Informal Physics Education in Lifelong Learning, Outreach & Recruitment

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Introduction

This paper concerns informal physics and astronomy education in a variety of contexts and its relationship to the recruitment of students into formal educational programmes. It draws on my personal experience of the distance education programmes of the UK Open University, the outreach activities of the Edinburgh International Science Festival (EISF), and the life-long learning activities of the Oxford University Department for Continuing Education. All of these institutions have some degree of engagement with young people (particularly the EISF), but this paper will mainly concentrate on adult learners. Each institution will be briefly described, along with some indication of its role in informal education and the effect of that informal educational activity on formal recruitment.

Recruitment and informal education

Recruitment is a concern in all universities, particularly in physics departments where there are many well documented cases of declining recruitment. Many universities would like to recruit more physics students; all would like to recruit the best.

Informal physics education is important in its own right because of its role in supporting scientific literacy, effective citizenship and social inclusion. It is certainly not the case that informal education is a mere adjunct to more formal kinds of education. Nonetheless, it is a simple fact that some of those who become involved in informal physics education develop a deep a desire to move into more formal physics education and will do so provided they have the appropriate opportunity. Thus, its involvement in recruitment to programmes of formal education is another important aspect of informal education.

The Open University

The UK Open University was founded in 1969. As its name implies, it was established to operate an open access policy and to make university education available to all those who could benefit from it. In order to meet the goal of maximum openness, all of its courses are modular and are primarily designed for part-time study, at a distance, though full-time study has always been a possibility. Undergraduate students are provided with purpose produced teaching materials in a range of media. Their learning is generally supported by a course tutor based in their region, and their experimental work is mainly concentrated in a number of week-long residential schools that are held in conventional universities during the summer vacation. Course grades are determined from a combination of continuous assessment and conventional closed-book exams held in exam centres all across the UK and beyond. Initially, admission was limited to students over the age of 21, but that restriction was lifted many years ago an a significant number of 18 year olds now opt to take their first degree with the OU.

Over time the Open University has grown to become the UK's largest university in terms of student numbers. In total, more than 2 000 000 students have studied with the OU and there are currently about 200 000 students enrolled in any one year, about 5000 of whom are based

in Continental Western Europe. Annually, about 5000 students embark on science studies at the OU, about 500 take introductory physics, and about 600 take introductory astronomy. The average student has a family and a full-time job, and is aged about 30. His/her OU degree will typically take 6-8 years and will cost the student about 6000 euros in accumulated fees.

The OU and TV broadcasting

The OU was initially conceived as a 'university of the air' that would work in partnership with the British Broadcasting Corporation (BBC) to transmit filmed lectures into people's homes. However, this idea was soon replaced by a 'blended teaching' model in which a wide range of programmes from the BBC/OU Production Centre were used alongside a range of media, primarily print. Although the value of broadcasting as a primary teaching medium may have been initially overestimated, the value of broadcasting in recruitment soon became evident. Many people who saw OU broadcasts found them interesting and comprehensible, and were thereby persuaded that might have the ability to undertake degree level study. This prompted some of them to register as students.

Developments in technology, and changing expectations on the part of broadcasters and audiences meant that the more didactic TV material progressively moved from broadcast (1980s) to video (1990s) and then to DVD (2000s). Broadcasting continues, but it is increasingly devoted to general service programming for the purposes of scientific literacy. Nonetheless, it still has some effect on student recruitment.

It is interesting to look at two examples that illustrate this development. The TV programmes produced for the third-level course *Understanding Space and Time* were typical of the course related programming of the 1970s. These were didactic programmes, co-produced with the University of California at Los Angeles, in which the distinguished astronomer George Abell and physics Nobel Laureate Julian Schwinger presented cogent insights into the structure and development of relativity and cosmology from a range of international venues. In contrast, the general service broadcast series *What the Ancients Did for Us* is a typical product of the 2000s. The style is much less formal. The presenter, Adam Hart-Davis, is a well-known TV personality, not an academic, and the emphasis is on accessibility. Despite the OU connection, those watching the programmes are unlikely to imagine they are watching anything like a university lecture. *What the Ancients Did for Us* ran for nine weeks from February to April 2005. 2.7 million people (11% of the total UK audience) watched the weekly broadcasts

