MOTIVATION: IS THE STUDENT EXPECTED TO HAVE IT OR SHOULD IT BE PROVIDED?

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This paper explores the responses of first year PhD students interviewed as part of a longitudinal research study on the Transition from an undergraduate to a postgraduate degree in Mathematics. One main issue that emerged from the data, among others, was the importance of motivation for the long term goal of writing an original thesis. The students' responses were analyzed using a grounded theory approach.

INTRODUCTION

There are several main differences between the structure of an undergraduate degree and that of a postgraduate degree by research in pure mathematics. As an undergraduate student, one attends lectures and has to write assignments and pass exams. There are always a number of students taking the same courses and so the student is part of a group with similar responsibilities, goals and anxieties. The members of this group are (or should be…) able to interact in a way that helps them overcome a large number of obstacles set throughout the duration of their studies. This fact provides encouragement and motivation to learn. When one becomes a postgraduate research student the scenery changes dramatically. Lecturers are replaced by supervisors. Understanding lectures and learning lecture notes is replaced by working on a specific research problem. The short-term goal of writing an assignment or passing an exam is substituted by the long-term goal of writing a successful PhD thesis. The student still belongs to a group of researchers, but they are now working on different research areas and are rarely able to help each other due to the speciality of their subjects.

Many research projects have examined explicitly students' different learning strategies. The focus has always been on how students learn in secondary education and as undergraduates. Very few projects were based on how students learn as postgraduates and even fewer on what motivates students to learn as postgraduate researchers.

The data discussed here is a part of a longitudinal study of the changes that occur as students move from undergraduate to graduate mathematics, beginning in the last year of undergraduate study and moving through to the completion of a PhD, which would normally take 3 to 5 years. Therefore, the research design studies overlapping

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cohorts of students, one beginning in the final year of undergraduate study, another beginning in the 1st year of research. The full data collected for the purpose of this research is still being analyzed, but certain issues have already emerged. This paper considers one of those issues, that of motivation. We focus here on interviews with six 1st year PhD students which took place in January-February 2003. All of them were from the Mathematics Institute of the University of Warwick and they had all completed successfully a four-year undergraduate degree in Pure Mathematics (MMath). One of the six students was at the time of the interview in the process of switching from a PhD to an MSc course. Interviewing that particular student offered another point of view about the issues in question and revealed some aspects which might have been concealed otherwise.

THEORETICAL BACKGROUND

Much research has been published on the transitional changes made by children going through primary and secondary education (Galton & Willcocks, 1983, Anderson, et.al., 2000) and even more on the transition from A-levels to University (Tall, 1991, Alcock & Simpson, 1999, Daskalogianni & Simpson, 2000). It is already known that the transition to University Mathematics causes serious problems for many students. However, there is strong evidence that the transition from undergraduate to postgraduate studies is also problematic. Especially the transition from a taught to a research degree involves significant changes in the way the students must deal with the subject. For that particular transition some research has also been done. For instance, Pole et al (1997) and Ford (1985) focused especially on this transition in the case of students in science, while Duffin and Simpson (2002) looked at the transition for Mathematics students with a particular focus on learning styles. However, apart from the above-mentioned research projects, not much research has been done on the changes of the students' learning strategies at that stage of their education. The main focus of this research is the way in which students deal with this transition and it is very interesting to look into how students with different learning styles react to it. While investigating these issues, something that seemed of great importance to the students is finding motivation to work.

Some questions arose,

> Does motivation come from the student (*internal*) or from other fellow students or the supervisor (*external*)?
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> Is motivation a factor for success or failure?

To address these questions it is worth looking at some existing theories, which deal with the importance of motivation.

Some students might not be able to find purpose in what they are doing. That rule applies to both undergraduate and postgraduate students. So, when a student talks about being motivated, he or she is seeking for the satisfaction of some need. Skemp describes motivation as "a description we apply to behavior which is directed towards

the satisfaction of some need. If we say that a certain piece of behavior seems motiveless to us, we mean that we do not know, and cannot even guess, what need is satisfied by means of it. So questions about motives are usually, in disguise, questions about needs" (Skemp, 1971, p.132). This is very much related to most 1st year PhD students, who are not yet in a position to see the purpose of all the reading that are being asked to do during their 1st year.

The need for undergraduates to submit assignments or pass examinations is a big incentive to motivate them to work at their studies. As Skemp (1971) claims, "if those who do not understand feel over-anxious at their failure, they will no doubt make greater efforts to comprehend" (p.125). However, this could lead the students to the other extreme. "The more anxious the student becomes, the harder he tries, but the worse he is able to understand; and so, the more anxious he becomes. […] In other words, for a simple task, the stronger the motivation the better the performance. But for a more complex task this is only so up to a point" (ibid., pp.125-126)

One would expect that students willing to start a PhD would be willing to read mathematics and gain some satisfaction from it. "there are some people for whom mathematics is a pleasurable and worthwhile activity in itself, regardless of any other goals which it may also serve" (ibid., p. 133). However, for some postgraduates the situation is different. They don't have specific deadlines and set their own goals. In the short term, the consequences of not meeting any general deadlines are minimal, but in the long term they can be catastrophic. This is why the student still needs to be motivated. "Starting from zero motivation, which presumably produces zero performance, increasing the motivation improves the performance" (ibid., p. 126).

