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TACKLING THE CRISIS IN PHD SUPERVISION THROUGH GROUP ACTIVE-LEARNING

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Introduction

In recent decades the issue of how best to supervise postgraduate research students has become more topical (McCallin & Nayar, 2012) as awareness has grown regarding the importance of good mentoring for student success (Barres, 2013). Yet there remain issues around completion rates and timeliness (Taylor & Beasley, 2005), as well as concerns about good students becoming demotivated and leaving the university after a bad PhD experience (Barres, 2013). Much research on postgraduate student supervision has focused on direct supervision, also referred to as a traditional one-to-one model, (e.g. Gill & Bernard 2008; Ives and Rowley, 2005; Pearson & Brew, 2002; Price & Money, 2002) and student and institutional factors (Manathunga, 2005). However, increasingly, the role of the Group Supervision Model (McCallin & Nayar, 2012), also referred to as Collective Academic Supervision (Nordentoft, Thomsen, & Wichmann-Hansen, 2013) has been identified as having potential within the academy, where staff time is being continually squeezed and staff to student ratios are constantly being expanded (McCallin & Nayar, 2012).

The classic narrative of a PhD is that of 'an isolated and lonely process' (Gill & Medd, 2013) and it has been argued that the Group Supervision Model offers additional social and emotional support to students (Parker, 2009), although other researchers have identified opposite effects (Nordentoft, Thomsen, & Wichmann-Hansen, 2013). The Group Supervision Model has been shown to work well within a PhD program, which aims to develop speculative, critical intelligence and expansion of the knowledge base, where patron roles can be taken on by other members of the research group (Buttery & Ruchter, 2005). However,

there can be problems in sustaining such a 'community of learning' within a doctoral program (Parker, 2009).

In recent years the role of research-skills teaching has been recognised as a sophisticated and important facet in the successful supervisor's tool box (Grant, 2010; Walker 2010). The benefits of teaching research skills through collaborative research projects and 'active learning' (learning that engages students in the learning process by doing meaningful activities and thinking about what they are doing, Prince, 2004) are widely recognised in undergraduate education (e.g. Lopatto, 2007), but there has been less focus on the benefits for postgraduate research students. The importance of peer-teaching is also recognised in a number of disciplinary areas (e.g. Boud, 2001; Boud & Middleton, 2003, Dawson, 1994) and Deakin, Wakefield and Gregorius (2012) highlight its potential for providing postgraduates with the skills they need to complete a PhD. This paper reflects on the experience of a cohort of postgraduate ecology students who took part in a group supervision process, in addition to the traditional supervision (one-to-one) model. We critique the experience as a supervisory approach and in terms of scholarly development of group supervision.

The Participants

This project was based within the Plant and Soil Ecology research group at Lancaster University. In addition to skills-development, the project aimed to create a supportive and interactive peer group by strengthening and extending the traditional 'lab group[1]' model. The project was initiated by the research group leader, Dr. Carly Stevens, after she recognised gaps in existing PhD supervision and training provision and an opportunity to enhance skills levels and cooperation across the group. All members of the research group were given the chance to join the project if they wanted to. Thirteen people participated in the exercise: one academic, one postdoctoral researcher, one laboratory manager, one voluntary laboratory assistant, eight PhD students and one MSc by research student. Students were not placed under pressure to join the project and several students opted not to because they felt it was not a priority at the stage they were at in their PhDs. Two PhD students opted not to participate. The PhD students involved in the project were at different stages of their doctoral degree.

Approach to Skills Training

The approach was designed to provide training for the whole group and to provide a peer-to-peer learning environment where mistakes could be made without adverse implications for individual research projects. During a natural science PhD there are many practical skills which need to be learned in order for the student to complete their project. These skills are also important post-PhD in applications for positions in academic or research institutions or for jobs in industry. However, learning curves for gaining these practical skills can be steep

[1] Laboratory or 'lab' groups exist within many of the natural science disciplines and are formed of faculty (or research principal investigators), early career researchers and other non-tenured staff researchers, technicians and research students who all share research/disciplinary interests, equipment and methodologies (although, not necessarily lab space). They may also formalise as journal clubs or working groups.

and it has been noted that many students currently entering postgraduate study have less practical experience than in previous decades (Smith, 2010). We decided that the investigation should be independent of everyone's PhD project and of any externally funded projects being conducted in the laboratory to avoid unequal benefits. The research group leader's role was redefined within this project as a facilitator (after Fenge, 2012) in an effort to create a mutual learning environment (Cox, 2005): "I enjoyed taking the role of facilitator and allowing group members to take the lead on the project. It was not too different from normal PhD supervision where I would hope students would take ownership of their projects."

The Project Phases

Phase 1 – Setting hypotheses and planning

The investigation was initiated with a workshop to enable all participants to devise a hypothesis to test and an associated experimental design. Twelve of the thirteen project participants were available on the day of the workshop. The 12 workshop participants were asked to consider possible topics and suggest hypotheses to be tested. As the wider research group focuses on the impacts of global change on plants and soils, the only restriction was that the project should investigate a topic within this research area. The facilitator moderated and kept discussions on track but otherwise had little input. The whole group then worked together to refine the experimental hypotheses. Design was limited by funding and time so, following discussions, we opted for a small scale mesocosm[2] experiment, utilising equipment and experience from previous successful research projects in the group (e.g. Orwin et al., 2014). The process of designing the experiment was conducted as a group. Individual staff members and students were allocated tasks to purchase materials and get equipment ready.

