APEX – Academic Professional Excellence Programme

Fellowship Pathway

DCQE Department for Curriculum and Quality Enhancement

Application Submission

Personal details		
Title:	Dr	Role: Reader in Astronomy and Astrophysics
First name:	Karen	Known as:
Family name/ Surname:	Masters	
Email address:	karen.masters@port.ac.uk	Tel ext.: 3137
Department:	Institute of Cosmology and Gravitation	
Faculty/Unit/ Institution:	Factulty of Technology/Teaching in Physics (SEES, Science)	

Requirements for your Application

- *Keep your focus on teaching and activities that support learning (as in UKPSF Descriptor 2 and APEX Dimensions).*
- *Where you provide direct evidence of, or a reference to relevant Dimension(s), please show as in this example: (A1, K3, V2, P1).*
- *If either Case Study guidance is not relevant for your particular role, please discuss your approach with your APEX facilitator.*
- *The total word count for sections a), b), c) and d) should be around 3000 words. Applications over 3500 words will be returned to you for editing.*

a) Introduction and Context *(150–400 words)*

- *Outline your current role in terms of your teaching, learning and learning support responsibilities at UoP / your Institution.*
- *Include the subject focus of your teaching; its extent and level and any additional responsibilities you undertake (eg. unit co-ordination, admissions tutor, placement co-ordinator).*
- *Explain briefly your earlier career milestones and experience of supporting learning in either HE or other relevant contexts.*
- *Ensure that you cover all areas of activity (A1–A5), all core knowledge (K1–K6), all professional values (V1–V4) and APEX dimensions (P1–P2) across your application.*

I joined the Institute of Cosmology and Gravitation (ICG) at the University of Portsmouth in October 2008, three years after obtaining my PhD in astronomy (K1). I was initially appointed as a Research Associate, and following a series of promotions and contract renewals became a Reader in Astronomy and Astrophysics in October 2015. Throughout this I have contributed to a variety of teaching in both the Faculty of Technology (Maths and Engineering) and Science (Physics), as well as leading and developing the ICG public engagement and schools outreach programme. Involving non-experts in research, and communicating with the public about my astrophysical research, forms a major part of my identity as a scientist. I am known both nationally and internationally for my involvement with citizen science (i.e. involving members of the public in analysing scientific data). In Summer 2017, I was invited to give a plenary talk at the "21st International Conference on Multimedia in Physics Teaching and Learning" on the topic of making use of citizen science, and open data in astronomy for teaching of physics (A5, K2, K4).

As a non-traditional physicist (i.e. I'm female, among the first in my family to enter higher education, and part of a dual career couple with young children) I have personal experience of the importance of active work for equity and inclusion in physics (V2). It is my observation (backed up by social science research; e.g. Bergin 1999) that people who do not feel they belong in a community can struggle with motivation,

and perseverance when the work becomes hard. Physics is often viewed as an exclusive field, accessible only to "mathematical geniuses". At the root of my beliefs as a teacher is my firm opinion that anyone, with the right motivation, can succeed in physics. However I recognise that the learning style which worked for me, does not work equally well for everyone (K3). I have a great deal of respect individual learners and diverse learning communities, and I am passionate about promoting participation in physics by countering the view that it is an exclusive topic (V1).

My experiences as a student were rather different to the modern pedagogy research based techniques employed at the University of Portsmouth, and which are included in the UoP Educational Strategy (UoP, 2016). As a physics student at the University of Oxford in the late 90s, I experienced one of the most traditional methods of teaching physics, in large lectures, with separate small group tutorials, and assessment on the basis of a series of exams taking place over a single week at the end of the degree. I then experienced life as an International Student, studying for a Masters/PhD in astronomy at Cornell University, USA. Here the course was made up of a set of independently assessed "classes", highly focussed on learning the content of a single (or small number) of published textbooks. End of teaching block exams were the primary assessment tool. While both these style of learning were something I excelled at, it was obvious that it didn't work for everyone (V1), and required high levels of self-motivation and self-discipline for a successful result (K3). These experiences backed up my belief that it is student motivation and passion for the subject which is the best predictor of success, and throughout my teaching I work to engage students to help them find their passion for physics, and their reason for choosing this field of study.

My current teaching responsibilities include being one of two Lecturers in U24199 "Space Science and Applications of Physics", and as Unit Co-ordinator/one of two Lecturers for U24568 "Computational Physics", both of which are units in the SEES Courses "Physics" (formerly “Applied Physics”) and "Physics with Astrophysics and Cosmology" (PAC). Via my role as Unit Co-ordinator for “Computational Physics” I have led on curriculum development for that (new) Unit, including meeting all deadlines for annual Unit updates, and attended Unit boards (K6). I also regularly attend Physics Board of Lecturers meetings where we discuss quality assurance and quality enhancement for all Physics Units (K6).