The supervisor is the person who is designated to work hand in hand with the student during his effort to obtain a PhD. Therefore (s)he is in a position to influence the student the most. The supervisor has traveled along the path of research that the student has yet to encounter and can help organize long term goals that will assist the student on the journey. This can involve not only introducing them to the subject matter but also helping them to build up confidence and consequently provide them with motivation.

When a student begins his/her PhD, the main goal is a long term one: to write a good thesis. As Skemp (1971) comments, "The rewards of doing something one enjoys are immediate, and conducive to prolonging the activity itself; whereas the more distant the goal, the greater the imaginative span required to relate present activities to it, the slower the apparent progress, in relation to the whole distance to be traversed, and, in general, the weaker the motivation" (p.134). From this viewpoint, the supervisor may help motivate the student by seeing the long term development as a series of smaller steps, one leading to the next but with the vital ingredient that success at an immediate task can increase motivation and encourage the student to build to the completion of the long term goal. In this way, the supervisor may play a vital role not only in the understanding of the subject matter but in building and maintaining confidence over the three years of study.

RESEARCH METHOD

The method used for this study is grounded theory. Since there was little existing work on this area, it was considered as best to search for a theory grounded on the data (Strauss and Corbin, 1998). To obtain an overall picture of the development from the final year of undergraduate study to the hoped-for completion of the PhD, two overlapping cohorts of students were interviewed in successive years, as indicated earlier in the introduction to this paper. The longitudinal approach was chosen because it seemed to be the best way to observe changes with time in the students' attitudes towards learning.

The interviews consisted of open-ended questions and gave the researcher the ability to clarify issues not very well covered by the students. All of the interviews were taken in January-February 2003, in the hope of students having already settled down and started working on their PhD projects. Then the interviews were fully transcribed and analyzed. The general question of "How is your PhD going so far?" was asked and most of the data discussed in this paper is based on and guided by the students' responses. The style used was the "conversational technique" by Burgess (1985). The purpose of this technique is to avoid leading questions such as "are you motivated by your supervisor?" and to seek amplification of the students' responses to allow the conversation to follow the students' thought processes. As the student spoke about his or her experiences, the interviewer took note of the student's words to formulate questions to encourage further clarification. In such conversations potentially many topics can arise, but certain themes came to the fore in many interviews and major theme was the issue of motivation.

STUDENTS' MOTIVATION

Motivation can be characterized as *internal* or *external*. Internal motivation is the one provided by the student, for example motivation due to a desire to succeed or motivation due to fear of failure, whereas external motivation is the one provided by external factors, like other students or the supervisor. Furthermore, one can define the levels of motivation as weak or strong.

Importance of motivation

It is important for any person in any position, to be able to motivate themselves in achieving their goals. In the case of a PhD student, one must keep oneself motivated to study hard. The following is an example of a student who dropped out of his studies for a PhD. The reason he gave was lack of motivation.

> Michael: After a while I just realized that I am not sure what I want to do yet… another three years… I am not sure I was really driven in what I was doing. […] I think it's just that I am really not cut out for it. I think that my levels of motivation are probably not high enough to do it…

Another indication of the importance of motivation, especially for somebody who is studying for a PhD in pure mathematics, is the nature of the area itself. Research in other subjects may lead to a satisfactory thesis even if the results are not enough to

prove the researchers assumption. In mathematics there exists an issue of uncertainty, which can lead to anxiety. What happens if the results one is hoping for cannot be reached?

> David: It's still very early… I don't know much about the area I'm supposed to research and this stresses me out. What if I cannot prove the things I'm supposed to? I could end up with nothing…

Internal motivation

It is a general belief that in the 1st year as a PhD student, one focuses on reading, in order to cover the basic principles of one's research area. Many students were able to realize that in order to move on and do any serious work for their PhD, they need to make sure they know all the mathematical background. For them, internal motivation is strong. For instance,

> Simon: I found it difficult… and then it made me understand how much more I needed to learn… I realized that I need to understand quite a lot ….
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> James: It becomes apparent that I need to learn some topics…and so I started looking at some of the graduate texts, going through them, trying to learn the machinery behind all that's used in this area. […] Trying to fill in all the gaps between the undergraduate courses.

In those cases, the students are able to motivate themselves to study in order to fill in any blanks from their undergraduate degree. This helps them overcome their weaknesses and understand their topics much better. That is when understanding and the satisfaction from viewing the PhD as a personal achievement becomes another mean for internal motivation.