Phase 2 – Establishing and maintaining the experiment

The experiment was set up at the university field station in spring 2013 and ran through the summer. The experiment involved periodic flooding of mesoscosms planted with different plant species mixtures. Experiment set-up was undertaken as a group with as many people as possible contributing. Regular monitoring of plant health was undertaken using rotas. Sampling of greenhouse gases provided particular opportunity for training and this was done in pairs with one team member who was experienced working with someone who wanted to learn the technique.

Phase 3 – Final sampling

At the end of the summer the final sampling was undertaken to collect plant and soil samples for laboratory analysis. This consisted of eight different elements of plant, soil and nutrient analysis. Tasks were divided up so that for individual jobs there were team members who were experienced working with those who wanted to learn new skills. Everyone was given the opportunity to sign up for methods that they particularly wanted to learn. Individual students and staff led training sessions for methods, where the majority of participants were unfamiliar but interested.

[2] Mesocosms are artificially created communities contained within large plant pots.

Phase 4 - Data analysis and what to do with the results

The initial plan for data analysis was for it to be conducted in much the same way as the practical work with results presented back to the group at a meeting. However, in practice, this task and the levels of prior knowledge required proved less suitable for peer-learning.

After discussion, a suggestion was made to write a paper discussing and critiquing the aims and process of this type of project and its benefits and learning outcomes for PhD and early career staff training. As this article is an unintended outcome it should be noted that participants weren't considering that this would be written when they were working on the experiment.

Outcomes

Following the end of the experiment we held a 'debrief' session to gain a better understanding of how participants felt about the experience and to identify benefits and recommendations for how this approach could be improved if we were to do it again.

Learning from peers

Providing students with the formal opportunity to learn from peers was one of the main aims in establishing this group investigation and was identified as a benefit by many of the participants. Specific benefits included building the skills of individual students above and beyond their own project scope, learning what skills other people in the group have, learning to use each other as a resource, and creating and enhancing group-held knowledge. As one participant stated: "Learning from other people and other peoples' experiences [is] especially valuable as there are a mix of disciplinary backgrounds."

Several participants have subsequently put the skills they learned into practice through activities planned as part of their own projects. Learning from peers not only benefits those who were learning but also those who were teaching — reaffirming knowledge and building confidence.

Participants who held knowledge and skills frequently employed during the process or which were central to the project's progress and success, such as statistical analysis knowledge and complex methodology skills, did, on occasion, find themselves over-committed. We recommend continued communication to identify and try and address this problem as it occurs, but suspect that it is somewhat inevitable and therefore the possibility of this happening should be acknowledged up front.

Participants also identified possible future benefits—conducting the investigation as a group produced a strong cohort and made students feel comfortable about asking each other, postdocs and the lab manager for help and advice post-project. This also provided benefits to academic and laboratory staff by establishing a network of support for when staff members are not available, consequently reducing staff time pressures by providing students with alternative ways to solve problems.

Experimental planning

Many of the students commented on the benefits of seeing the full life cycle of a project. When students start a PhD, they commonly have limited experience of research projects from undergraduate and sometimes masters research degrees. Learning about planning stages and considerations was identified as a particular benefit: "[It is] Useful seeing a project from start to finish, especially for people new to academia or [who] have been out of academic research for a while."

Teamwork

Teamwork is traditionally a relatively small part of a PhD but is a skill often rated highly outside of academia. However, the ability to work as part of a team and lead a group or line manage is also increasingly emphasized as a requirement for postdoctoral positions, as researchers are frequently required to work in collaboration with technicians, PhD students and casual staff. Participants felt they had learnt a lot about the logistics around group work and how to manage it properly. One explained: "[It is] good for the future, for example as a Post Doc Researcher [you are] managing a team and learning to not always put your own work first." Another stated that: "One of the benefits was working around other people, as the PhD process can be very individualistic."

Learning from mistakes

Mistakes are inevitable in research but can be worrying and frustrating for a PhD student who has limited time and experience. This investigation provided students with the opportunity to learn from the mistakes that they made in an environment where the results did not matter for their own PhD projects:

> [This approach] shows students that mistakes are made in other projects. Students just see the [journal] article – [they] don't see the messiness, the mistakes, the time put in for no gain, in papers. Selective reporting of the 'reality' of science can create an intimidating version of reality. So the group project gives reassurance, gives the student the confidence to make mistakes.

Due to differences in experience between the team-members the experimental method was, on occasion, implemented inconsistently. The less experienced participants learnt from these mistakes and these inevitably benefit their independent project work. However, this inconsistency did compromise the final scientific results and the resultant disappointment had to be managed. This was managed by a 'no blame' discussion, which included a focus on the resultant learning and the improved group dynamic.

