



## ‘This is Not Something You Solve in Week One of Third Year’: Applying a Transitions Perspective to Honours Learning and Teaching in an Undergraduate Degree Programme

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### ABSTRACT

Transitions as a concept is gaining increasing traction in both academic development and student experience enhancement, but little has been written about how it can be used to design research studies into learning and teaching. This paper demonstrates how a transitional perspective has been used to inform an exploratory study of the move from second to third year in an undergraduate maths degree at a large Scottish university. This perspective takes the staff and student experience into account and looks at third year not in isolation, but as part of an entire programme. In doing so, this study is able to offer a deeper understanding of this transition in mathematics which generates questions about the nature of the undergraduate learning and teaching environment for practitioners both within and beyond the discipline.

**Keywords:** transitions; undergraduate; mathematics; holistic; Honours

### Introduction

This qualitative study was designed to investigate third year learning and teaching experiences in a mathematics degree in a large Scottish university. First and second year form the pre-Honours element of this programme with years 3 & 4 (and an optional fifth) constituting Honours. The concept of transitions informed the research design as it “offers practitioners an additional lens through which learning and teaching theory and practice can be evaluated; it also provides a conceptual framework that maps the learning journeys of both individuals and institutions” (Shovlin, 2016). The application of the concept of transitions in this study generated a holistic understanding of the third year experience incorporating not only the knowledge and subject specific abilities required, but also the mindset, attitudes and approaches that correlate with a positive student experience. Although third year is the main focus of the research, the application of the lens of transitions to a particular stage of an educational programme, affords much more than an examination of this one stage alone. A transitions based study also offers a valuable programme-level perspective by exploring to what extent previous elements of the programme relate to and prepare students for the learning stage in question. Lastly, but no less importantly, transitions based studies such as this one require that student *and* staff perspectives are taken into account in order to discuss the assumptions and realities of both.

### Study design and analysis

Ten semi-structured interviews were carried out in September 2016 in the School of Mathematics. The interviewees were five students about to start their fourth year and five staff members who teach on third year core courses. Each interview lasted on average 50 minutes and informed consent was obtained through email and again at the beginning of each interview. The students were a mix of male and female and the group included both UK and international students. It is noted that no mature students or widening participation students are included in the present sample, but it is hoped to include these groups in a second iteration of this research. The researchers note that the study concerns only learning and teaching of pure mathematics courses as these are the compulsory courses in the third year of the degree programme. Investigating the issues around transitions in applied mathematics courses would be an interesting area for further research. Participation in the study was on a voluntary basis and staff and students were recruited through an initial email. Each interview was conducted by two researchers and was digitally recorded, transcribed and coded with Nvivo software. As the study was exploratory and dialogic in nature, it was grounded in a phenomenological methodology (Smith, 2008) which allowed the focus to be on the individual’s own interpretation of their experience. The interview format was semi-structured to offer participants the space in which to share and explore these interpretations. Each researcher firstly categorised the data independently before finalising second analysis nodes together. The findings from students and staff are presented separately under thematic headings and pseudonyms have been used throughout.

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Student Interviews

*'How was third year for you?'*

The researchers opened each interview by asking students how third year had been for them. The majority of this group (4 out of 5 interviewees) described third year as 'difficult' with some students using the words 'shock', 'absolute hell' and 'nightmare':

*It was intense . . . it was a big adjustment.* (Nina)

*Third year is the hardest year, it's a nightmare!* (Robbie)

*I thought honestly . . . it was hell, like absolute hell. And I really enjoyed the first and second year, so it was quite a shock to me.* (Steph)

However, in contrast, one student in the group found third year to be a very positive experience. Adam told researchers, "for me third year was, in terms of academics was the best year so far". Adam went on to explain that third year being his best year resulted from him having:

*...made the biggest improvement in terms of efficiency of working and also the number of hours I'd spend studying. . . I paid more attention to my studies and allocated way more time to study.*

*Difficult, how?*

Students used 'difficult' to describe a variety of issues which mainly related to workload and content. However, it is important to emphasise that difficulty is a subjective phenomenon that each student experiences differently. Students often attributed this difficulty to the 'newness' of third year material as Catherine illustrates:

*At school you sort of knew a little bit about calculus and linear algebra whereas you come into third year and it just feels like something a bit more new and you're building up on university stuff not just school stuff anymore . . . and so the material itself was quite difficult for me personally.*

