

Perspectives on Science

Course Development

Perspectives on Science (PoS) began as an innovative AS level in the History, Philosophy and Ethics of Science. Now it is offered as a Designed Programme within the Level 3 Extended Project. This is equivalent in size, status and UCAS points to half an A level.

The development of PoS has its roots in conversations amongst A-level science teachers who were keen to promote discussion and debate of historical, philosophical and ethical questions associated with science, and to make such debate a recognised part of the curriculum. At an early stage, the Royal Society Education Committee expressed interest in the project, and a grant from the Royal Society supported meetings of a project team and advisors (including Sir Alistair Macfarlane and the late Sir John Ziman). The project team is led by Dr John Taylor, Director of Critical Skills at Rugby School, and comprises teachers, academics and curriculum developers. With the subsequent award of grants from the Wellcome Trust and the (former) Particle Physics and Astronomy Research Council, the team was able to work with Edexcel to draw up a specification and assessment scheme, and to research and develop course materials for teachers and students.

Course Structure

The main aim of *Perspectives on Science* (PoS) is to help students develop skills of research, analysis, communication and argument in the context of the History, Philosophy and Ethics of Science. The eventual goal is that students should learn to develop, and defend, their own point of view on a range of scientific issues.

The emphasis throughout is on the development of skills, rather than the learning of factual content. As the skills required are quite complex and sophisticated, and novel for students at this stage in their education, they are explicitly taught in PoS rather than their development being left to chance.

Students spend approximately half the course learning relevant skills and vocabulary in the context of selected case studies. In the second half, they carry out individual research projects in which they research the 'story' behind a question with a scientific dimension, explore ethical and philosophical aspects of that question in depth, and present the outcome of their research both orally and in writing.

Course Materials

The course materials, which are published by Heinemann, use a variety of scientific examples (such as cold fusion, genetic testing and artificial intelligence) to introduce students to historical research and to ethical and philosophical argument. The materials also provide guidance for individual project work.

Nature of Assessment: the Research Project

PoS is a highly unusual qualification in that assessment is entirely by an individual research project in which students develop and demonstrate skills of research, analysis and argument. Students write a 6000-word report of their project and make a ten-minute oral presentation to their peers and a teacher-assessor. There are few constraints on project topics other than that they must be rooted in a science 'story'. In the last year alone, top quality work has been produced on questions as varied and challenging as the ethics of treatment of PVS patients, the philosophy of quantum mechanics, and the use of great apes in vivisection.

The assessment of PoS is designed to be 'fit for purpose'. As there is no prescribed content, and the emphasis is on sustained research and argument, a written exam would be

inappropriate. We are aware of, and share, concerns about some teacher-assessed coursework (that it can be reduced to sterile hoop-jumping, and abused through collusion and plagiarism) and we have striven to ensure that the PoS project leads to valid assessment of a worthwhile task. The issue of plagiarism is explicitly addressed: PoS students are taught what it is, why it is wrong, and how to reference source material correctly.

The PoS research project is a substantial piece of work occupying half the course. Students first formulate a research question then, with the teacher acting as a 'thesis supervisor', they carry out a literature search, state their own point of view, and present arguments and counter-arguments relating to their research question. Throughout the research period, students are expected to have frequent discussions with their teacher/supervisor and to contribute to work-in-progress seminars.

Students produce a written report of their research, structured under headings conventionally used for academic papers (Abstract, Introduction, Literature Review, Discussion, Conclusion) and must reference all sources using footnotes and a bibliography. Finally, they give a ten-minute oral presentation on their work to an audience including their teacher, and respond to questions.

The written reports and oral presentations are marked by teachers using criteria provided by Edexcel. The written reports are subject to moderation by external examiners, and for the oral presentation a second assessor is present in addition to the class teacher.

The complex and sustained nature of the research project, the supervision and reporting-back built into the research process, and the requirement for oral presentation, make it very difficult for students to collude or to indulge in wholesale plagiarism, and we are confident that the projects produced by PoS students are genuinely the result of their own work.

Response to PoS

PoS has been running as a pilot free-standing AS for four years, starting with just 69 students in a small number of schools. Since then, a growing number of both science and humanities students have taken POS; in 2007, 230 students from about 30 schools and colleges around the UK gained a POS qualification; in 2008, there were 343 entries.

Teachers and students have responded enthusiastically to PoS. Typically, a teacher described POS as 'a real breath of fresh air in a very stuffy curriculum' while students are equally positive. 'I have really enjoyed the course ...it has given me the opportunity to research a topic that I otherwise wouldn't have had the confidence to approach [and] taught me how to carry out a major piece of academic work.' 'The course was great because it allowed me to keep up my interest in things scientific despite not taking any sciences at A-level [and] honed my thinking skills.'

