often based locally. The breadth of the topics covered across the series allows the students to gain insight into potential careers, including those not usually thought of as being ‘STEM careers’, as well as highlighting the links between the maths they are studying and higher education, industry and the world around them. Awareness that studying STEM subjects is useful for a variety of careers, including STEM subjects leading to ‘well-paid and interesting’ careers [7], is essential for participating post-16, particularly among under-represented groups [1, 2, 6, 7, 8]. In the 2011 Girlguiding UK Girls’ Attitudes Survey, 43% of girls aged 7-21 said they were put off studying STEM careers because they did not know enough about the careers available [5, 8].

Self-identity and STEM identity

One of the major issues impacting on continued participation with the STEM subjects is the conflict between students’ own self-identities and their perceptions of these subjects. This is particularly highlighted for students in under-represented groups [6, 7, 8]. One of the most influential factors in deciding whether to pursue the STEM subject is a perception of their own STEM identity [6, 15]. Perceived difficulty is one of the barriers (students see STEM careers as being for ‘clever’ or ‘exceptional’ people), as are negative peer attitudes [1, 2, 6, 7, 8]. Again, this is particularly highlighted for under-represented groups, including girls. Girls achieving top grades in science and maths at GCSE are deterred from continuing to a higher level with such subjects, including physics, because they are affected by low confidence and an absence of peers in the classroom [16]. In the 2016 Girlguiding UK Girls’ Attitudes Survey, while only 8% of girls aged 11-21 said that ‘boys are better at science and maths’, 52% thought that ‘these subjects have the image of being more for boys’.

Masterclasses give students the opportunity to explore the topics outside the classroom in a supportive environment, helping to increase their confidence (as is highlighted in the evaluation of the Masterclass programme, both in 2008 and in the feedback from Masterclass Alumni students), and allows them to meet peers with similar interests and ability levels, so they can feel more as if the subject is ‘for them’. In the 2016/17 academic year, 54 of 68 Secondary Mathematics Masterclass series reported their gender split: 50.9% of the 2794 students in these series were female.

Role models

Another factor involved in students’ STEM identity is access to a variety of role models within STEM fields, and much of the research examined in this report recommends that students are provided with opportunities to meet a range of role models from backgrounds similar to their own [6, 8, 15]. A lack of female role-models is a recurring theme in the Girlguiding UK Girls’ Attitudes Surveys, particularly within the STEM subjects; in 2011, 60% said they were put off from studying the STEM subjects because of a lack of female role-models [5,8]; in 2016, 41% of 11-21 year-olds said there were too few role models working in STEM-related careers (and 35% said there were too few women role models teaching these subjects) [10]; and in 2018, 48% wanted to see more representation of women as role models in the STEM fields and other male-dominated careers such as politics [14]. The Masterclasses provide an opportunity for students to see a variety of different role models from a wide variety of backgrounds, through each session being led by a different person and with a variety of helpers supporting the sessions (including undergraduate students and sixth form students in some series). However, the efficacy of this can only be achieved if we have a diverse pool of volunteers, including a variety of speakers from different backgrounds. We work to ensure that there is a balance of speakers within each series, and a focusing on increasing our speaker pool, with a particular focus on speakers from under-represented groups.

Including families

Masterclass groups strive to engage families as well as students and we encourage them all to invite families to end of series ‘round-up’ and certificate presentation sessions where the families can learn a little of what the students have done and what career paths are open to them, plus next steps for engagement. Additionally, parents can come to celebration days at the Ri where we give them a fun day of

maths exploration and provide advice on how to support their offspring for further study, enrichment and future education and career paths.