For this Fellowship application I intend to focus on teaching in U24199 which I have delivered in two consecutive years (2015/2016 and 2016/2017). My contributions to this unit will allow me to demonstrate my approach to planning, and implementing innovative learning, as well as assessment of learning, and how I engage with quality assurance and enhancement (K6). In this Unit I have worked to make use of techniques to ensure active student engagement, as well as facilitating real world experiences to help with student motivation for their chosen course of study (A1,A2,A3,A4).

b) Reflective Account of Practice: Case Study 1 *(900–1200 words)*

- *Identify a series of sessions that you have recently designed and delivered to students.*
- *Provide a brief context for the session(s) in terms of the programme, its aims and the learners and learning needs it addresses.*
- *Provide a rationale for the design which should include some acknowledgement of the 'fit' with UoP Education Strategy.*
- *Include reference to the scholarship of learning and teaching and explain how you are being inclusive.*
- *Refer to how you have used student/colleague feedback to enhance practice and evaluate your practice.*
- *If appropriate, discuss your use of learning technologies and how this is used to support student learning.*

It is my view that students are more motivated to learn if they can connect their studies to their own interests and/or when they are reminder of the reason they chose their course of study in the first place (K3). This idea is backed up by research on motivation for learning (e.g. Keller 1987). Physics students at Portsmouth are a diverse group, choosing either to study "Applied Physics" or "Physics with Astrophysics and Cosmology", and as such have a diverse range of motivations for choosing the course (V1). These motivations range from choosing physics for it's impact of student employability, to wanting to learn about practical applications of physics in our day-to-day lives and how physics is used to answer the "Big Questions" about the formation and evolution of the Universe.

The "Space Science and Applications of Physics" unit (U24199) is a Level 4 Core Unit aimed at providing all first year Physics students with opportunities to explore real world case studies which are used to reveal how physics is embedded in a global context and underpins our modern society, as well as how we use physics to explore our place in the Universe (K2). I am excited by the content of this Unit partly because of how I believe it supports student motivation to succeed in the course overall via real hands on experiences, and linking the course to their life goals (for example see Bergin (1999) who discuss how students are more likely to become interested in a topic if it is relevant to their own goals, and that students and teachers both rate hand-on activities as facilitating motivation, K3).

There is evidence that many undergraduate physics students are highly interested in using physics to learn about the "Big Questions" about the formation and evolution of the Universe (e.g. Institute of Physics, 2012). In U24199 we showcase a range of possible ways physics can be used to explore the Universe in order to allow different students to explore or find their passion in physics. The activities which are used to frame this exploration include:

(1) in class lectures and activities to explore basic concepts in physics and astronomy and give background to external visits/talks (K2)
(2) visits to a local amateur astronomer run observatory (Clanfield Observatory on the South Downs)
(3) a traditional planetarium experience (at the South Downs Planetarium, K4),
(4) contributed talks from external experts working in aspects of professional astronomical instrumentation (often via virtual links, K4)
(5) attendance at local public lectures or events related to physics, e.g. in November 2016 the UK Space Agency sponsored event, "In Conversation with Tim Peake" (the UK's ESA Astronaut, V4,K2).

This range of activities gives students a chance to experience learning in many different settings, and develop habits for life long interest in learning physics (V4). For example, by interacting with the amateur astronomers at the Clanfield Observatory, or with members of the local Physical Society at public talks they are exposed to groups of people who are role models for the Portsmouth Graduate Hallmark of intellectual curiously (K6) - this may also be a source of motivation to some students. These sessions also contribute to a diversity of learning opportunities in this unit provide a way for use to respect individual learners and diverse learning communities (V1, K2).

In my personal experience as a learner, repetition of material via different media/at different times helps embed concepts and enhance the long term memorability of new ideas (K3). This is in line with standard ideas in human learning and memory research (e.g. Karpicke & Roediger 2008 who demonstrate that repeated retrieval, or use of new knowledge helps most with retention; V3). In order to help with the process of embedding knowledge the visits to the observatory/planetarium were planned in weeks immediately following more standard classroom based lectures on topics in Introductory Astronomy (K1). The two external visits for a single trip taking up an evening, which provides opportunities for informal discussion, as well as a bonding/team building opportunity for the students (contributing to their peer support environment, A4, K2). I find that students ask questions during these visits where they may not be comfortable speaking up during formal class time. The availability of Moodle Mail improved the visits mostly by facilitating the dissemination of logistical details (K4) which helped ensure that time during the

visit could be spent engaged in learning experiences.

