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# **The Need for Greater Support in Academic Writing for PhD Students in Mathematics and Related Subjects**

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## **Abstract**

Within the United Kingdom (UK), the graduate student population in mathematics departments seeking to obtain the higher degree of Doctor of Philosophy (PhD) has become increasingly diverse as a result of a number of factors. This student body faces a variety of challenges that raise questions about what provisions universities should provide in order to give these students the greatest chance of a successful completion of their PhD programme.

In this article I argue that universities should increase their provision for the development of the writing skills of PhD students and especially for those in mathematics and related disciplines. This is partially motivated by the new diversity of the graduate student body but also by the fact that undergraduate degrees in mathematics in the UK provide few opportunities for students to develop their writing skills. I argue for a centralized provision of support, either at the department or university level, to move the development of a student's writing away from their PhD supervisor, which is not ideal.

**Keywords** *Doctoral study, student development; mathematics education; skills; learning activities*

## **Introduction**

After successfully completing an undergraduate degree, many students want to continue their education further and many seek to be awarded the higher degree of Doctor of Philosophy (PhD). Currently, there are a number of different types of routes to obtain PhD (see, for example, City Graduate School 2013). However, in scientific subjects the *traditional route*, which I will discuss below, remains the most common path for students seeking to obtain a PhD. This is illustrated by the fact that in the School of Engineering and Mathematical Sciences at City University London only one of the 48 students obtaining a PhD in the last couple of years had not obtained a PhD via the traditional path (Chatelain, 2013).

In order to receive a PhD via the traditional route, students are required to complete a body of original research that typically occurs over a 3-4 year full-time programme. Having an idea and undertaking substantial new research is, in itself, challenging and yet there is more that students need to tackle in order to obtain this degree. Students are also required to present their work at various points in their degree programme. They will be called on to give oral presentations, written papers, and conference posters. By far the largest presentation task that a PhD student will need to undertake is to produce a thesis, which is an unavoidable component of a traditional PhD in the UK.

Students seeking to obtain a PhD are required to write a thesis that details the research that they have undertaken and the conclusions that they have reached (Ketteridge and Shiach, 2009). In addition to discussing their research, they must also tell the reader where their research fits within the body of existing research and knowledge in the area. This volume forms the basis on which students will be examined in their viva and is thus an integral part of the process that determines whether the student will be awarded the degree. It is therefore crucial to the success of the student that they are able to write to the standard required and it is also imperative that the student complete the written part of their PhD in a reasonable timescale, which is set by the institution together with restrictions that occur due to funding limitations.

The written work that appears in a thesis, as for other types of research documents, must be written so that it is clear why the research was necessary (Lester, 1996; Samuels and Deane, 2008). Further, it must explain in detail the research methods, results found, and conclusions drawn from each research chapter (Lester, 1996; Samuels and Deane, 2008). Finally, it is often the case that the whole thesis should be written in a coherent way with an overarching theme. Therefore, to write a thesis to the standard that is required for the award of a PhD requires considerable knowledge and good writing skills. But exactly where, when, and how, are students expected to acquire the knowledge and the skills in order to be able to do this?

### **The Current Situation and the Need for Change**

Murray (2005) discusses the fact that, so far, universities have typically taken the view that students will either have acquired the necessary skills and knowledge to write a thesis in a timely manner during their previous education, general knowledge, or that they are able to informally pick up the necessary know-how during their PhD. Given this attitude, while there has clearly been some substantial investment in universities to help students with their writing (e.g. University of Leicester, 2013), there has generally been a lack of centralized support for students who do struggle to write a thesis or a paper about their research (Murray, 2005). However, ideally there should be more help available at universities for students to access given that there are a number of issues with the institutional idea that was discussed by Murray (2005).

It initially seems reasonable for universities to expect that a student entering a PhD programme with a high grade, usually a 1<sup>st</sup>, in their undergraduate degree will have acquired, en-route, the necessary writing skills in order to undertake the challenge of writing PhD thesis. Indeed, there are many subjects for which this is currently the case due to the fact that many degrees have historically used essays as a principal form of assessment. However, there are a number of subjects, for which my subject area of mathematics is a good example, where students can have a 1<sup>st</sup> class knowledge of their subject area but lack the necessary skills to write a thesis, or research papers, to the required standard.

