

Masterclass Speaker Training Programme: Workshop Development – detailed notes

So, what does make a good Masterclass?

It could be any topic within the subject area, or a subject linked to it (like physics, medicine, art ...). The key point is that students should be able to do some real maths/ engineering/ computer science; they should be allowed to explore the topic in-depth, and it should be challenging for them. However, it should also be presented in a way that is easy for them to understand and that they can access.

The focus of the Masterclass should not be on a topic within the curriculum; if it was, by the time they get to this, they will get bored as they have already seen it. However, you can use curriculum topics as tools for investigating whatever topic your Masterclass is covering.

Planning your session: Step 1

Key points:

- What do you enjoy?
- What do you use within your work?
- What topics do you think are really interesting or important?
- Why do you find the topic exciting?
- What links are there to other areas or topical subjects?
- What can you show them about how the subject actually is practiced or used?

What topic could you cover?

Why do you find the topic exciting? If you think something is interesting and exciting, the students will see that. You can help them explore the aspects which you enjoy most.

What are the links between your topic and other subjects or ideas? Think about whether there is anything really exciting that you could bring in or whether you could link your activity to something the audience already know about, such as something from school or something topical. Are there any really surprising links?

If the topic is something applied, can you get them to explore those applications? If it's more abstract, what can you share about how it is used? For example, prime numbers are used in encryption and fractals are used in financial modelling and computer games.

Classes usually have some more formal teaching to get across the theory, but keep this short; the vast majority of the time should be spent with the students actually doing something. As a rule of thumb, don't talk for more than 15 minutes (shorter for Primary Masterclasses).

Can you show them how you use this topic in your everyday work (if relevant)? Can you get them to explore the wider issues around this topic, for example societal impacts?

Step 2: Aims and Story

Key points:

- What is the overall story of your session?
- What do you want the students to walk away with?
- What key ideas do you want them to explore?
- What are the 'wow moments'?
- Can you ask an overarching question that gets answered at the end?
- Can the question be motivated by a different context - a real life problem, something in the arts, a scientific challenge?

What do you want the students to walk away with?

What is the narrative?

These are arguably the two most important questions to consider. What do you want the audience to gain from your Masterclass? Think about what you want them to have found out during the class, what skills, knowledge or insights you want them to have gained.

How will your class fit together? What is the story, the narrative? This will help you decide what to include – think about how well everything first with your overall aims, and how well it all fits together.

How can you get the students to really explore the ideas? Can you get them to properly reason through their thoughts? Can you get them to think about why they are doing what they are doing, how it links to the real world, and how they would explain their reasoning?

Step 3: Choosing your activities

Key points:

- What activities could you include within your story?
- How will each activity contribute to the aims of your session?
- How will each activity contribute towards the students' understanding?
- What order should the activities be in? (work backwards)
- How do the activities link together?
- Students should be able to explore the topic and discover things for themselves
- Needs to be appropriate challenge and theoretical depth
- Don't just ask questions with definite answers – ask why, ask how things work, get them to really consider their reasoning and justify it
- The content needs to be different to what they will see in school
- Consider equipment & consumables

Ensure that the students are passively listening for a MAXIMUM of 15 minutes (shorter for primary students) – ensure you balance any listening time with them are actively doing something. The activity time should be longer than the time you have just spent talking/showing a video.

Make sure that you vary the type of thing they are doing too – for example, just practicing solving lots of equations will not make a particularly investigative session. Change what you are asking them to do and vary the length of the activities. If you are doing lots of discrete activities, think about how they link together and how you can build on each one – don't forget your narrative.

If you are having a big challenge or exploration activity, think about how you will scaffold this with earlier activities – so that the students have an idea of what they are doing and what they are aiming for, they are not just playing aimlessly.

See Step 6 for greater depth on each individual activity.

Step 4: Your ending

Key points:

- Can you link back to an original question?
- Can you show them something unexpected based on what they have been doing?
- Can you show them the links to the real world?
- Can you give them a 'wow' moment?
- Can you leave them something interesting to think about or discover?

Is there something really exciting you could have as your conclusion? Think about what point you wish to reach with your audience and how you could bring everything together. Consider what will make the students go 'wow', if there is a further application of the subject and whether you can leave them with something to think about and investigate. Is there an exciting video or demo you could show them to illustrate your ideas and leave them wanting more?

Step 5: Your beginning

Key points:

- Introduce yourself
- Tell students what you do
- Show them why you love your subject
- How can you introduce your topic?
- How can you motivate them to want to explore it?
- Can you show them the context, the overarching question (if you have one), the real-world links? How can you do this in a way that will hook them in?
- How will you introduce your first activity?

