Care for PhD Students

LMS Research Policy Committee

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1. Introduction

This is a document prepared by the Research Policy Committee (RPC) of the London Mathematical Society (LMS) with some ideas about caring for PhD students in the mathematical sciences. In recent years, the RPC has received several anecdotal concerns regarding students in mathematical sciences not completing their PhDs, with a lack of support being a significant contributing factor. This document aims to address this issue by suggesting some good practice guidance for university departments, PhD supervisors and students.

Some of the document is relevant to generic PhD supervision, but we have also tried to make some subject-specific points. The nature of PhD research varies significantly from subject to subject and general university guidelines which attempt to cover all subjects in the same way can fail to recognise this fact. Subject specialists in the mathematical sciences may wish to compare their own university's generic guidelines for supervision with the ideas presented here.

While the document outlines some potential issues and approaches, it is certainly not intended to be prescriptive. In many aspects of PhD supervision there is no unique 'right' approach. Even within the mathematical sciences, the nature of research can vary significantly, and different departments may have different research environments. Any approach must therefore consider the specific circumstances and needs of the individuals involved.

This is intended to be a 'living' document, which will be updated on a regular basis.[1] We encourage readers to provide feedback (both on the ideas covered in the document, and on anything that might be included in future versions). Please send comments to Katherine Wright, Society and Research Officer at the LMS: katherine.wright@lms.ac.uk. It is hoped that the document will evolve into one that is of real use to the mathematical community.

The document is divided into three parts: a) good practice for departments; b) good practice for supervisors; and c) good practice for students. In some cases, suggestions may apply to (but not appear in) more than one section; notwithstanding this, it is hoped that departments, supervisors and students will see the document as a useful resource and will take from it whatever they find to be relevant and useful.

One of the issues in mathematical sciences research at PhD level is that, although often highly rewarding, it can sometimes be a lonely activity, particularly in small departments where there may be very few people working in a particular area. For this reason, awareness about and support for mental health issues are critical — for departments, supervisors, and students. We discuss this in the following sections and have tried to tailor some of the points in the document with this issue in mind.

[1] The current version of this document was written mostly before the Covid-19 pandemic. We are aware that new patterns of work may arise from the necessary adaptations made during this period, particularly regarding the use of technology; these may be fed into later versions of the document.

2. Good practice for departments

2.1. Supervisors and graduate tutors

A central issue of PhD supervision includes meetings between supervisor and student (typically lasting between one and two hours), in which student and supervisor discuss mathematical sciences or mathematical research life. While previously these took place in person, it has now become easier and increasingly familiar for both parties (particularly in times of Covid-19 lockdowns) to conduct them virtually; in-person meetings are still, however, the ideal where possible. A common problem, however, is that the supervisor may be the only person with whom the student can have such a discussion, leading to possible feelings of isolation and a lack of confidence.

- There are various models to try and mitigate this problem, usually involving shared supervision or a second supervisor.
- If circumstances allow, shared supervision, where both supervisors are involved in the day-to-day supervision, can be very helpful (and this is particularly important in interdisciplinary areas, particularly where the topic of research spans areas covered by different departments).
- Joint supervision can, however, be inappropriate in some circumstances and should not be driven by issues that do not relate to the welfare of the student (such as HR rules concerning the need for staff to supervise students).
- An alternative model is that each student has a second supervisor, whom they meet separately from the primary supervisor at least once a month (perhaps on a more informal basis). This would give the student an opportunity to discuss their progress with someone else. While the second supervisor should ideally have some understanding of the research area, they need not be an expert.
- It should be noted that anyone with a formal role in the supervision would normally not be allowed to be an internal examiner, and this should be considered when assigning the supervisor roles.

There are other possible approaches to address this problem (and some of the points made below, particularly in Section 2.3, will build on this), which include promotion of networking.

- For example, students should be encouraged to go to graduate schools and other such events aimed at supporting them.
- If resources permit, activities aimed at getting students with similar interests from different departments or universities to work together can also be helpful.

Notwithstanding all this, departments should ensure that there is someone clearly signposted who has responsibility for pastoral care, for instance a graduate tutor or PhD mentor, who is approachable and available if students encounter difficulties.

- As well as being available in case of problems, the graduate tutor (or tutors, depending on the size of the department) should meet every student on a regular basis, e.g. one to three times per year (there is an argument to say that the need for more frequent meetings with the graduate tutor is greater in the first year).

