



KEY TAKEAWAYS:

- The Physics and Astrophysics MSc at Cardiff University is a unique course which exposes students to postgraduate research culture through a research group teaching model.
- We are past MSc students, now PhD students, and full members of the MSc teaching staff.
- We have played an active role in the design, delivery and adaptation of postgraduate taught modules from 2018-present, furthering our professional development as early-career academics.
- During COVID-19, the entire research group model, including teaching and group work, was successfully adapted and delivered to students online through remote-learning platforms.
- By acting as mentors and role models for students, we have created effective learning environments to meet the needs of our students.

1. INTRODUCTION

The Physics and Astrophysics MSc courses have been taught at Cardiff University since 2015. These courses are unique because the inherent design and implementation of the modules directly exposes students to postgraduate research culture through a research group teaching model.

The number of students on the course has been growing rapidly over the past 6 years (see Table 2). As a result, the design and delivery of the core modules have been adapted by employing MSc graduates, now PhD students at Cardiff University, as teaching assistants (TAs). We, the TAs, provide unique support as we have shared learning experiences with the students.

2. MSc COURSE STRUCTURE

The MSc contains two core modules (Core 1 in the Autumn semester and Core 2 in the Spring semester) alongside elective modules (see Figure 1). The core modules are specifically designed to transition a student who has completed an undergraduate level degree into a postgraduate researcher by teaching them how to plan and undertake a scientific research project. In Core 1 the students conduct a micro-project within the research group model, and in Core 2 they learn how to write literature reviews, grant and research project proposals. A research project is then completed by students spanning the entire Summer semester.

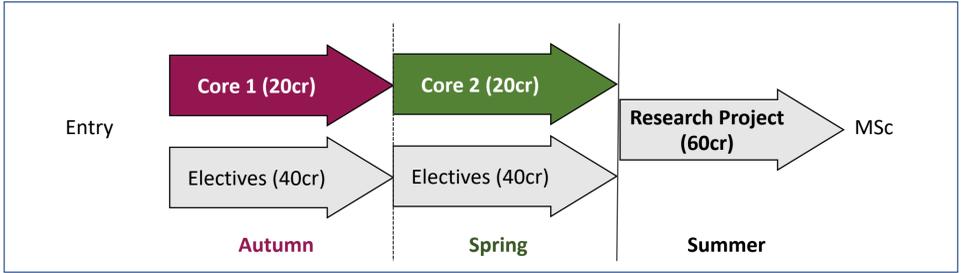


Figure 1. The module structure of the MSc in Physics and Astrophysics at Cardiff University. The TAs are involved in the design and delivery of Core 1 & 2.

CORE MODULE DUTIES	
Core 1	Core 2
<ul style="list-style-type: none"> Lead micro-project research groups Organise group meetings and informally assess progress Facilitate group discussion and problem-solving Provide training and assistance related to the subject of the project (e.g. on physics, mathematics or programming) 	<ul style="list-style-type: none"> Lead discussion groups during plenary sessions Design and deliver demand-based extra-curricular research skill workshops (e.g. LaTeX, Origin, Git and GitHub)

Table 1. TA roles for both Core modules. Our roles extend beyond typical demonstrating and marking duties.

3. THE RESEARCH GROUP TEACHING MODEL

The cohort is split into small groups, each with a specific focus. The inherent structure of this model directly reflects the true research group structure of the School of Physics and Astronomy. The topic of each research group is closely aligned with the research of the group leader, who is either a full member of the faculty or a TA, such as the authors. The TAs are directly responsible for guiding, mentoring and assisting the students through formal weekly meetings and informal discussions.

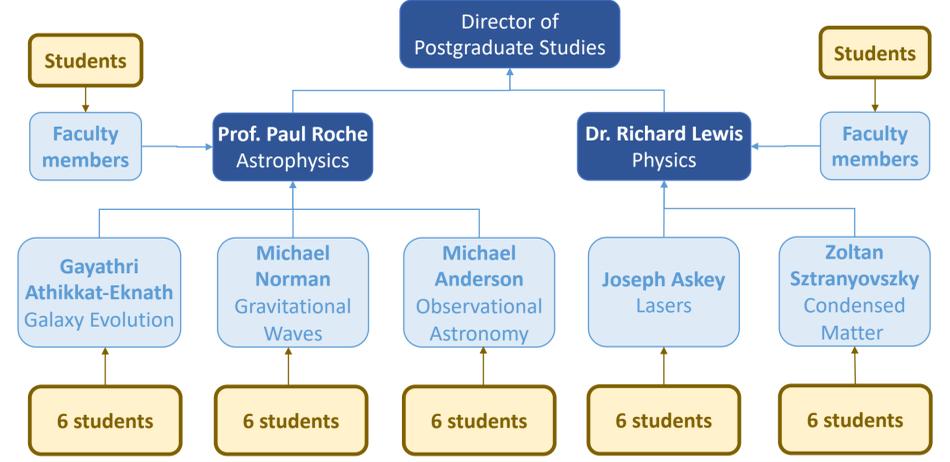


Figure 2. Research group teaching model structure of Core 1. Each TA has supervisory duties, reflecting the role of an academic.