Make sure you introduce yourself at the beginning! Say who you are, what you do, how you use maths in your work or what your interest in it is. Give the students some idea of you as a mathematician/engineer/computer scientist (or similar). You are there as a role model as well as the workshop leader.

Think about the hooks into your class – and the relevance – they respond really well to things they can relate to themselves or the world around them, but this doesn't mean you only have to look at applied things. You can motivate topics with interesting questions or challenges (e.g. current open problems/unanswered questions)

Step 6: Developing your activities

Key points for each of your activities:

- What do the students need to do?
 - What questions can you ask?
 - Is there something practical which the students could do within the time?
 - What theory do you want them to cover?
 - Will it all fit within the time, or will you need to cut it down?
 - Would they really be investigating a topic, or just answering questions?
- Is the level right? What understanding does the activity rely on? How will you know if the students have this understanding, and help them gain it if not?
- How can you introduce and conclude the activity so it motivates what they are doing and links to the overall aim?
 - What are the 'hooks' and the links to the overall aim?
 - Can you ask a big question that they will answer in the course of the activity?
 - Can you make contextual links?

Structure:

A good structure helps guide students with what they need to think about/draw their attention to, and helps to break the task down if necessary.

- How can you gauge students' prior knowledge?
- How will you remind them* of things they are likely to have seen already? (there will be a range of experience)
- How will you introduce new ideas?
- How can you guide them on what they need to think about without giving the answers? Can you ask questions rather than tell them things?

- How will you demonstrate an idea or method? How will you know they are able to do what you are showing them? Ideas include:
 - Ask a student to model it first, ask students to critique, then show/re-iterate process to students
 - Deliberately do it wrongly and ask students to correct you
 - All students do the example whilst you do it
 - Find a way of all students showing you their attempt so you know if they're okay to move on
- How will you gauge understanding? (see "Support" for more details)
- How will they know what they are aiming for?

Don't introduce something completely new in your problem sheets; make sure you explain and perhaps include examples before asking the students to use methods which are unfamiliar. Also don't introduce new notation in problem sheets if possible.

Crucially, think again about the 'wow' moments throughout your class. Will they all get there? How can you ensure that they all get to experience these moments when they are working at different speeds? You could ask the slower ones to move onto certain aspects of a problem that are particularly important, or bring the whole class together to discuss the most important points

*Remind students of things they should know, don't just expect them to remember. It is surprising what they forget simply because it is a Saturday morning or they are not in their own school/with their usual class. Introduce new theory in 'baby steps'.

Practicalities:

- What preparation do you need to do?
- What equipment or resources will you need?
- Is the equipment easy to source and transport to the Masterclass?
- If the equipment is consumable, how easy is it to replace? How much prep time will you need for the resources? How much will they cost?
- Are there any risks to doing these activities/using this kit, and have you done a risk assessment?

Support:

- Where are the difficult points?
- How will you know if students are struggling?
- How will you support them if they are?
- Try to use questions as a way of gauging their understanding and eliciting further understanding.
 - Think about how you want to respond and make this clear to them. Hands up is appropriate sometimes – but bear in mind it doesn't help you gauge student understanding, and too much means the experience is passive for many students.
 - If you need to tell or explain something to students see if you turn it into a question, and have them tell/explain it to you.
 - Ask them to justify their reasoning.
- What support will you give helpers to allow them to help students?

Extension:

- How will you ensure all students have enough to do, but don't feel like they are missing out?
 - Can you get students to adapt activities for a new situation, or think about 'the general case'?
- How will you facilitate extension activities?
- What support will you give helpers to allow them to facilitate extension activities?

- Remember to give them information on questions they could ask or activities they could suggest to the students to prompt deeper investigations or give them something further to think about.
- Also tell them what they should not ask – e.g. something you are planning to discuss later in the workshop.

Good extension activities need to be easy to facilitate. You need to have things the students can do which don't require you to stop the whole class to explain the next thing, as others will still be working on the initial problem. The students are coming from different schools and will have been taught different things in different orders, and will naturally work at different speeds anyway – they will not all have the same prior knowledge.