In order to allow for an evaluation of the effectiveness of the learning triggered by this experience, I collected immediate student feedback following both the November 2015 and February 2016 observatory/planetarium trips (K5). Feedback demonstrated the value students placed on this experience, even when the weather is too poor for actual astronomical observing (which in itself teaches about the practical realities of astronomical observing, V4). In addition, students keep a journal of their learning experiences in this unit, which is handed in for assessment at the end of the academic year (see Case Study 2). Informal feedback could be collected from comments in those journals, and this has contributed to planning and quality enhancement for future years (K5, A1, K6). Reflective comments from the students demonstrated the value they place on the trip; it was described as "a unique opportunity", "insightful into the world of astronomy", an "exquisite trip regardless of weather conditions". One student particularly commented on the benefit of having the trips follow lectures, helping them to relate their in-class learning to real life research, adding further support to the planned structure of holding the trip in the week following formal lectures (K3). The trips are routinely noted in "the best part of the unit" in student feedback, and provide a strong memory for students to link to concepts learned in this Unit, and I hope motivate them for the remainder of the course (K2). This feedback ensures we will continue to run this visit as part of the Unit (K6).

I believe that external visitors contribute enormously to the content of this unit, bringing in inspirational stories, and tips for motivation well above and beyond what we can deliver as the "usual lecturers" (e.g. Bergin 1999 talks about the importance of novelty for motivation). It's hard to get much more inspirational than the first official British astronaut. In November 2016, students had the opportunity to attend a "Conversation with Tim Peake" event during which he talked about his journey to the International Space Station (K2). Using a variant of "Stop/Start/Continue" feedback (K5), I collected comments on the in the class period immediately following it, asking students to post notes for if they found the event "Interesting" or "Inspirational", and providing some reflective comments. In a class of 60, there were 10 voluntary contributions to "interesting", mostly focusing on the practical details of living in a space station. Under "inspirational" 7 student contributed, talking about how learning of Tim's struggles will help with their motivation, and the commitment shown by astronauts giving extra time to contribute to outreach activities. The feedback demonstrate how this experience adds to their learning journey, and their motivation to continue studying (K3), and we will work to ensure external visitors remain part of the Unit in the future (K6, although it's not likely we'll often be able to get an astronaut!).

Overall I believe the contribution this unit makes to student motivation and inspiration is positive, and I remain a strong advocate for the use of real work experiences and external trips/visits to enhance motivation, and through them learing outcomes (Pintrich 2003) in undergraduate physics students (K2).

c) Reflective Account of Practice: Case Study 2 *(900–1200 words)*

- *This is likely to focus upon assessment and support you provide for students. Provide a scholarly rationale for the design of a particular piece of coursework / examination to which you contribute significantly.*
- *Explain how you prepare students for assessment and justify the approaches you use to help them succeed.*
- *Refer to sources of student support within UoP or elsewhere; these may involve the use of learning technologies.*
- *Discuss summative marking practices and any quality assurance issues.*
- *Consider the extent your assessment design/support/ marking and feedback has been effective drawing upon data available. Discuss any specific enhancement you have made as a result of this.*

Summative assessment in U24199 (see Case Study 1 for a description of the Unit) is composed of:

1. A "Portfolio" comprising a reflective account of the student's learning journey through the Unit
2. A "Popular article" on a physics related topic of the student's choice.

These are chosen to (1) help student to develop a reflective learning style, and embed a habit of regular note taking; (2) to support the development of "soft skills" essential to success in any career. It's not enough to know about the content of physics, students must also learn how to communicate about physics to be fully prepared for any physics based career (V4, A3).

I mark the "Popular article" making use of a marking a rubric in TurnItIn which allows for quality assurance (K2,K6). A fraction are second marked by the Unit Coordinator, and we agree on final marks in a moderation meeting (K6). Following my experience in reviewing submissions for the popular article in April 2016, I noticed a significant skill gap in basic academic writing among the students in the class. To combat this, and to enhance the quality of learning in the Unit (K6) in 2016/2017 I introduced both a special session on writing physics, with tips and advice to avoid the most common pitfalls (A4), and gave the opportunity for a draft submission to a chance for the students to obtain some formative feedback, and help them avoid the most common errors. Draft submissions were reviewed for 45/60 (75%) of students in 2017 demonstrating a good level of engagement with a non-summative submission. The final submissions for students who took advantage of this opportunity achieved an average mark of 63%, while those students who did not make use of the draft submission did not meet as many learning goals (with an average of 49%), indicating that the introduction of the draft submission for formative feedback is helpful to students learning outcome (K5,A3).
I make use of formative assessment during the lecture time for this Unit. This serves the dual purpose of allowing me to assess in real time if the majority of the students are following the content of the session (and if necessary change the pace or content level), as well as creating active learning opportunities for students to remain engaged in their own learning (K2). Research shows that the typical attention span is 18 minutes (Verner & Dickinson 1967; V3, K3). Sessions for "Space Science and Applications of Physics" are typically timetabled in 2-3 hour blocks. I designed the lectures to give opportunities for active learning opportunities at least every 18 minutes helps student to remain engaged and motivated (Gauci et al. 2009). The idea is that this avoids creating a "Passive Learning Environment" in which students can easily disengage (Biggs & Tang 2011, A1, K2, K3).