Students also qualified what difficulty in terms of content meant by talking about the gap they experienced between what they were being expected to do and their self-perceived ability to do so, as Robbie describes:

*I just couldn't get my head around what this abstraction thing was. I would sit and learn maybe about a cyclic group and then they'd ask me about a completely different group in the exam and then when I looked at the answers it just said 'abstract to cyclic group, do this' and it was like, you look at it and you'd think how am I meant to make that connection?*

Students also used the word 'difficult' to describe their experience of not being able to see a proportionate return of their effort in their performance and/or understanding:

*And when I was revising it I felt like I was getting it. But then I really struggled to apply it to any question and I've never revised that much in my life, and it clearly still didn't feel like enough . . .* (Steph)

When the word difficult was used with reference to workload, the majority of students were expressing how they found it difficult to adjust to having to spend longer on course work due to it now being at a higher level.

Interviewer: *When you say it was a little bit more difficult for you, difficult can mean different things for different students, so what was this difficulty, how did that feel for you?*

*Just in terms of workload, I was required to put a lot more into it and it was more difficult to get my head around things than it was coming from school into first and second year.* (Catherine)

All students also commented on the overall structure of third year which they described as being 'uneven' in terms of workload distribution between semester one and two. Students told researchers how "all of the deadlines bundle up into that really short period at the end", which, as Robbie explained, resulted in him "stumbling to try and get everything done".

In particular, students reported finding the uneven spread of exams to be one of the most difficult parts of the third year workload, "because six exams, in the space of three weeks was just like...crippling" (Nina).

*The difference between first and second year and third year*

All students in the study, even Adam who found third year to be his "best year so far", stated that going from second year to third year was a bigger adjustment than the transition from school to university. As students explained, this may often be because they had "seen a lot of the content in first year before, in A Level" (Nina). Whereas in third year, "it seems to have just been new instantly and I'd definitely noticed that I wasn't following the lecturer's train of thought as well as I had done in first year" (Nina).

The essence of what all students in the study said about the difference between first and second year and Honours is encapsulated in the following explanation from Robbie:

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*in the second year a lot of what you could do is just study at the last minute, pick up the notes and learn. Whereas in third year you've reached the stage where it's like 'Oh, I can't do that anymore!' it isn't just a case of reading the notes and turning up on the day. . . So, I think third year required a lot more understanding of the material rather than just being able to learn it by rote almost . . . and now I have to sit and think through the material and almost be able to teach myself in it. I don't really know how to describe it to be honest.*

However, it is important to point out that the difficulty and 'step up' that third year presents were both elements that students were expecting. All students informed researchers that staff had told them how much harder third year was going to be. Adam described having been "warned" about the difficulty of third year and felt that these messages might "scare" some students. Catherine commented on how she was also aware of the "jump" that she was about to experience:

*It's just always going to be a little bit of a jump wherever you put it but I think as a student you know that it's going to occur in third year because you know it counts that these are the Honours courses, so it's actually just getting yourself in gear to prepare yourself for that jump.*

Therefore, this demonstrates that students' cognisance of the fact that something is going to change in the future should not be understood as an indication of students being prepared for this change. In this instance, telling students about the 'step up' does not equate to 'Honours-ready' students complete with the pre-requisite knowledge and "meaning orientation" approaches to study (Nieminen, Lindblom-Ylänne, & Lonka, 2004) that third and fourth year demand.

### Reflection

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All of the students in the group were able to identify and reflect on behaviours, attitudes and approaches that may have contributed to the experience of 'difficulty' they reported. Catherine used the word 'difficult' to describe a situation in which the level of work she had done previously no longer brought her the desired results:

*So in third year going from doing sort of the minimal to get an okay grade to bumping up to try and get a 2:1 was quite difficult to do. . . And in some cases I think I left it a little bit too late but I did also try my best throughout the year so it was quite a difficult one for me.*

As previously mentioned, Robbie had indicated that he had "learned by rote" in first and second year. Robbie's description of his former approach to studying corresponds with many aspects of Nieminen et. al's (2004) "reproducing orientation" study profile which is characterised by a surface approach to study and a conception of learning as the intake rather than the construction of knowledge (p. 392).