Families are one of the most important influencers on attitudes towards the STEM subjects and on students' decisions to continue with their studies post-16 [1,2]. The Aspires report states that (p30): *'Supporting families to feel comfortable and knowledgeable about science and to see its relevance to their everyday lives and futures might help more students, but particularly those from under-represented groups, to develop and sustain science aspirations. Funders might prioritise support for interventions aimed at families, not just individual students.'*[4]

Inclusion

The Masterclasses remain free to the vast majority of schools and families, allowing access for students from low-income families. As is shown below, the Ri strategy for the next five years is to increase the number of disadvantaged students gaining access to our offerings. Masterclasses are well placed to achieve this aim, being nation-wide and free.

The main difficulty that the Masterclass team observe with reaching disadvantaged students is lack of engagement from the schools in disadvantaged areas (possibly due to resource-strapped teachers not having the capacity to take the time to engage rather than a lack of willingness, and the cost of travel to reach the Masterclasses each week). These areas will be more formally assessed going forward as we try to overcome barriers to participation.

As has been discussed, the availability of a diverse pool of volunteer speakers and helpers is also a factor affecting the inclusivity of the Masterclasses. In addition to improving our volunteer recruitment, we are also offering new speakers training in unconscious bias and inclusive learning, which will support them to better construct their sessions so that all students can be included, helping them to feel that the topic is relevant for them, and to support students from a range of backgrounds [12].

Continued engagement

End-of-year events

End-of-year celebration events¹ further extend the engagement of students involved in the Masterclass programme. In 2017/18, 868 Mathematics Masterclass students attended one of the regional events out of the 3041 invited to do so, with three of the regional events running at capacity. All attendees are introduced to additional opportunities for them to continue their involvement in the STEM subjects as they progress through their education and are signposted to accessing advice on careers and future study. Research has shown that the lack of awareness of the importance of the STEM subjects on a range of future careers (not just direct STEM careers) is a major factor in them choosing not to study STEM subjects post-16 [4].

Masterclass Alumni

Follow-on Masterclasses for older students have been running in London since 2005 and also take place across the UK (for example, sixth form series in Kent and Essex, Year 10 and 11 series in Oxfordshire and Glamorgan). In addition, Masterclass students are often invited to similar activities which are not part of the Masterclass network, such as the Year 10 "maths club" in Merseyside. In London, we have been able to extend the follow-on Masterclass provision so that all students attending a London series in Year 9 (including those who attended Engineering and Computer Science Masterclasses) can be invited back in years 10, 11 and 12.

¹ Celebration events have been held for Masterclass students at the Royal Institution for many years, with the first regional celebration held in 2006 in Liverpool; this has since extended to seven Mathematics-focused celebration events being held annually.

Uptake of Masterclass alumni opportunities can be demonstrated by evaluating the London follow-on Masterclass programme: In 2017/18, 776 Year 9 Masterclass students were offered the opportunity to book places on the Year 10 Masterclass series at several venues in London for the following academic year. Of these 776 students, 318 took up the opportunity (240 places were allocated and 78 remain on our waiting list). This high return rate of 41% is a clear indicator of success of the programme in terms of student keenness to participate again.

In 2017, we launched a mailing list for Masterclass alumni students, who receive a newsletter several times a year signposting them towards enrichment opportunities, careers advice and other activities for them to further extend their involvement in the STEM subjects (the importance of which is highlighted above). We have also run several alumni events in different areas of the UK for students on the mailing list. 1598 students have signed up to the alumni mailing list since its launch with the 2016/17 cohort of students, which again highlights the perceived value of the programme.

Impact on Masterclass speakers

Masterclass speakers benefit hugely from their involvement in Masterclasses.

Quotes from two Masterclass speakers:

The Royal Institution's Masterclasses have a far greater problem solving emphasis than lessons at school can usually have, the latter being focused on a syllabus, and so have the potential to help to encourage the development of mathematicians (i.e. people who are intrigued by and wish to address unsolved problems) rather than just people who are very good at maths.

I just wanted to say how much it's an absolute pleasure to be a part of this, working with you guys and seeing the creativity and enthusiasm of the students, it's fantastic. I hope you still want us to be part of the amazing masterclasses and as promised we will always try and make ourselves available for when you need us.