Within mathematics degrees in the UK, due to the nature of the subject, there are usually very few, if any, modules where discursive essays are used for assessment purposes and so students have had limited feedback on their writing. Samuels and Dean (2008) have noted that mathematics undergraduate students often have weaker writing skills when compared to students studying other subjects. Thus, during the PhD programme students from mathematics, or similar, degrees are likely to require more help to develop their writing, and need more feedback on discursive pieces, than current students from other disciplines in order to bring their writing to the required level.

While there are few opportunities for undergraduate mathematics students in the UK to develop their writing skills it is likely that some students in this area will already write to a good standard due to the knowledge that they acquired in school or college. However, it is important to note that, there has been an increase in UK student numbers over recent decades in higher education and this has brought with it a marked increase in the diversity of the student body (Ketteridge and Shiach, 2009). Therefore, students that are currently being accepted by universities into mathematics PhD programs can have radically different prior experiences, educational backgrounds and learning styles. This diversification makes it difficult for universities to determine, in advance of the start of a PhD programme, the exact current writing ability of each of the students. Therefore, it would be prudent for universities to consider providing some extra centralized assistance that can be accessed during the students PhD time so that issues can be resolved to enable the student to successfully complete their studies. It should be noted that, while there is currently a need for extra support for those students in mathematics and related areas, support is likely to be needed in a broader range of subjects given that there is a growing movement in a number of subjects away from essays to other forms of assessments (Leedham, 2009).

In addition to the growth in diversity in the UK student population, there is also an increasing number of students from overseas (Ketteridge and Shiach, 2009) and it is now the case that many students that are being taken into PhD programmes in the UK do not have English as their first language. Such students, when studying in the UK will need to write their thesis in a non-native language. While there is a minimum entry requirement for the English ability of the students that are taken into PhD programs the proficiency will vary between students and some will find the task of writing a thesis more difficult than others, which further motivates universities to question if their graduate student support is adequate for the 21<sup>st</sup> century graduate student population.

While there is typically no centralized help within universities for students who need to develop their writing skills alongside conducting their graduate research, there are often informal methods by which current PhD students find help to develop their writing. For example, some students do receive help from friends and family members. However, for many students in mathematics departments it has frequently fallen to the student's supervisor to develop the students writing, in an ad hoc way, alongside developing the student's research.

## **Should the Development of a Student's Writing Ability be left solely to the PhD Advisor?**

A student working one-to-one with a supervisor can be a very powerful, individual, way to develop the student's writing. However, there can be problems with a system where this is the only place that a student can access support. At a basic level this system is heavily reliant on the supervisors themselves having an excellent standard of writing in that particular language, but this may not always be the case. This scenario, together with the types of problems that it can cause, was articulated by one of the students posting on a forum for PhD students at Nature Network (Nature Publishing Group, 2011). This student is a non-native English speaker and her supervisor, while a good researcher, also struggled with writing in English as it was not her native language. Hence, this student was struggling to develop her writing to the necessary level and was at a loss what to do.

Setting aside the supervisors own writing knowledge, there can still be problems with a system where there is only the supervisor to develop a student writing ability. Kamler & Thompson (2006) discuss the fact that some supervisors see students as either able to write or unable to write. Thus some supervisors do not think that writing is something that can be developed and is something that they are powerless to, or should not, do anything about.

Even when a supervisor does see that writing is something that can be improved there may still be problems with a system where the supervisor is the sole point that a student can look to for support (see, for example, Samuels and Dean, 2008). First, this will only give the student a very narrow view of writing in the supervisor's style. Second, just because a supervisor can see that it is possible to develop a student's writing ability, and wants to help a student, does not mean that they equipped with the knowledge of how best to do this for different students that they are supervising. They are first and foremost appointed as experts in their own subject area and, while some may be excellent writers themselves, this does not necessarily mean that they know how to help students who have writing issues that are very different to anything that they have personally encountered.

With the plethora of books on the market discussing writing problems and how to deal with the many issues that might occur (see, for example, books tailored to writing mathematical documents by Krantz, 1998 and Higham, 1998) it would be easy to conclude that any problem can be tackled easily by any supervisor so long as he or she can find a solution in the book and applies it to the student. However, in reality there are complicating factors and one of these is how a supervisor views his, or her, role and his or her own supervision style. This can lead to supervisors not considering the full range of options to help the student.