Ideas include:

- Get students to think about 'the general case'. *E.g. what about an n by n size square?*
- Adapt activities for a new situation/change something in the question. *E.g. What if you can use a different material with certain properties?*
- Work backwards. *E.g. if this is the solution, what could the question have been?*
- Considering real-world constraints. *E.g. How much would this solution cost? What if your budget were limited to £X?*
- Considering societal implications. *E.g. what are the implications to your privacy? What could this do to the economy – could we all lose our jobs to robots? What is the environmental impact to this engineering solution you have designed? If you solve this problem, what would this mean for internet security?*

Voices:

Vary the voices heard in the session – for example:

- Instead of telling the students the uses of something, ask them to come up with some ideas.
- If one or more of your colleagues wants to get involved, why not plan a joint session with them?
- Videos are a great way to get across concepts which are tricky to demonstrate in the workshop room, or show off an exciting piece of kit that it's not possible to use in/bring to a Masterclass session. They are also an excellent way to bring in an extra voice – if someone has made a video showing something you want to share, and has done it in a really good way which fits in well with your narrative, why not show that rather than talking yourself?

Practical Notes: Timings

- Timings will be different every time you do the class. Some students will work quickly, others slowly and they will all have different prior knowledge.
- Remember to include a break
- Don't skip your ending, as it is very important – you want the students to walk away thinking about what they have done, not thinking about a rushed finish.
- A timeline is really useful to see what you want to cover, how you want to do it and how long it is likely to take. It will also help you keep to time on the day.

Work backwards from the end:

- How long is your ending?
- How long is needed to tidy up/give feedback?
- How long will the end of the previous activity take?
- How long is each activity?
- How long is your introduction?
- What are your 'time marking' points – bits you know you need to get to by a certain time?

- What can be added in/taken out if the timing is off without disrupting the flow of the session?

Plan extra time into your session as things will take longer than you expect – leave yourselves some wiggle-room. For example, it may take longer than expected to go over some essential notation; have things you can squeeze or take out, or have particular questions on worksheets that you can get them to focus on if there is not time for everything. Also have things you can add in, just in case everything is going quicker than you expect! Every time you deliver your Masterclass it will be different. You could make everything in modular sections, which can be added in or taken out to suit.

If you are using a presentation and need to skip some slides, do this when the students aren't looking – freeze the screen to 'hide' some slides, or do this while they are busy with another activity. As long as you don't tell them they are missing things they won't worry about it, but if you tell them then they will go away disappointed. It is good, however, to leave them with things they can investigate at home or at school.

The break is usually between 10 and 15 minutes – check with the organiser if they have a set time for this, or if they are happy for you to include it at a natural point about half-way through your class. Check if the students will stay in the room or go elsewhere for the break. In some series the students will need to move into different rooms for breakout/workshop sessions. **THIS WILL TAKE FAR LONGER THAN YOU EXPECT!** Make sure you build in plenty of time for this. Check with the series organiser if this is the case.

DO NOT end up with you talking most of the time and little or no time for student activities – aim for them to be doing something for at least two-thirds of the time (not just listening and answering questions in the whole group, but everyone engaged and actively working on something) – with them doing stuff far more than that at primary level.

Planning

As soon as you know what you are planning for your Masterclass, sort the date with the series organiser (this may need to wait until they have the dates finalised). Give them a topic and description. The organiser will need this to ensure there is a balance of topics within the series, so if you need to change topics make sure you discuss this with the organiser and see if this is possible.

Once you are scheduled to do a Masterclass:

- Check necessary contact details:
 - Who is your point of contact before the Masterclass?
 - Is that the same person who will be there on the day?
 - What should you do if you get lost or delayed?
- Check your audience:
 - What is the student age-group?
 - How many students are expected?
 - How many helpers are expected?
 - Does the Masterclass organiser know of any special educational needs or other accessibility requirements, and if so, what do you need to do to accommodate them?
- Check timings, and if there are any special circumstances – e.g. finishing early on the final session to give certificates, expecting to start a bit late on the first session, having to account for moving between rooms?
- Check venue details:
 - Where is it?
 - What space is available and how is the room set-up?
 - Do you need to bring your own computer or board pens?

- Check the facilities:
 - Will you have AV and something to write on?
 - Do you need any additional facilities and can these be provided? For example: a flipchart, OHP or visualiser, an internet connection or sound?
 - Do you have any special set-up requests – for example, do you want the students to be sitting in groups of a certain size? You will need to check if this is possible within the space, and who will be sorting this – it might be you moving tables and chairs at the start and end of your session, which you will need to allow extra time for.
- You may need to tweak your class to suit the space and facilities available.
- Confirm any additional requirements:
 - What kit will you need?
 - Can this be sourced easily?
 - Who will source this – you or the venue?
 - What materials will you need to produce yourself? Is this possible?
 - Who is doing any required printing?
 - How will any kit/printing be transported to the venue?
 - Helper preparation:
 - What will you need to prepare for the helpers?
 - Notes? Solutions? Potential questions they could ask the students to give them an extension activity to think about?
 - Will they need a demo of any equipment before students arrive?
 - Who will do any helper-related printing or prep?
 - Plan for any potential problems – always have a backup for AV issues, failed demos, etc.