Robbie began his Honours years with his second year study approach which left the "thinking to the end". This resulted in a situation in which, "come exam leave I was just spending twelve to sixteen hour days just sat in the maths lab desperately reading through and thinking I don't know any of this". Looking back, he identified this approach as having resulted in "what I think was one of my worst marks this year because I sat down in the exam and I completely panicked". This panic led him to adopt a deeper approach to his third year studies and he expressed a wish to have engaged in this behaviour earlier in his degree. However, Robbie admitted that the only thing that would have led him to have worked harder throughout third year is if "second year had completely shocked" him "like third year did". He went on to explain:

*At the end of the day that's what I needed, I just needed something to turn round and show me that I can't just blag everything at the last minute.*

### Advice from students

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The theme of doing more work earlier in the year and adopting more effective study habits continued into the advice that interviewees wanted to pass on to new third year students. Keeping up with first semester courses was a point that was stressed by all students in the group:

*Expect to put in more hours and . . . just make sure that you sort of are going over a little bit of the old material maybe even in the holidays or something and use the time wisely. (Catherine)*

In addition to time-management, the majority of students in the interview group (4 out of 5) also talked about the importance of mindsets and confidence. Confidence was often mentioned in connection with learning how to keep going when faced with a level of mathematics that was initially incomprehensible:

*Emmm, as far as attitude is concerned, it's the whole, if you're going through hell, keep going thing. (Nina)*

*I think the biggest thing for me is just having confidence that you can do it because if you don't think you can and you're sort of knocked by past experiences like bad exam results in the past, I just think that affects you massively if you do have that mindset. (Catherine)*

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*Yes. I guess the thing is the attitude should be willingness to learn . . . now, at the beginning I cannot understand very well but then I was willing to learn more and I paid more attention to the course. So a willingness to learn and not be afraid about things being difficult. (Adam)*

### Staff Interviews

#### Teaching third year: the staff experience

When explaining the rationale of the research study to staff, the researchers began by introducing the commonly agreed conceptualisation of transitions to Honours as 'a step up' (McCune & Hounsell, 2005). The researchers wanted to know if and how this 'step up' translated to the study of mathematics. The term 'step up' resonated with all staff in the interview group as exemplified by Edward's comments:

*I think a step up is certainly true, in maths we do experience this phenomenon that you described, that it is a step from second to third year.*

Staff saw the increased difficulty in work level as part of this step up with all staff referring to a 'higher level of abstraction' and an increased expectation to work more independently with abstract concepts. As with students, 'demanding' was also used by staff to describe both level and workload, as exemplified by Stefan:

Interviewer: *Demanding in terms of?*

*The level is higher, the amount of work they have to do especially on their own . . . they have to learn quite a bit from the notes themselves. . . I don't go through every single proof or every single statement detailed in my lectures.*

All staff were also of the opinion that there were issues with current pre-Honours to Honours transitions across the Scottish HE sector. Staff felt unable to define the precise nature or cause of these issues, suggesting instead that they were likely to result from an interaction of multiple factors:

*...since I've been lecturing this course and I think that all of us feel the same way, something is happening . . . I don't know what it is . . . maybe it's the first year that the students actually need something from what they learned in the past, I don't know, but between second and third year our students have not assimilated the main concepts of second year, and so as a lecturer of that year, my experience is that I cannot trust, I cannot assume anything. (Edward)*

Stefan related the same phenomenon, "I don't know what can be done about it, but definitely there is something missing in pre-Honours years that I think students need". Stefan went on to explain how this issue presented lecturers with a dilemma of whether to, "spend time at the beginning to do very basic things", but "that takes time away from the course". Discussing the same issue, Edward explained that at the beginning of his courses "there are certain things that I have to revisit [with the students] but I don't know how much I should revisit and how much not". Whilst revising material in this way took valuable time away from the course, he thought that if he didn't students might think that "Edward is talking about something that I have never seen before and I didn't understand it, he's has not even bothered presenting this. Of course, my own perspective is very different as I know the students have seen this material in the past, so we have a problem".

Staff also explained how this issue directly impacted upon their teaching practice throughout the course, not only at the beginning:

*when you want to solve a problem in any course then you need to be able to differentiate, you need to be able to manipulate expressions. And it makes no sense to try to teach them something at that level, if the things that should be automatic by that time somehow are not. If you have to pay attention to this stuff at this level, you cannot at the same time pay attention to the stuff at that level. (Stefan)*

Apart from the notion that something might be 'missing' in second year, attendance and engagement were also discussed by staff in relation to third year transitions issues. Staff explained that there is a general expectation that attendance is likely to "tail off" but that this trend was beginning to increase:

*I personally felt that the attendance dropped too quickly this year, and it got really very alarming in the last week. Eventually I lose population in my courses, but I felt that this time it happened too quickly. (Stefan)*

Christina shared how this drop in attendance affected her on an individual level saying that this was somehow "sad for the lecturer". Similarly, Edward also shared how non-attendance felt, recounting to researchers that students had told him "I am not attending your lectures, because attending your lectures will not guarantee that I will improve my mark in the exam . . . it's not a nice comment to receive".