2.2. Monitoring progress

Monitoring student progress is very important in all subjects but perhaps particularly so in the mathematical sciences, where it may not be completely clear as to how much has been achieved so far (in contrast to, say, a more empirical research subject where there may be a wealth of experimental data available). Given this, it is vital that the review process is taken seriously.

- Annual review is probably appropriate in most instances but there may well be a need for more frequent reviews during the first year.
- It is best if the department has a clear and consistent policy of whether the review is independent of the supervisor or not. The supervisor will be able to provide research context, and this may be easier verbally than in a written report. But it is also the case that it can be difficult to facilitate intellectual discussion between the student and supervisor.
- The review should fit in naturally with the normal submission timetable, with appropriate material submitted at each stage (for example, an outline of the proposed area of research early on with a detailed thesis plan coming much later).
- The requirements on the students should be constructive (for example, helping to make sure that the students start writing down their results early on); we do not want the students gearing their work to producing material which will not be helpful in their progress to an eventual successful outcome.
- It is particularly important to determine during the first year whether the student has a reasonable expectation of being able to complete a PhD in a timely fashion (this is much better being flagged during the first year than, say, after three years).
- A related issue is the need for clear exit points for those who cannot make it (with ideally the possibility of some interim qualification so that the student has something to show for their work).
- In any case, reports from the supervisor will play an important part of the process (particularly with regards to flagging problem cases).

2.3. Cohort building and working environment

Cohort[2] building is important in all PhD programmes but, for reasons mentioned above due to the nature of research in mathematical sciences, is a particular issue in mathematical sciences (both intellectually and socially).

- There are two main topics here: the environment in which the students work and the activities available for them to engage in.
- We appreciate that these may be particularly challenging, especially in situations where there might not be very many students in a particular area.
- In terms of space, students should normally have their own desk and computer with sufficient room next to them for books, printouts, and so on.
- The student offices should ideally be reasonably close together and close to appropriate breakout spaces with plenty of whiteboards.
- Apart from providing appropriate space for each individual student, the work environment should provide attractive spaces for various forms of interaction with fellow students (from one-to-one through to larger groups).

[2] By 'cohort', we mean the set of all PhD students in a department, not just those in a particular year.

Where possible and appropriate, students can be encouraged to work together (this usually makes most sense at the beginning of their studies).

- If numbers permit, journal clubs, reading seminars, or even just two students working together to understand some background piece of theory, can be very helpful.

One problem is that there are sometimes no opportunities for general socialising (particularly those not initiated by students).

- This can be addressed by holding social events for staff and students (involving the students in the organisation is a good idea) and having a range of different types of activity. Instead of the default “let's go to a pub at the end of the afternoon”, one might hold social events during the day.
- If attracting enough participants is a problem, events that span two or more departments (say, Mathematics and Physics or Mathematics and Computer Science) can work well. Opportunities to meet with non-mathematical scientists are also helpful, both socially and intellectually, and for career development reasons. Typical examples include industrial study groups, interdisciplinary seminars and university training for teaching or tutoring.

We will address seminars in Section 2.4, but should mention here that having a specific PhD seminar, where PhD students give short talks about their research, can also be very helpful.

- One model might be that every PhD student should talk at least twice a year, with the talks combined with a regular social event (such as a PhD seminar followed by lunch).
- Students could also be supported in organising graduate workshops (though this can be very time consuming and the amount of work involved should be taken into consideration).

2.4. Seminars

Seminars are critical to a mathematical environment but can be negative experiences for students.

- A student may already be suffering from a lack of confidence, and this can be magnified by a failure to understand any of the seminars given by visiting speakers.
- This is often compounded by the questions and subsequent conversations at such seminars being dominated by academic staff.
- It is important to tailor the seminar environment to suit students as well as academic staff and we explore some possible ways of addressing this.

There can be a range of different types of seminar, such as general colloquia that everyone is expected to attend, more specific seminars held by individual research groups or application areas, and so on.

- This is very healthy but the needs of PhD students in such a programme should be taken into account.