Impact on organisers

Organisers volunteering to run Masterclasses take on a not insignificant burden – there is a relatively large time commitment involved. Despite this, Masterclass groups find great value being involved in the Ri Masterclass community and great value adopting the Masterclass framework for their mathematics outreach activities, and the support it bring from the Ri Masterclass team. Many groups have been running Masterclasses for a very long time, a demonstration of their commitment to the Ri Masterclass programme; as of the 2017/18 academic year, 38 series had been running for at least 10 years, with 14 of these running over 30 years.

Quote from an organiser:

This is the first time we have worked with the Ri to organise a masterclass series. It has been wonderful experience and the help and support the Ri has provided to the speakers, helpers and event coordinator throughout our journey has been exceptional. I look forward to continuing our work together in the future.

Case studies and Testimonials

We gathered several case studies of Masterclass alumni who are pursuing careers in mathematics and STEM subjects, and who now contribute to the programme as volunteers. Appendix II lists case studies and a small selection of the many spontaneous testimonials gathered from Masterclass participants – students, teachers and volunteer alike.

A few individuals of note who participated include:

- Eugenia Cheng, Scientist In Residence, School of the Art Institute of Chicago, Honorary Fellow of Pure Mathematics, University of Sheffield, author of 'How to Bake Pi' and other books
- Vicky Neale, Whitehead Lecturer at Oxford's Mathematical Institute
- Demi Allen, EPSRC Doctoral Prize Fellow at The University of Manchester Mathematics Department
- Abigael Bamgboye, First-year, MEng Materials Science and Engineering at Imperial College

Conclusion

We hope this summary report shows the positive impact of the Masterclass Programme on the students who take part each year.

As we mentioned at the start of the report, this programme would not exist without the valued support of The Clothworkers' Foundation and we thank you again for this support, and for helping us to make a positive impact on the many students, families and teachers detailed here.

Appendix I. Alumni impact survey 2018 – results

Results of the September 2018 survey of Masterclass Alumni students used to measure impact of Masterclasses. Sixty-one students responded, providing the following data.

Question 1 asked which type of Masterclass the students attended. Some students attended more than one series, so total came to 81. The results show that the majority of students attended secondary mathematics Masterclasses. This result was expected since the mathematics network is the largest one of all subjects.

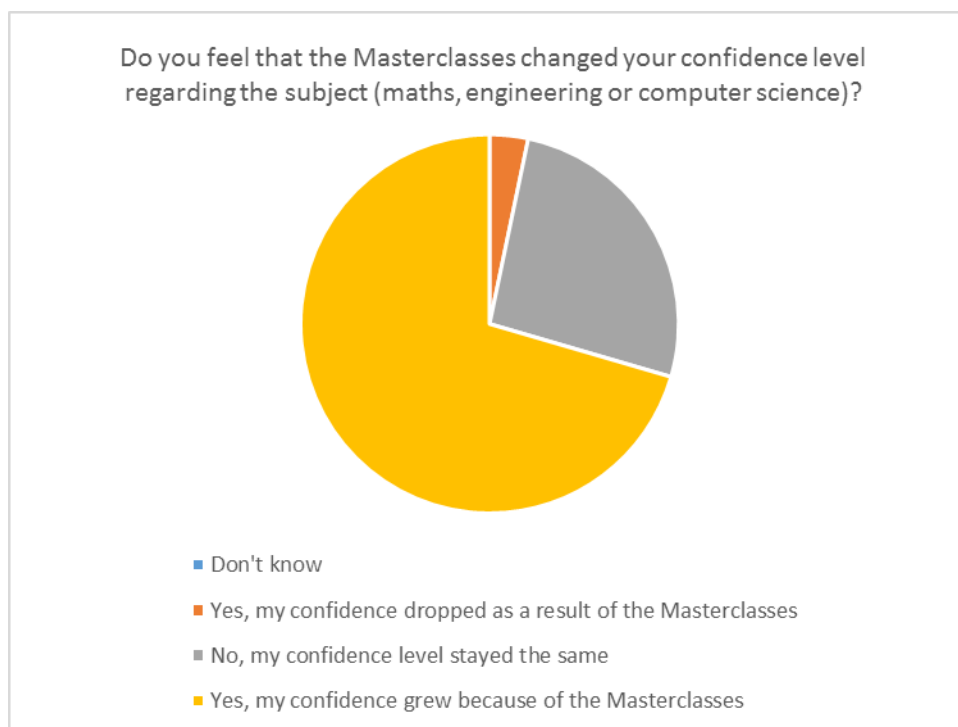
Q1. Please tell us which type of Masterclass you attended:		
Primary mathematics Masterclasses	3	4.92%
Secondary engineering (year 8 or 9)	6	9.84%
Secondary mathematics (year 8 or 9)	38	62.30%
Secondary computer science (year 8 or 9)	3	4.92%
Secondary mathematics at higher than year 9 level	31	50.82%
TOTAL	81	

