Planning and Delivering Small Group Teaching

Introduction

• **The definitions of terms in small group teaching** in mathematics are not universally agreed, but usually by a small group session we mean something like a ‘tutorial’, which is effectively an exercise class in which students work through problems together with help on call from an expert such as yourself. This sort of class is dealt with under the session on facilitating problem solving classes. In this session we are looking at ‘real’ group teaching where the objective is to get interactions between students and tutors to facilitate learning. ‘You really learn something when you are put in the position of having to teach it’. It is the interplay between students and tutors that provides a greater range of learning activity.

• **SGT can enhance motivation of students**, because they have more control over the proceedings and more personal input and direct feedback.

• **SGT has a wider range of learning activities** including learning by doing, learning by trial and error in a safe environment, learning through interaction, having to explain and justify your ideas, general transferable skills such as communication, teamwork, etc.

• **Learning through interaction** is perhaps the prime strength of SGT. It involves all of the key gambits in a learning activity: initiating ideas and lines of thought; explaining them; listening to new ideas; questioning with a genuine desire to know; responding in a disciplined and organized way; discussing and playing with them. Each of these is a skill we should aim to develop to high levels.

• **The precise role of SGT in mathematics** is of course restricted profitably to specific areas of mathematics. For example, one would not use it for routine topics such as matrix algebra calculations, or for problem solving for which conventional exercise classes are more appropriate (That is the subject of Session 2). One would use it for topics that would benefit from discursive and argumentative treatment. For example, a particularly long and involved proof, such as that of Cauchy’s theorem; a tough mathematical modelling exercise; a sizeable practical statistics exercise; harvesting a wide range of applications of a simple topic such as quadratic equations. All of these require a wide range of ideas and skills that an individual student might lack, but the group as a whole possesses. And members of the group will have to use all the interacting skills to produce the final product.
• The specific objectives of a SGT session to which you are assigned should be provided by the lecturer whose course you are supporting. Make sure you fully understand these objectives, and think carefully about what sort of group activities will best achieve these – small groups of four/five collaborating as a team; pairs role playing as for example ‘prover’ and sceptic.

Preparation
• As early as possible to give maximum gestation period for ideas and design and production of materials

• Lecturer responsible for course should give you necessary teaching and learning materials, which you should regard only as the starting point on which to design your own teaching strategies and activities

• Read widely on topic to get an overview and broad perspective (ie don’t just read your old college notes). Sources include a range of books, websites, lecturer’s notes, past exam papers

• Consult widely with lecturer, colleagues, fellow PGs, etc.

• Rewrite notes on the topic in your own words – reassemble and restructure the ideas and content, make sure you can prove things ab initio yourself

• Design tasks to meet objectives including such things as organising the groups, assigning tasks, etc. For example, if the object is to develop skills of sustained precise and rigorous mathematical argument you might split them into pairs with one playing the ‘prover’ and the other a sceptic whose job it is to insist on precision, clarity, and so on. Or for a complicated modelling exercise you may split them into say groups of 4-5. Don’t forget that all such tactics have implications for accommodation, possibly equipment. And of course you will have to give them precise instructions. For a wider range of tasks aimed at various types of mathematical objective, see Mason (2002), page 105.

• Ensure an appropriate amount of material in terms of intellectual challenge and background of students and time available (allowing for students follow up study time). There is a tendency to go over the top on this and try to do too much.

• Know the students present – background, motivations, interests, etc. Anything which helps you appreciate how you might best get your messages across. This is particularly important in the case of service classes

• Know what the students know and HOW they know it, by which we mean how they have learnt the material, the methods used, etc – get on their wavelength

• Remember the students are not clones of you, and will almost certainly not be as good or interested in mathematics as you are. The job is to teach the students you have got, not what you wish you had.

• Get an overview of the topic of the session – what is the core idea(s), is it to prove something, what then is the shape of the proof? Is it to develop skills in a certain technique, say integration by parts, what then are the crucial steps in the technique? What sort of questions does this pose for the groups?
• **What are the n (usually very small) key points** in the topic, the absolutely key ideas that the students must get if they are to crack the topic? In the average session there would normally be at most three or four such ideas, and the session has to be built round ensuring that the students get these. Unless so directed, they will think everything that crops up is equally important. Indeed one valuable group exercise would be to get them to study a body of work and identify for themselves the key messages therein. Example: In a whole course on complex analysis there are only about a dozen such key points/ideas, and one per session would be a reasonable coverage rate.

• **Identify intellectual sticking points** and design specific activities to deal with these. There shouldn’t be too many, and you need at least ten minutes for the students to have a fair crack at such things. Example: In solving a linear DE by integrating factor the step when, having multiplied by the factor, you convert the LHS to the derivative of a product always causes difficulty. This is usually because they are simply not fluent enough with use of the product rule, and in reversing it. So give the groups ten minutes working though some examples of the product rule, gradually working up to the sort of thing you are doing in the solution of the DE. This is time well spent. Like learning to ride a bike - when they haven’t quite got it, it seems impossible to them, but when it suddenly clicks, they’ll not easily forget it.