## What students need

Staff were asked which skills and attributes were pre-requisite for successful Honours level study and three clear themes emerged from these discussions:

- i) engagement and motivation
- ii) mathematical fluency
- iii) mathematical 'gumption'

### i) Engagement and motivation

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Engagement and motivation were deemed as essential student attributes by all staff:

*I would say that motivation is very important. Sometimes, even though I've been here for long enough, it still manages to surprise me how, for my standards, whatever that means, how low the level of motivation the students in third year have.* (Stefan)

Engagement for staff meant not only attending lectures but being motivated enough to "keep up" with the work:

*I would like students who are interested in the subject. Who attend lectures, who keep up with the work, and who really try to follow the course continuously.* (Stefan)

Andrew also emphasised the importance of continuous learning, relating that he always advised students to "do the reading as the lecture on the Thursday will depend on you having done the reading on Monday or Tuesday or Wednesday. So if you haven't done the reading then the lecture on Thursday will be a complete waste of time for you".

Despite the existence of a tail of non-engagement, staff were keen to point out that this did not describe all students:

*...the students that do engage, by and large, seem to engage either very, very, well or at least quite well, so I'm really very pleased with that. So the 75% of students who do engage and pass their course and generally pass it with pretty good scores.* (Andrew)

### ii) Mathematical agility/fluency

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Mathematical fluency was seen by all staff in the study as a pre-requisite for Honours level success as Stefan explained:

*...students should make sure that they master year two in the very least and they should be able to feel fluency with doing calculations. If you are struggling with calculations in year two, year three is going to be very, very difficult.*

Similarly, Andrew also explained that students coming into his third year course "needed to be familiar with particular concepts and be able to work with them without having to look up the definition each time". In this way, he would "like to see a greater degree of internalisation of the basic concepts from previous courses".

Stefan highlighted that it was essential that students got enough practice in solving problems as it was precisely this practice that fostered "this sort of agility". Stefan suggested that if students had this level of practice in years one and two then it would help them to "concentrate on the things you are supposed to be learning at that level in third year".

He also described how an increase in students' levels of mathematical fluency might affect his teaching practice as "if students knew the basis stuff well you could focus in on more interesting things".

### iii) Mathematical gumption

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'Mathematical gumption' is a term that Douglas used to capture the particular mindset or approach to learning that the discipline requires. He explained that:

*...a version of mathematical gumption will mean knowing that if you read something you might not understand it the first time you read it. It might be incomprehensible, but having the braveness which has come from experience, knowing that you'll get there.*

An integral part of mathematical gumption, and something that the School presently focuses on its first year induction is understanding that it "is ok not to understand initially". The second element of this mathematical gumption is "being able to analyse your own argument" which is something that the School's first year course on proofs and problem solving encourages students to do. Douglas explained that this course had been designed to introduce first year students to elements of challenge, abstraction and the "struggle" that was an inherent part of the discipline. Students had already provided staff with positive feedback on this course e.g. "Well, this course is really hard and I loved it!".

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Similarly, Andrew also talked of the satisfaction that students derive when they see they can:

*...rise to a challenge. They might have had a lot of doubts whether they can in the first place at the beginning of the course, but by the end of the course they realise they can, and so it's a great feeling of self-satisfaction for the students. More than anything else it's about grappling with the concepts.*

### What would work?

#### A third year induction

An induction for new third year students is one of the possible interventions that could enhance the Honours learning and teaching experience for both students and staff. Researchers wanted to find out staff's opinion on the efficacy of such an intervention and for staff to share their own ideas of what would work.

The researchers explained to staff that one of the purposes that a third year induction could fulfil would be to remind students of course material that they might have forgotten, but would need in third year. The aim of this type of induction would be not to 'deliver' this content but to highlight to students the need for a greater degree of involvement in the management of their own learning. On the whole, staff thought that this type of intervention may be worth piloting as it could "give students an indication of 'Oh my God, I have forgotten what a matrix is'" (Edward).