> James: It was ok because I started to understand it and I was enjoying it ….
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> Adrian: I think that it's really good when you start to understand something that you didn't understand before. Now I'm really looking forward to actually getting on to doing my own research.
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> Simon: It's good fun. I guess the first couple of months I kind of tried to get the ball rolling. It's kind of stressful. You try to figure out how much you're meant to do and what exactly you're meant to do, but once you got started…Now I kind of know where I'm heading. I know what I'm going to be doing, so that's good.

The importance of internal motivation is undeniable. All six students understand that. For instance, Simon stated:

> Simon: Because you have to find where you are going… You have to find the right books… You have to find motivation… You don't have anyone to push you to do it… and I am sure it will be a good experience… I will be stronger in the way that I work… […] So, it's a personal achievement.

This is why one of the students especially, likes to rely on his own powers.

> Adrian: The problem here is that you are pretty much on your own. You have got to decide when you need help from your supervisor. It's not really up to your supervisor, it's up to yourself to go and do it.

External motivation

However, many students really struggle to find reasons of their own to do some work. Their internal motivation is weak. This is where external motivation plays a crucial role. The students rely on various external factors in order to continue working.

Sometimes motivation (or inspiration) comes from the work of other researchers.

> James: You read through things that would otherwise look quite boring. I mean, why should I learn about characteristic classes […]? Well, if you've seen some mathematicians recently doing some interesting calculations using them, then that's a good motivation.

For Simon, funding is absolutely necessary in order for him to continue his studies. However, in order to continue receiving that funding one has to work hard and produce results in one's research. This becomes in time quite an important factor for external motivation.

> Simon: If you want to succeed, when you want to get a scholarship in Warwick… you need to do a lot of work…

The students that were interviewed in this part of the research were at that time 1st year PhD students. This means that they had completed their undergraduate degree quite recently. It is apparent from the interviews that their great majority was used to learning in a certain way and for specific reasons. The most important of those reasons was passing the exams. Even if the students were not internally motivated to learn, they were motivated externally by the need to avoid failing their exams. It is implied by the students, that lack of obligation can cause lack of motivation. This is why in several cases the need for external motivation is apparent. For instance:

> Peter: You don't have lectures and exams. You don't have this support… […] That's why I believe they should do something to push you even further. […] At first when you are doing a PhD they should keep on giving you things to read.

The main source of external motivation is the supervisor. James and David have noticed that.

> James: It's against the way I've been trying to learn. If I haven't got any motivation I try and get it from my supervisor.
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> David: I don't like to learn things without a good reason. So I try to get a reason. some big area where there are lots of open questions and know some of them and think…right, I want to get to the stage where I can sort of approach some of these open questions, so I have to get that from my supervisor or from looking at papers he's recommended.

The supervisor can help the students gain motivation in more than one ways. The following student was asked by his supervisor to give a presentation.

> Peter: There's one paper in particular that I've been given to read…I've been asked to do some presentations on it. So I have to understand it really and deep.

However, it is apparent from many of the interviews that the best way for the supervisor to motivate the students to learn is by giving them more specific tasks. Although reading takes up a very big part of the first year as a PhD student, this can

sometimes become tiresome and seem pointless. It was satisfying, according to three students, to work on a specific calculation, to produce a solution to a problem and not just read all the time. It actually helped them apply all the material they have been reading and see the outcome of their efforts. Giving them a small and not especially demanding problem to solve at the beginning has proven vital for their motivation. It is expected from a student to encourage oneself through personal achievement and excitement.

> James: We haven't quite finished the calculations, but it's kind of a motivating calculation.
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> Adrian: What have I actually learned? Where am I going? What am I doing? … So actually getting settled on doing something, on doing some particular problem is good. That kind of settles things down. You see what's going on.
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> David: I like working on specific problems instead of reading paper after paper.

CONCLUSION

The general impression that one has, keeping in mind the students' responses, is that although some of them are able to keep themselves motivated, there are a number of students who struggle to find reasons to work. Those students who possess internal motivation seem to face fewer problems in maintaining their drive to complete their goals, whereas those with weaker internal motivation are sometimes in desperate need of some kind of external motivation in order to keep working. However, even if the student receives the external motivation that is required, there is no guarantee of success. It will be of interest in the longer study to see whether internal motivation does indeed lead to a successful completion. In the data discussed in this paper, some ways of external motivation seem to have a stronger effect than others.

The method that seems to have the biggest possibility for success is to give the student smaller tasks, for example feasible calculations or smaller problems that they can work on. This is in contrast to reading "endless" amounts of literature on a specific topic, which in many cases can become tiresome and seem pointless. Short-term targets have the potential to keep students' minds away from the sometimes overwhelming goal of "getting a PhD". If these problems can be solved by the student—and for long-term success, the ability to solve suitable problems on the way can provide steps in the right direction— then with a little help from the supervisor, personal confidence may grow and the student's interest in the work is more likely to be maintained.

The data showcased in this paper provides an important insight of the students' attitudes towards their studies for a PhD. Nevertheless, the full data has now been collected, covering the whole range of development from undergraduate through postgraduate study, including interviews with more students and follow-up interviews with the same students at a later stage of their research. The process of making further comparisons during the long-term development will soon begin.

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