Risk Assessments

Check what risk assessments (RA) are available for the venue – is there anything you need to be aware of?

Each Masterclass series will have a general RA covering normal classroom activities. Are your planned activities included in this? If not, is it an easy addition?

If you are doing activities beyond 'normal' classroom stuff, you will need to write a risk assessment and share this with the organiser/venue/Masterclass team in advance. If possible, this should be written in consultation with the organiser, as they will know the venue/room setup/what usually happens during the sessions. A RA is an exercise to ensure you have thought through any potential risks to do with your activities and how to mitigate them – including how you and the helpers should manage the activities and work with the students to minimise any problems. Ask the Ri team if you need any help.

Final prep

Make sure you share the final versions of your materials with the organiser – for them to print (if applicable) and as a back-up for on the day.

Make sure you have a checklist for the day, and that everyone knows what they are supposed to be doing. Have backups just in case. Write out:

- All the things you need to prepare (e.g. presentation, worksheets, kit) – check off when you have done them, when they have been checked/ proofread/ tested, when they have had any necessary updates, and when they are printed/prepared ready to go
- Make a list of everything you need to take with you and make sure you pack it
- If you are working in a group, check everyone else has what they need
- Ensure the organiser/venue has everything you have requested – get confirmation from them, don't just ask and assume all is OK. Also, check they have the obvious things (e.g. board pens) or bring your own.

Session Development: next steps

Think about the topic you have discussed today. What do you need to research? What other ideas do you have? Keep your narrative and the other key aspects of the class in mind throughout. Check out the subject-specific notes for additional advice.

Check-in regularly with the Masterclass team, ask questions and send us materials – it's much better to get regular feedback than have to re-do something which wouldn't work with the students you want to work with.

Make sure you practice your ideas – on your friends, with students if you can, and for yourself. You will need to have a go at any problems or activities so that you can correct any errors in the instructions/questions, see whether the instructions are clear and so that you can have any solutions ready for the class. Get someone else to do this too – you know the topic well, and you know what you are talking about. The students won't, so get someone else to look at it with fresh eyes and get them to give you honest feedback. Before you deliver the class, you will need to use this to produce your final presentation, notes and worksheets. You will need to proofread these carefully – leave a few days between writing them and proofreading if possible.

Masterclass visit

If you have not done so already, visit a Masterclass and see what happens – get an idea of format, level, and what is possible within the time. Even if you have been to a Masterclass, check if there are any coming up on a similar topic to the workshop you are planning and go along to get an idea of how another speaker approaches it. You'll pick up ideas of things you want to include, tweak or not do – remember that their style may not suit you. Many of the Ri Summer Schools are based on Masterclasses. Have a look at the programme and see if there are any you want to help at. The students are different, but it will give you a good idea of possible content.

Delivering your session

The earliest you'll be able to deliver a Masterclass is in the autumn term (and depending on your location/the age group you want to work with it may be spring term). As is said above, let us know as soon as your topic is finalised – we'll schedule you in with a date/venue as soon as we can.

If you can, plan to go along to one of the earlier sessions in the Masterclass series which you will be delivering in. You'll get to see the setup and consider how your session will work in the space. This will also give you a good idea of the level of the students and their dynamic – are they a really quiet group, noisy, etc? Groups will relax and get livelier as the series progresses, though no less engaged.

You'll get feedback from your first Masterclass from the supervisor or one of the team, if we can make it, and student feedback at the end of the series. Plan to have a chat with your Masterclass team point-of-contact after this first session so you can go through any necessary tweaks. A Masterclass is never perfect the first time you deliver it, and the development does not stop there – you'll play with it several times before it's your 'final' session. Be open to feedback from the helpers etc. – they are often either teachers or are Masterclass veterans. Even really experienced speakers need to try things several times before they are 'finalised', and if you do one Masterclass for any length of time you'll adapt it as your style changes, or you find more material to add in, or if you get bored with one of the activities and want to try another. It helps things to stay fresh and exciting for you as well as the students!

Thank you for being a part of the Masterclass programme!