Two other examples, both from 2005, will give some sense of the scale of impact that can be achieved through general service broadcasting of this type:

In the case of *Stardate Titan*, 1 million viewers watched live reports from ESA HQ and elsewhere as the Huygens space probe landed on Saturn's moon Titan on 14th January 2005. The programme had special access to the OU's Prof John Zarnecki, a long-time member of the Huygens science team and PI for the surface science package.

Rough Science, was broadcast weekly in January and February 2005. On average 1.7 million people watched each broadcast as a team of scientists tackled a series of 'survival' challenges on the island of Zanzibar.

In addition to the programmes themselves various 'follow-up' services are available through the website www.open2.net. The site includes a discussion forum, broadcast schedules and information about relevant OU courses. It has a clear role in student recruitment and is supported by the OU because of its contribution to recruitment.

The Edinburgh International Science Festival
The Edinburgh International Science Festival is an annual event that features both a family programme and a series of events for adults. It takes place over a period of about a week at Easter time and occupies several venues all across the city of Edinburgh. The family activities are mainly based in the Assembly Rooms in the elegant New Town district. The programme of lectures for adults is mainly based in the lecture theatre of the Royal Museum of Scotland, but a number of other venues are also used, including facilities hired from the University of Edinburgh. (There is also a schools programme that operates outside the time of the festival itself.)

The Festival programme is established a year in advance with advice and help from practicing scientists who comprise a Programme Advisory Committee. Speakers are drawn from across the UK and beyond. The Festival is concerned with science in general (including maths and technology), but physical science is always well represented in the annual programme, especially through astronomy and cosmology. My own contributions to the Festival have ranged from presenting lectures on the physics of time travel and the history of quantum physics, to fronting a live audience conversation with Sir Arthur C Clarke (via a satellite link to his home in Sri Lanka) and chairing a press conference on Scottish Innovation.

Over the years the total number of events in the adult programme has varied between about 60 and 100, involving a total of between 22 000 and 42 000 people. The family programme (which also attracts adults) involves a roughly similar number of events (though they are generally of a more 'hands-on' nature) and generally attracts about 45 000 participants.

Many of the events are sponsored by individual universities and/or learned societies (University of Edinburgh, Napier University, Heriot Watt University, The OU in Scotland etc.). The Festival organizers are sensitive to the fact that some of those who sponsor events are educational institutions with an interest in recruitment and are happy to allow a reasonable level of recruitment related activity during the sponsored events (handbills and flyers can be distributed to the audience, banners placed on the stage etc.)

Universities are also encouraged to buy advertising space in festival programme which is printed in large numbers and freely distributed to people in and around Edinburgh and beyond.

Oxford University Department for Continuing Education
Oxford University has one of the UK's oldest 'external studies' departments, now known as the Oxford University Department for Continuing Education. Its many areas of activity include continuing professional development courses, international programmes that draw a wide range of specialist groups to the academic environment of Oxford, online learning, and public programmes that consist of a wide range of day and weekend events together with a variety of ten and twenty session weekly classes (many of them evening classes) and several residential summer schools. The Department also has strong links with Kellogg College, the youngest of Oxford's 35 colleges, which provides an academic base for students working towards a number of post graduate qualifications. Thanks to this broad spectrum, the

educational activities of OUDCE range from highly informal to very formal, and the Department provides members of the public with the opportunity to move from one end of that spectrum to the other. There is also movement between the programmes of OUDCE and the similar programmes at other universities. For example, some students who participate in the more informal OUDCE activities will eventually enrol in formal undergraduate study at the Open University. Similarly, some of those who have studied formally with the Open University will choose to continue their study through OUDCE.