CORE 1 COVID-19 ADJUSTMENTS

- Existing lab-based projects were converted to computational and theoretical projects. The projects were simultaneously challenging and accessible for students of all backgrounds.
- Weekly in-person group meetings were transformed to online meetings using Zoom and Microsoft Teams. Continuity of supervision and research exposure was upheld, but personal supervisor-student relationships were undoubtedly hampered.
- Online repositories and learning environments streamlined resource sharing and curation. This further upheld continuity of the research experience.

CORE 2 COVID-19 ADJUSTMENTS

- Online live-lectures were combined with breakout room sessions for discussions on group and individual work. This meant no loss in continuity of module delivery.
- Live-lecture content was unchanged but delivered online.
- Breakout rooms, led by TAs, were successful in encouraging students to think critically about coursework. Participation in discussions from students were at times poor, and the inherent limitations of the technology used (slow internet, only one speaker at a time) hampered efforts to alleviate these issues.

	Academic Year	Student Intake	Student satisfaction (%)		Number of TAs
			Core 1	Core 2	
	2021/22	(65)	-	-	7
Authors transition to remote teaching	→ 2020/21	57	88	94	4
	2019/20	39	89	-	4
Authors become TAs	→ 2018/19	24	86	87	2
Authors complete MSc	→ 2017/18	19	94	91	2
	2016/17	22	90	88	0
	2015/16	14	94	85	0

Table 2. Number of new MSc students, teaching assistants, and student satisfaction scores in each year. 2021/22 values are predicted. All authors were MSc students in year 2017/18. Student satisfaction has remained consistently high, even with increasing student numbers, throughout our time as TAs.

4. TEACHING ASSISTANT REFLECTIONS

- "Demonstrating on these courses has helped me understand the need for a carefully crafted pedagogy and the benefits of developing a teaching structure that is self sustaining. Having faced the challenging aspects of the course myself as a student and drawing from this experience, whilst also being conscious of the diverse experiences that other students may have, I have learnt how to reflect on providing the most effective support for the diverse learning needs of the students that I teach." **Gayathri Athikkat-Eknath**
- "There is a certain kind empathy and understanding that is only obtainable with personal experience – it is therefore somewhat of a paradox of pedagogy that it is often impossible for an educator to objectively take part in a course that they have themselves designed. The resolution of this paradox I feel comes as one of the most beneficial aspects of the current arrangement. Having spent a year myself trying to navigate the intricacies of what essentially amounts to a very similar course to what is currently being run, my brain is very acutely attuned to how best to approach it. I think that this understanding comes across in my ability to guide and mentor the MSc students under my supervision." **Michael Norman**
- "As a student on the MSc Physics course at Cardiff University, I found the research group setting a personal and inclusive approach. Now, as a TA, I aim to create the same environment that also inspired me to be a researcher. I find that in this setting we can really focus on the individual learning experiences, which is important as students come from a variety of backgrounds. In a remote learning-environment it would be difficult to create a peer support structure between a large cohort of students but with the research group approach that we take this becomes possible and follows naturally." **Zoltan Sztranyovszky**
- "Leading the research projects, along with designing and running research skill workshops has made me a better researcher, giving me the experience to co-supervise research students in the future, and also the confidence to present and explain my work at various levels of expertise." **Michael Anderson**
- "I have been fortunate enough to lead both in-person and remote Core 1 research projects. This has given me the experience of how to organise, plan and adapt student-driven, open learning activities. This has undoubtedly helped my own teaching and research practice. I strongly feel the involvement of former MSc students as TAs has improved the learning experience of current students, through our shared experiences." **Joseph Askey**

5. CONCLUSION & OUTLOOK

- We have gained direct experience in teaching unique postgraduate taught core modules and have actively participated in the design, delivery and adaptation of these modules.
- Through the research group model, we have gained first-hand experience in planning, leading and assisting within research groups, facilitating the transition of students who have completed an undergraduate degree to postgraduate research work.
- With the knowledge and experience gained, we all have a solid basis for applications to Associate Fellow and Fellow of Higher Education Academy (AFHEA and FHEA) certification.
- Despite significant challenges (rising student numbers and transitioning to remote teaching), the MSc student satisfaction scores have remained consistently high.
- We recognise that the continued development and success of the core modules relies on the support from the TAs which, in turn, will help us continue to develop our professional practice.

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