• **Find an acorn** for the session that encapsulates what we are about and that they can keep referring back to throughout the session. This provides the students with a familiar ‘home page’ on which to try out ideas. Example: In teaching first order DEs the simple IVP \( y' = y, y(0) = 1 \), provides a suitable ‘acorn’ on which everything else can be built (Cox, 1996). [Or use Fahmi’s poster]

• **Find hooks, aide memoires, etc** for key ideas – make them easy to remember, and in fact a useful group activity might be to search for as such simple devices for remembering particularly complicated mathematics results and ideas.

• **Ensure accommodation is appropriate**, and decide how you will use it in the session. In fact, this is quite a technical matter and may be out of your hands.

**Running the session**

• **Set rules/agenda from the beginning** and make sure everyone understands the requirements for a conducive learning atmosphere. This includes timekeeping, disciplined working, etc

• **Give the objectives of the session** (Mason, Page 127) and explain briefly what you are going to do, and why.

• **Give some motivating introduction** – a bit of relevant history, an example, reference to the exam or coursework, something relevant to them, etc.

• **Clear instructions** on a handout, or better displayed on board or OHP so they won’t lose it.

• **Start with easier tasks** to get them used to working together
• **Give them ‘entry methods’ to exercises**, not ‘hints’. That is, general principles they can adopt to get started on any exercise or project. Have they seen a similar thing before? How does it differ from other examples they have seen, and how can they generalise what they already know to suit this new case. Can anyone guess an approach that the rest of the group can check out. If you find it is essential to give a hint to actually get a group started off, then perhaps that means the exercise is not expressed well in the first place and next time you might rewrite it. The point about group work is that within a reasonable sized group there should be someone who can make a start on a problem.

• **Make sure everyone is involved and engaged** – for general ploys for encouraging participation see Session 3 of this workshop. In the case of group work the main point is that the group should regulate itself in maintaining a disciplined, productive work ethos in which everyone contributes. However, in going round the groups you should be alert to such things and bring in the bashful members and keep a lid on the vocal ones.

• **Be only a supportive, positive and inspirational presence** and don’t intimidate, intrude unnecessarily, embarrass or threaten anyone. Learn to stand back and let go when necessary. Really, groups should only interact with you to tell you about progress, or to ask for general advice. Sometimes you may be asked to adjudicate on a disagreement between group members. Then you have to ask whether that is what you should be doing – isn’t the point of the group to resolve such issues themselves?

• **Keep them guessing – literally!** Encourage them to use trial and error and guessing as a technique for tackling problems. Let them see that making mistakes is fine – just do it quickly. They can sometimes learn as much from mistakes as from correct steps.

• **Keeping fresh** – no matter how many times you have seen something, when explaining it to new students it is their first time, so maintain enthusiasm and freshness in explanation and in responding to their queries. It is easy to appear world-weary and blasé when asked a question for the nth time. But it is the first time for these students. So treat the issue with the same interest it should generate on the first occasion you encountered it. Indeed you can make a point of the fact that many students meet the same difficulty. Be interesting and stimulating (Mason 2002, page 60).

• **Get students to help each other** – that is the whole point of a SGT session of course, but in the early stages they might be a little inhibited about this. Emphasise that that is what they are supposed to be doing. One important role you can play in the groups is as an impartial channel, helping the members of the group to talk to each other initially through you and then you can bow out and leave them to it.

• **Don’t answer a student’s or a group’s question directly**, but get them to move towards the answer, and also bring in other students, open up the question for wider discussion.

• **If they get really stuck, you can go through it on the board**, but be able to explain it – treat explanation as a skill that you have to learn. It is not easy, and it doesn’t matter how well you ‘know’ your subject, if you can’t explain it to students then you don’t really know it. Be able to explain **sensibly** as well as logically. Explain by listening and dialogue.
• **Maintain discipline** and keep order. Such things as dealing with persistent latecomers, disruption, lack of application, etc are some of the most stressful aspects of teaching. And unfortunately, such things do occur. Your strongest weapon is a sure confidence in your position, status and role. If you are placed in charge of any group of students, whether it be for a tutorial, group session, invigilating an exam, etc, then that is precisely what you are – in charge. Worse, you are also responsible for the session, and for ensuring that all students have a productive learning environment. Most students really do want that and they see it as your job to provide it. They will almost certainly support you in dealing (sensibly) with disruption and inappropriate behaviour (Even tolerating latecomers is not an option, because eventually everyone will come late – or not at all!). In fact, in SGT such things are less of a problem than in a large lecture for example. It is fairly easy to control behaviour in the small group environment. What is more difficult however, and needs constant attention, is keeping them on task. They can wander off for a number of reasons. They’ve finished anyway – clearly the task was too easy, give them something else to do. The task is inherently boring and their interest wanes – give them something else and revise the task (or drop it) next time. They have ground to a halt, can’t see how to progress and have found something else to occupy themselves with – the task is possibly too hard, and in any case you have to decide whether to give them some help, or another task.

**Ending the session**

• **Finish appropriately** with some sort of plenary session to allow groups to feed back on their progress, which you may then pull together to summarise the lessons that have been learnt. If the exercise was structured properly then similar messages may emerge from the separate groups, and will be all the more convincing for that.

• **Give follow up work**, to consolidate and build on the outcomes, and possibly to be handed in later.

• **Describe briefly what you will do next session**, and ask them to bring necessary materials and do any preliminary work necessary.

• **Make notes for yourself on how it has gone**, how could do better, any promises to students (always do whatever you said you would do)?

***(Definitions of important terms such as ‘syllabus’, ‘objectives’, etc)**

References