Lee (2007) discusses that there are many different types of supervisors by grouping them into different idealized supervision models for conceptual simplicity as *functional*, *enculturation*, *critical thinking*, *emancipation*, and *relationship development*. Whatever the style of the supervisor, it is possible for there to be issues with providing support to develop a student's writing. For example, the functional supervisor takes a role akin to a project manager and is very good for a student that needs deadlines and tasks to help improve their writing. However, a functional supervisor can struggle to have the type of relationship with the student where they can discuss the problems that they are having and so this type of supervisor may not fully uncover some of the underlying issues that the student is having and so the student's writing development may be slow.

In reality, few supervisors fit into each of the five idealized categories listed above. Even when supervisors have a principal supervision style they can develop and become more flexible over their career and it is generally important that a supervisor is one that is capable of adapting to different situations with ease (Wageningen 2011). However, such development takes time and is reliant on supervisors recognizing that development is necessary.

In summation, current systems that rely on supervisors as the sole source for assisting students with the written aspects of a PhD are not the most satisfactory approach. While it is undoubtedly good in most cases for the supervisors to play a role, the way that the supervisors view what supervision sessions are to be used for, as well as their role, can impact on the student's development.

### **Suggestions for the Future**

Clearly, the system is not completely broken because many students are obtaining their PhD each year in mathematics from universities across the UK. However, simple completion numbers do not show the whole picture. While a student who has difficulties can still complete their thesis at some point, in almost all cases, they will take far longer. This will place an additional financial burden on the students that may cause them to exit the programme without finishing their PhD. Indeed, students that do not have the necessary support may fail to complete their PhD even if there is not a financial issue. So, even though the system is not broken, it's possible that the graduate student experience can be improved.

As part of an examination and development of the support available for graduate students, the discussion above suggests that there should be an increased provision of support to assist students, particularly those in mathematics and related subjects, to develop their writing knowledge and skills. This provision should enhance the support that is already available in this area through the student's PhD advisor.

Given that current students are constantly using technology, it seems that an appropriate starting point to help students with their knowledge of writing is to provide some short modules on certain topics via Moodle (2013). The advantage of providing online modules via Moodle is that supervisors could then direct students to a learning tool at the point an issue presents itself. Students could access such a resource straight away and, if these modules involved self-testing, they would be able to get some instant feedback on their understanding. There are a variety of topics that could be packaged as an online module and these could include, for example:

- When to use *which* and when to use *that*.
- Punctuation in documents that include equations.
- When, and how, to use references.

There are undoubtedly a number of topics that are better suited to interactive workshops and so the online provision should be supplemented with one-day sessions throughout the academic year. These sessions could look at topics such as:

- How to begin to write a thesis.
- How to approach reducing a document that is too long for a specific word limit.

Through such interactive workshops students would not only learn about the specific topic but also form support networks that they may later call on to discuss writing issues. To take some of the responsibility from the PhD supervisor, some university departments do run limited writing workshops for PhD students (see for example, Samuels and Dean, 2008) but these are not generally offered across the UK and provision in this area is at a very early stage here at City University London. I feel that a full online and workshop programme at City University London, to enhance the writing skills of graduate students, would be a welcome addition to the support framework that we have in place for these students. However, for such a programme to be effective it would need to be clearly communicated to all PhD supervisors, as well as the student body.

In the longer term, in order better to prepare students for further study, Universities in the UK might re-examine how undergraduate degrees in some areas are assessed and consider increasing the number of discursive assignments. This would require moving part of the assessment of mathematics degrees away from calculation-based questions and require more creative assignment tasks, which still ensure that the learning objectives can be tested in a satisfactory way. Further, due to the fact that PhD students often move universities for their PhD, the shift in undergraduate assessment would require national, and international, coordination between universities to ensure that there is a common standard about the written component of an undergraduate degree, which seems unrealistic. Therefore, it seems better for universities instead to accept that students from mathematics degrees might need to develop their writing skills alongside undertaking new research and provide suitable support for this activity.

This article has highlighted a topic that I feel deserves further consideration and investigation. To determine fully the assistance that is needed by PhD students, a detailed study is required and a dialogue with current students in mathematics, and related areas, must form a part of such an investigation. I hope this project may be undertaken at City University London in the near future.

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