- If students are expected to attend specific seminars (such as colloquia), it is helpful to provide guidelines to the speakers as to the range of knowledge of the students and what background can be safely assumed.
- There are other ways that may help students get something out of the seminar. For example, if there are at least two students in the general area, the students could do some reading and then try to prepare and give each other an informal presentation on the background material.
- An alternative is that the speaker is asked to give an informal pre-seminar talk aimed at the students to bring them up to speed so they can better appreciate the seminar itself. However, while this could be very helpful, it may be that few speakers would be happy to do this.
- A variation on the previous point would be to have pre-seminars run by the students for the students. The seminar speaker would not be in attendance (and members of staff would not normally be present either).
- A potential problem with pre-seminars is that speakers might skip some introductory material, assuming that everybody "knows the basics". The briefing given to seminar speakers should stress that this must be avoided.
- To address the problem of conversations with the speaker being dominated by academic staff, departments could organise a meeting after the seminar where PhD students discuss the seminar with the speaker without any academic staff present.
- Asking the students to write a few sentences after the seminar summarising the key points/ideas, or at least what they got out of the talk, could also be constructive.
- A related issue is that of socialising with the speaker. It can happen that some aspects of this (such as the meal with a visiting speaker) are not open to students and that the only opportunity for this to happen occurs in a pub where some students may feel uncomfortable. This should be considered when organising the schedule for the day.

Organising seminars by visiting PhD students can also be very helpful.

- These can be part of the main seminar series or else a separate series organised by the local PhD students (either on a departmental basis or within research groups).
- When PhD students give seminars, it is essential that they have opportunities to present their research in a friendly environment.
- Departments should have a system whereby PhD students give regular seminars, discussing their progress and getting feedback from academic staff and other students.
- A particular instance of this is when a student is going to give a presentation at a conference; having them give the talk first in the department, and then getting constructive feedback on the proposed presentation, can be very helpful.

2.5. Training

Appropriate training of PhD students is essential, but this can be difficult if resources are stretched. Participating in training organised by consortia of different universities can be very helpful but we will mainly focus here on what can be done within a department.

- A very important part of training is due consideration as to what the students need, as it can otherwise be at the wrong level or not perceived to be relevant by the students. It is important to remember that many students will have (and wish to have) highly successful careers outside of academia and training should reflect this.
- With regards to general skills, some are obviously relevant (such as proficiency in LaTeX for most students) but others, particularly generic ones supplied at university- (as opposed to departmental-) level may be much less so. A particularly important generic skill, however, is learning to communicate with non-experts.
- It will not be cost effective (nor, in most cases, possible) to supply all such training at departmental level, but a suitable balance as to what is supplied in the department and what is supplied centrally by the faculty or university should be achieved.
- There are also subject-specific aspects, and these are sometimes supplied by suitable courses, either within the department or within a network of mathematical sciences departments from various universities. Examples include programming and ethics.
- Also useful are opportunities to attend meetings and conferences, particularly those specific to the student's area of study. The LMS Scheme 3 grants are relevant here, for example.

For many students, particularly those who wish to pursue academic careers, it is very useful to acquire teaching skills.

- Students should be encouraged to teach and be supported so that they become good at doing so.
- While there will inevitably be a significant amount of comparatively routine work, such as marking, there should also be some more interesting and challenging work which involves direct interaction with undergraduate students.

For many students it is useful to see and contribute to the use of mathematical sciences outside of a mathematical science department.

- Students should be encouraged and supported to take part in knowledge exchange events, be informed of national events such as study groups with industry and be engaged with the wider community beyond the local university. These can provide interesting opportunities and research challenges, and it is often beneficial to provide time for the students to pursue them as well as advantageous to the department in developing external links.

On top of this, many PhD students contribute significantly to the life of the department beyond their immediate research and teaching activities, and this can help develop a range of further skills.

- Quite apart from organising seminars, as mentioned above, possibilities include organising social activities, helping out at open days for prospective students (both undergraduate and postgraduate) and with outreach activities, serving on departmental and university committees, becoming a peer supporter, and so on.

2.6. Format of theses

Many universities have regulations about the format of theses which appear to come from humanities or social sciences; these often specify issues such as word counts and double spacing, which can be unhelpful for mathematical sciences.

- Appropriate rules for mathematical sciences might include such stipulations as the fact that the thesis should normally be prepared using LaTeX.
- Even if not required by university regulations, students should have a soft copy of their thesis available to send to their examiners (in addition to the hard copy being supplied through the official channels).
- Given the nature of the subject, it may take examiners significantly more time to read a thesis in mathematical sciences compared with some other subjects. Notwithstanding this, an upper limit of 10 weeks or so would normally be reasonable.
- A page limit can be appropriate, but examiners should be able to assess the thesis without relying on a detailed reading of the appendices (if any); this is to deter students from putting excess material in the appendices but making it necessary for the examiners to read them anyway.