There is evidence that continuous feedback on their understanding helps students to remain motivated in their learning, and quickly make changes which can help them learn more effectively (Cauley & McMillan 2010; A1, A2, A3, A4). I made use of the concept of "feed forward" introduced in a CPD session I attended on Small Group Learning (A5, V3). This allowed for real time, instantaneous feedback on conceptual understanding. While students were encouraged to participate in the response, this was not required, and answers were available to all students attending the lecture equally (therefore making sure it's inclusive for students in the session, V2).

In order to facilitate immediate feed-forward during lecture time I made use of a low tech student response system, known as an ABCD card (based on "CAPERcards" from the "Center for Astronomy and Physics Education Research", K4). Students were asked to answer multiple choice quizes sprinkled through the lecture notes and aimed at checking their conceptual understanding of the subject material presented to them (K1). An ABCD card is a folded piece of paper which can be used to display an answer A, B, C or D in bright contrasting colours, allowing the lecturer to make a quick visual assessment of the conceptual understanding of the class as whole, while enabling individual students to keep their own answers relatively private (if held against their chest, and with all students facing forward, only the lecturer can see the results). I considered the use of more technology drive student response systems (e.g. I learned about

Nearpod in the CPD session on Small Group Learning), however my choice to instead make use of a low tech version was driven by a desire for inclusivity - with this method the lack of smart phones, or laptops in lecture could not be a barrier to inclusion (V1, V2), as well as not wishing to be distracted by technology for technology's sake (K4).

Students need sufficient time to digest information, consider the question posted to them and feel able to provide an informed answer (Tobin 1987; A2, A4). I made use of long pauses for the mini-quizzes to make sure I gave students this space. I found the quizes to be useful in enabling me to quickly notice common misconceptions, and this allowed a real time tailoring of the level of the presentation of content. Students commented on the use of this method saying (e.g.) "I enjoyed the mini quizzes we would have to test our knowledge and recap on this topic - I think it's the best way to learn" (K2,K3). The first time I delivered the lecture in this way I invited peer observation from the Unit Coordinator for quality assurance (K6).

As well as the formative feedback opportunities (as "mini-quizzes"), I make use of small group activities, and hands on work to promote a variety of learning styles and break up the passive information sharing parts of these sessions (V1, K2). These activities included having students work in small groups, moving around the room to discover their (imagined) location in the world from astronomical observations, hands-on work to create their own "Star wheels" and consider the motions of the stars and planets over the course of a year, and a group discussion activity to work out the type of astronomical telescope facilities needed to observe astronomical objects of interest in recent scientific news (e.g. "Planet 9", Tim Peake on the ISS, or black hole accretion discs). A student commented that "[the] method of flipped learning and group work was [] engaging and got us to actual work" (A4, K2). In my view it also had the benefit of demonstrating a wider range of "soft skills" necessary to succeed as a physicist, from practical hands on work, to group discussion and collaboration. In this way my sessions contribute to the Unit goals of enabling students time and space to develop these skills, which is in line with the UoP Education Strategy (UoP 2016) to provide career enhancing activities for students to learn through experience, as well as contributing to them having opportunities to develop the Hallmarks of a Portsmouth graduate (K6).

d) Reflective Account of Continuing Professional Development *(500–800 words)*

- *Use this section to provide general reflections on your teaching and/or support of learning.*
- *Include details of how you have improved your practice as a result of reflection and action on peer and student feedback, the scholarship of learning and teaching and participation in continuing professional development (attendance at events, work-based development activities, committee involvement, projects and online CPD resources) and link with CPD record.*
- *Ensure you take into account how you have addressed and supported the UoP Educational Strategy priorities.*
- *If there are aspects of the UKPSF where you feel that your case studies are rather 'light', use this section to demonstrate your awareness of this and make additional comments.*

During my APEX Continuing Professional Development, and while writing this submission I have reflected on how my experiences as a student are not representative of how Portsmouth students learn, and how my own learning preferences are not a good model for a Portsmouth student. Particularly valuable in this realisation was attendance at a session on Small Group Learning, as well as most recently a session on "Feedback that Works". Marking popular articles from the first year physics students, was also eye-opening, revealing how much work on Academic Skills a typical student needs. As a result I am keen to ensure we put more help for that into the Level 4 Units, starting with U24199.