Question 2 asked the question of why the student attended the Masterclasses in an effort to understand the student's initial motivation for attending. The results show that 95% made a personal choice to attend the Masterclasses.

Q2. Please state why you attended Masterclasses:		
My parent/carers made me go	1	1.64%
My teacher made me go	0	0.00%
I decided I wanted to attend when I was offered it	58	95.08%
I wanted to put it on my CV or UCAS form	2	3.28%
TOTAL	61	

Q3: Impact Assessment	NOT AT ALL	NOT VERY MUCH	NEUTRAL	YES, A LITTLE	YES, A LOT	DON'T KNOW	TOTAL	% positive response	% Yes, a Lot
Did you enjoy the Masterclasses?	0	0	0	8	53	0	61	100	87
Did they change your level of interest in the subject?	1	2	10	27	18	2	60	75	30
Did the Masterclasses you attended impact your decision when choosing the school subjects you took at age 16 and above?	3	3	13	21	14	6	60	58	23
Do you think the Masterclasses you attended impacted your choice of subject at university or higher education, if attending?	1	6	7	20	8	17	59	47	14
Did you receive any career information during the Masterclass?	6	16	10	18	5	5	60	38	8
Did you value the opportunity to learn in a group of like-minded peers during the sessions?	0	1	3	12	43	2	61	90	70

Question 4 was asked to gauge whether the students felt a change to their confidence levels regarding the subject they studies in masterclasses. The results in the following pie chart shows that 70% of students thought their confidence grew as a result of the Masterclasses.



Questions 5 and 6 were free text questions asking the alumni to name one good thing and one bad thing about the Masterclasses. We were able to categorise the responses as follows:

Q5: Name one good thing about the Masterclasses:

interest in subject & knowledge	working with peers	applications of subjects in real world	excitement and enjoyment of the subject	Interesting venue/experience of studying at university	the whole experience	growth of confidence	Helped understand path to study maths at university
35	8	7	5	5	1	2	1

Q6: Name one bad thing about the Masterclasses:

None	Distance to travel	Saturday morning	My friends were not there	too hard	too easy	series was Not long enough	Not enough hands-on activities	Not enough breaks	too long	Not long enough	not enough career info
19	11	2	6	4	2	4	2	2	1	3	1

Appendix II. Case studies and testimonials

Vicky Neale – case study

(Masterclass alumni and now Masterclass volunteer as a speaker, and professional mathematician)

I did indeed attend Ri masterclasses when I was at school -- they were great! They were held in Eastleigh, I think at Barton Peveril College, perhaps? I think that I went to six Saturday morning sessions, and I think that I was in Year 9 at the time, so that would have been the 97-98 academic year (gosh what a long time ago).