2.7. Financial support

It is important in mathematical sciences that students have the opportunity to attend conferences and other meetings related to their work.

- If a student does not have their own research expenses account associated with their funding, the necessary expenses would normally be covered by the department. The amount will vary with the field, but £500–700 a year (or £2,000 over the course of a PhD) would be typical for this kind of support. This can sometimes be supplemented by a general pot to which students can 'bid'. Not only does this allow for more expensive visits (e.g. outside of Europe) to be funded as one-offs, but it also gives students a semi-formal low-stakes opportunity to make a case arguing for the support for their research.

Financial considerations also relate to the monitoring issues described in Section 2.2 and the ability of students to complete on time.

- Some students (particularly those from overseas) may be worried about the financial impact of failing to complete their PhD; in some cases they may even be liable for covering the fees themselves should this happen. This can be a very serious matter; departments should be aware of any such financial issues and how this impacts on the students concerned.
- A related issue is that university scholarships often last for three years only and departments could top these up to 3.5 or 4 years to match those provided by EPSRC.

2.8. Inclusiveness and wellbeing

The issue of inclusiveness follows on from the points made about building cohorts made in Section 2.3. While departments will seek to create a sense of identity among their students, particular issues can arise with minority groups. There are a variety of approaches departments might wish to consider to help mitigate this.

- A buddying/mentoring system can be very positive in making new students feel included; this could be tailored to help particular groups of students such as (for example) female students in a department where almost all PhD students are male, or students from different cultures who have difficulty adapting to student life in the UK.
- Getting groups of students with shared identities or concerns together can be helpful, although this may well need to be done on a faculty or university basis to generate enough people. Some of this might happen naturally (for example, through university societies) but departments could investigate ways that would benefit their own particular groups of students.
- It is helpful to make clear the support that is available for students in the event of illness, or in cases where the student wishes to take parental leave or has caring responsibilities.
- There should be a named person, such as a Dignity and Respect Officer, available for students to discuss any worries or raise concerns about their experience in the department. This person should be independent of student supervisors or role holders in the graduate school.
- It is good practice to include PhD student representation in the department's Equality, Diversity and Inclusion committee, not only to ensure that PhD student voices are heard but also to provide an interesting and thoughtful point of view on general matters of culture in a department.

As mentioned, mental health is a particular concern, which departments should be aware of and make efforts to address.

- There should be clearly designated members of staff who can support students with pastoral or mental health issues. This could be a graduate tutor or PhD mentor (a role descriptor for a PhD mentor -- from the School of Mathematics at the University of Edinburgh -- is included at the end of this document for information).
- It is helpful if there are general resources available to students to help them cultivate good mental health and resilience -- often universities provide these, and it is then the role of the department to make sure these are publicised effectively.
- It is also helpful to make all staff within the department aware of the issue of mental health, including how to nurture good mental health and where support may be accessed if required.

3. Good practice for supervisors

Here we make some further points about the nature of supervision, following on from those made in Section 2.1.

An initial question is that of choosing the topic of the thesis. There are a range of possibilities here, including the following:

- Let the student suggest a question. Some students (particularly those financed from overseas in more applicable areas) may have something specific they want to work on (and this may even be related to their funding).
- The supervisor first assigns a question or problem to which they already know the answer, and which should not take the student too long to solve. After seeing how the student gets on with this, the supervisor either follows up with further suggestions based on this or else suggests a change of direction.
- A variation is for the supervisor to give a generalisation of something they have already done and are confident that will work out and see how the student gets on.
- Some projects will be motivated by a particular application or be related to specific data sets or experiments. In this case, gaining familiarity with the application or data and related examples may be a suitable first step.
- A more radical approach is for a supervisor to suggest a topic far away from their current area of work to lower the risk of the supervisor getting over-involved in the research. This can have a greater degree of risk (particularly for weaker students) and its appropriateness also depends on the extent to which the research is collaborative between the student and supervisor (we will touch on this again in the issue of authorship of publications).
- A question related to all these approaches is the length of time a student should be allowed to bang their head against a brick wall before the supervisor suggests (or enforces) a change of topic.