Confidence and reflection

There are a number of benefits around confidence that have already been raised; confidence that making mistakes did not mean the end of the project and confidence to approach others in the group to ask for help. Another benefit identified by a participant related to confidence: after the project students felt more comfortable making decisions within their own project and they felt more comfortable passing their knowledge on to others. The process of doing the project and discussions held afterwards permitted reflection on peoples' positions within their project and the research group and how to conduct reflexive science.

Lessons learned and recommendations for future projects

Participants suggested a number of recommendations for future projects of this kind. Many of the changes suggested were outcomes of the process itself: the need for clearer hypotheses; the standardisation of laboratory protocols up front; considering data analysis in the planning stages; giving more thought to the scale of the project and the level of time input needed; and having reminders of the hypotheses throughout the project. These points are all good scientific practice and that they were raised by participants shows positive participant learning outcomes.

There was also discussion around the need for the allocation of roles and responsibilities as it was "challenging, organising lots of people." We specifically tried to reduce the hierarchy of the traditional laboratory group model in order to foster a more equitable community of learning in line with many definitions of a 'community of practice,' which coheres through mutual engagement (Cox, 2005). However, interestingly, a number of students thought there was a need for "supervision at key stages from experienced people" (although not necessarily the 'usual' group leaders). This was because with a large group involved there were times when it wasn't clear who was directing certain activities. Allocating task leaders would have overcome this. From a staff perspective time input in the early stages of the project was quite high, this was most onerous for laboratory and postdoctoral staff who did not have time allocated to this type of activity. Making students fully responsible for aspects of the project could have reduced this but it should be expected that students will need more support early in the project, especially when undertaking activities that are unfamiliar.

Other suggestions for improving future projects included: establishing projects spanning multiple years, which would provide the opportunity to join a larger scale investigation; applying for funding, which would add to the experience gained; and drawing on a wider range of expertise to make the project more multidisciplinary. There was also a request for formal recognition for participating students, for example, in university training records. From the perspective of the lead academic and other staff there was a need for departmental recognition of the time input required to run such a program.

Reflection after the Project

One year after the completion of the project we discussed the outcomes with three students who had participated, one who had been at the early stage of their PhD at the time (Participant 1), one who was doing experimental work (Participant 2) and one who was writing up (Participant 3). The group leader asked them to reflect on the project and conducted semi-structured interviews.

All three interviewees felt that the project helped them to build practical skills, irrespective of the stage of their PhD.

> Because the group was made up of people with different projects and different skills and experience you could… learn more skills at once. So with one to one supervision generally your supervisor is a specialist in one area of your project but not necessarily in all parts so you could benefit from lots of supervisors teaching you things or their students. (Participant 2)

> Firstly, you get to hear several peoples' opinions about a single issue rather than just hearing the opinion of your supervisor; which I think is quite useful because people tend to have different ways of… thinking about a certain problem, especially if they are from different fields… and then the other thing is … rather than just talking about it we were able to go and do the actual practical work and you don't get to do that as often with your supervisor one-on-one. (Participant 1)

> It provides personal experience because by talking through a method or technique with your peers you can be a bit more honest about how you found a technique, tell each other short cuts and little tips… a supervisor tells you about a method and references and might tell you about a protocol but you miss out on that personal experience a bit. (Participant 3)

Participant 1 (early stage) did use learned skills within their own project and one of the two students (at a later stage in the PhD process) has applied techniques in a subsequent job. All three students felt that there were benefits for the group in terms of strengthening the group dynamic.

> It made me more comfortable with others in the group because obviously I hadn't been around that long and I think I was more comfortable around everyone, it made me more comfortable bouncing my ideas off them about my own project for example and just more conformable going to them with questions and just advice. (Participant 1)

> I don't know if it changed the role of the research group but it changed the dynamic because we all had one thing in common… those sort of shared experiences bonded the group. (Participant 2)

> It reinforced that community spirit of helping each other out and it makes it a lot easier to talk about problems you have got. A PhD can feel quite isolating so it is nice to be able to talk about [them] and find out that other people have got the same problem. (Participant 3)

Participant 1 felt that the project would be most valuable to those in the early stages of their PhD:

> It is like a jump start into learning techniques that you are probably going to have to do as part of you PhD and also, if you are part of a group, it is a good way to get to know everyone on more of a personal level than just seeing them in the lab every now and again. (Participant 1)

Participants 2 and 3 felt it was useful for everyone and having this experience later in their PhD provided the chance to look back on how much they had learnt.

Concluding reflections

When participants were asked if they would repeat the exercise in future years they responded positively. Reflection from the three students interviewed a year after the project concluded has shown that this process was clearly beneficial to students in helping them to become a strong cohort who learn from each other and are more confident in their research. We recommend this as a possible tool for natural science supervisors to enhance the supervision and mentoring experience for their students. By working with other supervisors the load can be shared and students with similar research interests or approaches, who may otherwise not interact, can become a supportive network. We suggest that active group learning as part of a Group Supervision Model can complement the traditional model of supervision often used within the natural sciences.

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