Another possible element to include in a third year induction is input and advice from former third year students. This style of peer led induction features in student transitions literature as good practice and is already widely used across the sector. Staff in the study could see the benefit of this style of induction as students are more likely to act on the guidance of peers than staff as Stefan explained:

*...of course, they believe the students more than they believe me . . . this thing of having students who have already done three years to tell people coming into year three what to expect . . . the 'don't make the same mistakes that I made', this kind of thing would definitely be useful.*

Although staff supported the idea of a third year induction, they cautioned against it being seen as a panacea. Whilst staff agreed that a third year induction could help to make students more aware of the behaviours and attitudes that correlate with a successful Honours experience, as Stefan explained, it was felt that "this is not something you solve in week one of third year". Specifically, for mathematicians, developing skill in working with abstract concepts is critical to success at Honours and as Christina explained:

*I think that developing this kind of thinking and this kind of ability to work with abstract definitions is something that takes a very long time to develop. And I think having one week before year three is not going to help with that so much.*

Instead, Christina and the rest of the staff interviewed, felt that the optimal solution would be to continue to gradually increase the amount of abstraction in years one and two:

*I think having students work more with a little bit more of the abstract stuff in the earlier classes for a little bit and then you know, they get used to sort of working this way over a time period . . . I just think it takes a long time to develop and it's not something you can quickly do.*

All staff shared Christina's opinion that transitions to Honours would be enhanced if the introduction of abstraction and challenge into first and second year be continued and increased. Christina explained that this "sudden change in expectations from year two to three is a hard step and it may come a bit too late".

Douglas echoed Christina's sentiments pointing out that "if the degree was organised differently we could present this material in year two and get them started on it earlier". Andrew supported Douglas' opinion on degree organisation explaining that the current modular system doesn't allow students to build connections between courses, commenting that "education these days is broken into so many small pieces that it is very difficult to leave things to develop".

### Discussion

This transitions study, focusing on the move to Honours in an undergraduate maths degree is a reminder of the heterogeneous nature of the student experience. Third year experiences in this study ranged from, "the best year ever, in terms of academics" to "absolute hell". However, the majority of students who participated in this research associated third year with some degree of 'difficulty' and the transition was described as a 'step up' by both students and staff. It is important to emphasise that this 'step up', in this instance, must not be understood as deriving from a 'gap' between first and second year content and third year course work. Instead, in support of findings from McCune & Hounsells' (2005) previous study into year three bioscience students' "ways of thinking and practicing", the jump that students describe appears to be derived from the required shift from first and second year study habits to Honours level learning approaches. The latter demands both a deeper and more active approach to learning complete with effective study techniques such as self-testing and distributed practice (Dunlosky, 2013; Entwistle, 2009). Therefore, whilst this

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'step up' cannot be neatly attributed to a content gap, a gap may still occur if new third year students lack experience in the deeper approaches to study that correlate with achievement and positive learning experiences (Hermann, Bager-Elsborg, & McCune, 2016)

As staff, we may expect, and thereby assume, that students automatically study in the deeper way that third year demands, but this study suggests that this assumption is unsafe to make. Previous to third year, students in the study described "doing the minimum" in years one and two still being enough to "get a 2.1" (Steph) and how it was possible to "learn by rote" and almost "leave the thinking to the end" (Robbie). This paper suggests that the negative third year experiences that many students described may be largely attributable to their continued application of first and second year study habits to a learning environment in which they are no longer valid. If students view Honours as the only years that 'count' and have encountered success with their approaches to study in first and second year then they are unlikely to have seen the need to use these years to develop the 'meaning orientation' (Nieminen et al., 2004) that Honours level study requires. Students in the study told researchers that they had eventually developed effective approaches to Honours level study, but this was almost always in response to a negative experience e.g. the 'meltdown' that Catherine described.

It should be noted that there are already innovative teaching practices in years one and two of this programme, in particular, year one courses are taught using a flipped classroom and peer instruction model, and all courses in years one and two are examined via open-book exams. Despite this, it appears that years one and two of this programme are not yet offering students sufficient opportunities to both understand and practice the deeper levels of learning and engagement that Honours level study demands.

How this can be done more effectively would appear to be a pertinent question to be also asked in other programmes and disciplines as it is inline with Biggs' (Biggs, 1996; Biggs, 2003) 'constructive alignment' of the curriculum which calls for programme design that has the development of 'high quality learning' at its core. It may be as Andrew suggests that by leaving the introduction of these elements until Honours years, "we are doing our students a disservice".

### Biographies

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