I spent six Saturday mornings with other young people who shared my excitement about maths (possibly they weren't all quite as excited as me, but they were excited enough to be there on a Saturday morning), and with teachers and session leaders who were also enthusiastic. I can still remember the topics of some of the sessions.

One was on Pythagorean triples and Babylonian tablets, which must have been one of my earliest tastes of number theory. One was using dynamic geometry software (which I'd not come across before) to explore circle theorems (which we hadn't met at school at that stage) -- I remember being enormously excited not only to have found that the angle at the centre always seemed to be twice the angle at the circumference, but also with a bit of prompting I just about managed to prove it too. There was a session on sundials, we made one out of a plastic bottle, and another little yellow cardboard one lived on my desk for years afterwards, along with the card showing how you had to read it differently depending on the time of year. And one involved estimating the area of the Isle of Wight using a Monte Carlo approach.

I feel slightly bad that I can't remember the other two...but four out of six 20 years later isn't bad, and maybe demonstrates the impact that the sessions had on me!

I think that we also went on a coach trip to the Ri in London later in the year. I remember going to the building, and seeing the famous lecture theatre that I'd seen on TV, but I'm afraid I remember nothing at all about what happened once we were there!

I always enjoyed maths at school, from a very young age, but the Ri masterclasses when I was in Year 9, and then UKMT activities later in my school career, were for me transformational in showing me what mathematics could be beyond the school curriculum, and for giving me really challenging mathematics to think about (definitely a good thing!). It was also exciting for me to meet others, both my contemporaries and also adults, who shared my excitement about the subject. The only bad thing about the masterclasses was that they had to stop -- but I found other ways to continue exploring mathematics subsequently! I've been involved in maths outreach in various ways since I was an undergraduate, and it's been a privilege to work with young people at Ri masterclasses in Lincolnshire, Oxford and Worcester [and, in ten days' time, in Cambridge...], hopefully giving others the same opportunity that I was fortunate to have when I was at school.

After school and A levels at sixth form college, I studied Maths in Cambridge (at Trinity College). I did three years as an undergraduate, then stayed on for the fourth year, then did a PhD in Additive Number Theory, also in Cambridge. After that, I spent several years as Fellow and Director of Studies in Mathematics at Murray Edwards College, Cambridge, getting increasingly involved in teaching and outreach, including volunteering with the UKMT and leading Ri masterclasses. I also worked with colleagues from NRICH, and spent two years working on the Cambridge Mathematics Education Project. I moved to Oxford in 2014, where I am the Whitehead Lecturer at the Mathematical Institute, University of Oxford, and a Supernumerary Fellow at Balliol College. My current role combines undergraduate teaching with work on public engagement with maths, and in between teaching, radio and media work, writing a book and giving lots of talks, I still volunteer with UKMT and lead Ri masterclasses.

Vicky Neale, Whitehead Lecturer at Oxford's Mathematical Institute

(https://en.wikipedia.org/wiki/Vicky_Neale).

Abigael Bamgboye – case study

(Masterclass student alumni, currently undergraduate student)

“When I was younger, I took part in maths masterclasses that were run by the Royal Institution and held here at Imperial. The maths covered in the masterclasses was so diverse. One class I remember vividly was about the maths behind earthquakes. There were other classes about probability and the circus. They covered such a wide range of topics, and it was so interesting to have a different perspective of a subject that, before university, you typically rote learn. One thing I’ve really liked about doing Materials here is studying the variety of different subjects, because now I’m seeing maths in a new way. I learnt how to do the maths by studying Further Maths at A-Level, but seeing actually how to apply it within the context of Materials adds a whole new dimension to it.”