One issue that should be discussed early on is whether the student has a particular career in mind.

- Students often need to be reminded that a PhD can lead to many different jobs, and that the academic route is not the only one. The mathematical sciences have great influence in many areas of work, particularly through modern technology, and transferable skills as well as other training are also important.
- If the student does wish to pursue an academic career, then the issue of early publications arises (so that, when the student starts applying for positions, they have something concrete to present as well as their thesis).
- Another issue is whether the project has a natural continuation after the PhD (or whether the student will have come up with new questions).
- In any case, will the work equip the student with a sufficient breadth and depth of knowledge to eventually formulate new questions themselves?
- Whatever the student wishes to do, it is important to help them build a network of contacts that will be helpful for them when looking for a job after the PhD.

Another significant issue is that of publications. There are important issues that need to be discussed with the student early on in their studies.

- Is the intention for these to be solo-authored by the student or joint-authored with the supervisor (and possibly others)? This will depend on the level of independence of the student (from one extreme of largely independent work by the student through to the other of a close collaboration with the supervisor), as well as the norms within the field of study.
- Following on from this, if the student is intent on an academic career, do they need solo-authored publications? In addition, when the student starts applying for jobs (towards the end of their PhD studies), do they need publications to be already submitted (or even accepted)?
- Most universities say that PhD theses must contain publishable material, but the timing of the publications could be very important to some students.

A related point is that it can be very helpful for the student to write down all of their material properly as they go along (even if the material is not submitted as publications at that stage); this should be checked thoroughly by the supervisor on an ongoing basis.

- This has several advantages, including tracking the progress that has been made, getting an accurate estimation of what remains needs to be done, and boosting the student's confidence (in that they can see that they really have achieved something).
- This is particularly pertinent in mathematical sciences; one might believe that important results have been established but, without a proper write-up, gaps in the arguments can be easily overlooked and, if this is only discovered late on in the student's studies, it can have a serious impact on their ability to complete a suitable thesis on time.

As far as interactions between student and supervisor are concerned, it is a good idea to establish expectations early on.

- Simple questions include how often the student will meet their supervisor (ideally at least once a week during term-time, particularly at the beginning). This can point usefully to reasonable expectations for working hours and encourage students to achieve a healthy work/life balance.
- While, in some cases, keeping things flexible is desirable, students will need to focus to complete their PhD and it is worth thinking about establishing a clear working relationship (for example, what is expected for the next meeting, or perhaps slightly longer-term goals) from the outset.
- A structured approach can have benefits. For example, one might say that students should always have clear written plans, agreed with their supervisor, of work targets for (say) the next three months and the next six months (always understood, nevertheless, to be subject to change).

It is important that supervisors know what departmental and central pastoral support services are available and how students can access these. Often it will be supervisor who identifies when a student has personal/family/health issues.

4. Good practice for students

Many of the suggestions of good practice pertinent to students are implicit in the points for departments and supervisors above. In this section we build on these issues a little more from the student point of view.

- Your supervisor will discuss issues, such as the frequency of meetings, with you early on in your studies. Do take these conversations seriously and explain if you are not comfortable with what is being proposed (for example, if you would like to meet more frequently to begin with).
- While your supervisor is usually responsible for suggesting an appropriate area of research, do give feedback as to what sorts of things interest you and how you are getting on with the current suggested area.
- Your supervisor will suggest appropriate courses and background reading to develop your knowledge and skills. In addition, you will need to investigate a significant amount of material to understand the background to your research. This will be largely in the form of research papers and other existing knowledge, and this will also be necessary for writing your thesis in due course, as that will almost certainly contain a chapter or two surveying previous work related to what you are doing.
- As mentioned in the introduction to this document, research in mathematical sciences can from time to time be a lonely endeavour and there are ideas expressed in the preceding sections as to how this can be mitigated. Do try and make use of the opportunities presented for getting to know your fellow students, becoming part of the department (or research group). Make sure you also know what pastoral support is available and how to access it.
- Do talk to your supervisor about your career aspirations. In some cases, this will be clear, for example, if you already have a lecturing position at a university and you have been funded to enhance your qualifications by completing a PhD, or if you are working on a specific application area with external funding. However, in such a case, there may be specific requirements imposed by your funding body and, if so, this is something else you should discuss with your supervisor (or other people in the department as appropriate).