I have been impressed with how well the ideas of active learning, and use of simple student response systems has been in keeping students engaged in long lecture sessions. I am an advocate at the Physics Board of Lectures the use of student response, and plan to engage in future CPD sessions on the use of technology to facilitate this, although as Philip Race notes (Race 2009) "digital should be regarded as a tool not as an end in itself", and I have been impressed with how well simple low tech student response works.

In my research community I have explored the inclusion of minority groups in active learning (e.g. asking questions at conferences, Pritchard et al. 2014), but I have yet to work this experience into teaching a group which is dominated by white men. My CPD has had a themed of inclusion and equity in physics running through it, and I continue to explore these aspects of my field, and the pedagogy in it. Recent experience with a student on the autism spectrum has made it clear I need to obtain training on best practices interacting with this group, to support myself to support such students. I am also interested in further training on how to support students to become more self motivated, and take advantage of feedback and learning opportunities presented to them.

I am committed to maintaining my professional development which will support me to continue to pursue

high quality teaching and learning in a University setting. In my view a good teacher will never stop seeking opportunities to improve and enhance their learning skills, and I look forward to the future challenges teaching in a University setting will bring (K6).

e) Bibliography

List the books/articles mentioned in your narrative with the referencing system used in your subject area.

Bergin, D.A., 1999. Influences on classroom interest. Educational psychologist, 34(2), pp.87-98.

Biggs J. and Tang K., (2011), Teaching For Quality Learning At University, McGraw-Hill International, 2011

Cauley, K.M. and McMillan, J.H., 2010. Formative assessment techniques to support student motivation and achievement. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 83(1), pp.1-6.

Center for Astronomy and Physics Research, "CAPER", www.caperteam.com, [Accessed 1st March 2017]

Gauci, S.A., Dantas, A.M., Williams, D.A.& Kemm, R.E., (2009) "Promoting student-centered active learning in lectures with personal response system", Advances in Physiology Education, 33 (1), 60-71

Institute of Physics, 2014. Institute of Physics in Scotland Survey of First Year Physics Students 2014 http://www.iopscotland.org/policy/education/file_63162.pdf, [Accessed 4th October 2017]

Karpicke, J.D. and Roediger, H.L., 2008. The critical importance of retrieval for learning. science, 319(5865), pp.966-968.

Keller, J.M., 1987. Strategies for stimulating the motivation to learn. Performance Improvement, 26(8), pp.1-7.

Levine, A. "Physical scientists can do anything: Here's how you start your career planning". Blog post for Physics Today: Jobs, https://www.aip.org/jobs/career-advice/physical-scientists-can-do-anything-heres-how-you-start-your-career-planning, [Accessed 4th October 2017]

Pintrich, P.R., 2003. A motivational science perspective on the role of student motivation in learning and teaching contexts. Journal of educational Psychology, 95(4), p.667.

Pritchard, J., Masters, K.L., et al. (2014) "Asking gender questions: Results from a surve of gender and question asking among UK astronomers at NAM2014", "Astronomy & Geophysics", October 2014.

Race, P. (2010), "Making Learning Happen - and getting assessment and feedback working better". A talk at the Dundalk Institute of Technology, accessed at: https://www.dkit.ie/system/files/Phil_Race_Making_Learning_Happen_Through_Assessment.pdf [Accessed 1st March 2017].

Tobin, K., 1987. The role of wait time in higher cognitive level learning. Review of educational research, 57(1), pp.69-95.

University of Portsmouth Education Strategy 2016-2020; available from www.port.ac.ul/educationstrategy

APEX Professional Record	
I confirm that my *APEX Continuing Professional Development Record* is attached	☒

Reference 1	
Name of referee: Prof. David Wands	Role: Head of Department
I confirm that a *Reference Form* in support of my application is attached	☒

Reference 2	
Name of referee: Dr Hooshyar Assadulahi	Role: Principle Lecturer; Unit Co-ordinator
I confirm that a second *Reference Form* in support of my application is attached	☒

I declare that the information provided is true and accurate to the best of my knowledge and confirm my commitment to maintaining, developing and enhancing my professional knowledge, skills and competence through continuing professional development.

Signature: Karen L. Masters Date: Friday 13th October 2017