--Abigael Bamgboye, First-year, MEng Materials Science and Engineering at Imperial College

Demi Allen – case study

(Mathematics Masterclass alumni and now Masterclass volunteer as a helper, supervisor and speaker. Post-doctorate mathematician)



As a year 9 student, I attended the 16th series of Mathematics Masterclasses at Truro College in 2006. I returned to the Truro series as a volunteer in 2010 and, since then, I have also volunteered at Masterclasses and celebration events in Edinburgh and Bradford. From 2015 to 2017 I had the great privilege of being part of the organiser team who established a series of Mathematics Masterclasses in North Yorkshire (hosted in York) which have been running successfully since Spring 2016. During my time as a PhD student in York I assumed various roles as organiser, speaker and helper for the Masterclasses in York. The popularity of the new series in York and the positive feedback received was extremely gratifying. When asked *“What did you enjoy the most about these sessions?”* one of the student comments received after the first series in York was: *“The maths was very fun and most of the time I felt challenged and like I was being taught for my mental ability/understanding of maths rather than based on my age”*. This sentiment was echoed in a number of other student comments with students enjoying *“Doing the maths and exploring topics and concepts we don’t do in school”* and appreciating *“The high level of maths”*.

Demi Allen, EPSRC Doctoral Prize Fellow at The University of Manchester Mathematics Department

Rachel Dorris, Clothworkers Fellow in Mathematics:

The mathematics Masterclass programme has been going strong since its inception in 1981. Initiated by the then Ri director, Sir George Porter, and Sir Christopher Zeeman who had delivered the Ri Christmas Lectures in 1979 on the topic of mathematics. Zeeman, who was a hugely charismatic presenter and teacher, generated such enthusiasm and interest for his Christmas Lectures that the Ri decided to kick-start the Masterclass programme as a way to build on his success. Zeeman continued to deliver engaging and educational mathematics Masterclasses for many years to come. The Masterclass ‘family’ – the network of volunteers that work hard to deliver Masterclasses across the whole UK every year – are part of his legacy. When Zeeman sadly died in 2016, we were able to collect many personal anecdotes and memories from people of their time in the early years of Masterclasses and their fond memories of Sir Christopher Zeeman. The Ri article celebrating his life personifies the special nature and the bond of the Masterclass family (<http://www.rigb.org/blog/2016/march/sir-christopher-zeeman>).

Testimonials from Masterclass participants and families

Alumni

"These classes have changed my views about maths as the maths taught at or school is very different to the real-life situation mathematics taught at these lessons which has certainly proved to be useful. These Ri masterclasses also pushed me to take Maths for A levels."

"I always enjoyed maths at school, from a very young age, but the Ri masterclasses when I was in Year 9, and then UKMT activities later in my school career, were for me transformational in showing me what mathematics could be beyond the school curriculum, and for giving me really challenging mathematics to think about."

Masterclass speakers

"The Royal Institution's Masterclasses have a far greater problem solving emphasis than lessons at school can usually have, the latter being focused on a syllabus, and so have the potential to help to encourage the development of mathematicians (i.e. people who are intrigued by and wish to address unsolved problems) rather than just people who are very good at maths."

"I just wanted to say how much it's an absolute pleasure to be a part of this, working with you guys and seeing the creativity and enthusiasm of the students, it's fantastic. I hope you still want us to be part of the amazing masterclasses and as promised we will always try and make ourselves available for when you need us."

Organisers

"This is the first time we have worked with the Ri to organise a masterclass series. It has been wonderful experience and the help and support the Ri has provided to the speakers, helpers and event coordinator throughout our journey has been exceptional. I look forward to continuing our work together in the future."

Parents

"I am emailing to thank you and your colleagues for all of the support you have given to each of the classes this year. My daughter has thoroughly enjoyed every one of the sessions and has learnt a lot about Maths from different perspectives. It has been a fabulous opportunity for her and I would like to extend our gratitude."

"We are very appreciative that you make these opportunities available to local kids - it is incredibly valuable and really does make a difference."

Teachers

"I just wanted to say thank you for remembering to reach out to us. The Masterclasses you provide are really appreciated and form an important part of our curriculum enrichment for children with potential in maths."

"My students have come back buzzing from the sessions - so exciting!"

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