PoS has been welcomed by universities. For example, PoS Advisory Panel member Dr Graeme Gooday (Senior Lecturer in History & Philosophy of Science and Director of Learning and Teaching in the Department of Philosophy, University of Leeds) writes "This is a truly excellent innovation in AS learning that equips students not just with unparalleled research skills that will benefit them throughout their higher education and/or employment, but it also gives them advanced understanding of the important yet complex engagement between the humanities and sciences in ways that no existing qualification comes close to rivalling."

PoS students

The PoS course is aimed primarily at post-16 students with an interest in the implications of science. Some of these students specialise mainly in science subjects, while others are studying mainly humanities and may be taking no other science-related subject. Many take PoS in addition to the normal AS/A-level timetable.

Pilot centres represent a broad range, having a wide geographical distribution and encompassing all types including sixth-form and FE colleges, and 11-18 schools in both the state and independent sectors.

Examiners and moderators have commented favourably on the high standard of work produced by PoS students, particularly in comparison with, for example, General Studies. The PoS course is a demanding one. Experience over the past two years indicates that it tends to be the more able and motivated students who complete and submit their research projects, and the grade statistics are skewed towards the high grades. Weaker or less-hard-working students are less likely to complete the course.

The following comments from students indicate that they appreciate the value of PoS in developing their thinking skills and in preparing them for degree-level work.

"Regarding the PoS course, I have enjoyed the independent work which allows us to pursue our own interests. I thought the sections on critically analysing an argument and summarising work were very useful. In my case, it has helped me with my university applications as I was asked about it in several university interviews, and the interviewers seemed somewhat impressed that I was given the opportunity to perform my own research into an area of my choosing. Above all I have enjoyed this course so am very happy I decided to do it."

"I have really enjoyed the PoS course, mainly because it has given me the opportunity to research a topic that I otherwise wouldn't have had the confidence to approach. The course has taught me how to structure and carry out a major piece of academic work, which has been useful in other subjects and will be extremely helpful at university. I am also grateful to have had the opportunity to do an oral presentation. I don't do drama or any languages and thus this has been an invaluable and useful skill to learn."

"The Perspectives on Science course was great because it allowed me to balance my curriculum and keep up my interest in things scientific despite not taking any sciences at A-level. The course honed my thinking skills and skills of critical analysis. Part of my coursework was sent with my Oxbridge application and I think it was a strength of my application. The piece offered a more unusual aspect of history and demonstrated how history has dramatically influenced modern interpretations in the philosophy of science. Philosophical discussions on both Kuhn and Marx formed a large part of my interviews and I was prepared for the rigorous debate by the Perspectives on Science course. I felt that in choosing a topic to research in such depth I was able to study something that suited my interests and has changed my outlook on a number of things."

Latest Developments

In the academic year 2008/09, PoS has moved to the new Extended Project (EP) assessment framework. This new framework accredits project work with a qualification equivalent to AS. PoS has played a highly influential role in shaping the development of the EP, establishing standards and providing a model for other such courses. The PoS project team has worked closely with the Qualifications and Curriculum Authority and with Edexcel. John Taylor has been appointed Edexcel's Chief Examiner for Extended Projects. Currently, a team of writers is producing resource materials to support Perspectives style teaching and learning in different subject areas. These will be available from Spring 2009.

A conference was held at Rugby School on May 13 2008, addressed by Professors Simon Blackburn, Niall Ferguson and Michael Reiss, and Dr Ralph Levinson, exploring the value of PoS as a model for the Extended Project.

Professor Niall Ferguson, of Harvard University, writes: "Five years of teaching in American universities have convinced me that English secondary education has two fundamental weaknesses. There is still too much

reliance on exam-based assessment, which encourages cramming and learning by rote. And the A-level system perpetuates the fatal 'two cultures' divide between Arts and Sciences. That's one reason that even stars from the best British schools find the going tough at Harvard. They're not ready for continuous assessment. And they're not ready to spend the morning on literature and the afternoon on physics. The appeal to me of the Extended Project, as exemplified by the Perspectives on Science course pioneered at Rugby, is that it offers a cure for both these problems."

Dr Ralph Levinson, of the Institute of Education at the University of London, who has led the Wellcome funded academic study into PoS, writes: "There is no doubt that both teachers and students are enthusiastic about this course. Students welcome the independence, the opportunities for exchanging views and researching topics in depth. One of the most illuminating comments was from a science teacher who felt the course had opened up his thinking so that teaching science in a social, historical and ethical context to younger pupils was now part and parcel of his pedagogy."

Professor Michael Reiss, of the Institute of Education, writes: "For too long school science and mathematics education have been pre-occupied with short-term demonstrations of competence under examination circumstances. The new extended project is a breath of fresh air. It provides the opportunity for students to develop their intellectual muscles by researching a topic they have chosen rigorously and in depth. This should prepare them better for higher education studies and the world of work."

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