The OUDCE public programme in Physical Sciences is nothing if not wide-ranging. Listed below are some of the public day and weekend events that have been presented over the last few years, mainly at Rewley House, the Oxford home of OUDCE. The programme encompasses the whole of physical science (including astronomy, chemistry, geology and biophysics) but in selecting illustrative examples I have deliberately emphasised the more strongly 'physics' oriented courses, even though this fails to reflect the full richness of the programme.

2006: Magnetism and the Cosmos; Plasma - the forth state of matter.
2005: The geology of hard and soft rocks; Planets of the Sun and other stars; The Expanding Universe; Satellites of Planets, Stars and Galaxies; The Dysfunctional Brain; Einstein on Trial.
2004: Stars: their Birth, Life and Death; Earth's Geological Riches; Frontiers of Fundamental Physics; Life in the Universe; The Molecular World; Science and the Oceans.
2003: The Functioning Brain; Galaxies and the Universe; The New Universe (dark energy and all that); Cosmic Origins The Rapidly Changing Earth; The Sounds of Science.
2002: The Beauty of Science; Understanding the Big Bang; Quantum Physics in Action The Violent Universe; Volcano Day; Understanding Quantum Physics.
2001: Space, Time and the Universe; Frontiers of Cosmology - The Early Universe; Introduction to Cosmology; Matter in the Universe; The Physical World; Microworlds.
2000: Frontiers of General Relativity; Introduction to General Relativity; Astronomy; the way ahead; Highlights of 20th Century Science; Science from Space.
1999: Frontiers of Quantum Physics; Introduction to Quantum Physics; Looking into the Sun; Astronomy Now; Approaching Absolute Zero; Antimatter: Fact, fiction and application
1998: Understanding Relativity; Time and the Earth; The Exploding Universe; Extinctions; Marvellous Molecules.

A few highlights from earlier years include:
FTL: Faster Than Light (1997); Superstrings and Fundamental Forces (1997); Medical Imaging; Science, technology and clinical practice (1996); The Quantum Universe (1996); Electricity in Nature (1996); Inside the Nucleus (1995); Entropy, Chaos and the Arrow of Time (1995); Einstein, Space and Time (1994); The Importance of Magnetism (1994); Lasers and Holograms (1993) The Importance of Light (1993); The Importance of Gravity(1992)

As an example of the somewhat more formal weekly classes (mainly evening classes, consisting of ten 2 hour sessions delivered over a ten week term), here are the classes offered inside and outside Oxford in the academic year 2004-2005.
In Oxford: From $E = mc^2$ to Black Holes; Planetary Landscapes; Earth's riches; Matter in the Universe; The Geology of the Ice Age; Introducing Geological science; Introducing Astronomy.
Outside Oxford: Science in Art; Quantum Physics; An Introduction to the Universe; The Human World in the Physical Universe; Fossils; The Amazing Universe; Worlds in Space.

The weekly classes provide a particularly important link between formal and informal physics education. Many of the students are drawn to the classes purely out of interest, but the classes are now required to offer the students the chance of obtaining formal credit. The activities that lead to credit vary quite widely, and are sometimes resented by those with no interest in obtaining any formal recognition of their study. Nonetheless, the accreditation is valued by others and has been used to help some make the transition into formal university education.

One particularly interesting example of 'informal' education that deserves a mention is the physical science contribution to the Oxford Discovery Programme. This programme is offered in the extraordinary environment of the Cunard ocean liner Queen Mary 2. The ship, currently the world's largest ocean liner, spends part of each year cruising, but much of its time is devoted to Atlantic crossings between Southampton (in the UK) and New York (in the USA). These crossings take about a week and include five full days at sea. On each crossing the Oxford Discovery programme occupies these five 'sea days' and typically consists of four or five parallel courses covering a wide range of topics. Physical science is often one of these topics. The teaching facilities on board the Queen Mary 2 are outstanding. In addition to well equipped lecture rooms and excellent computer facilities that provide internet access at all times, the main lecture theatre also contains one of the ships major attractions; the world's only ocean-going planetarium. The planetarium shows help to give astronomy a particular prominence on the QM2 and astronomy courses are a highly successful part of the Oxford Discovery Programme according to the assiduously collected audience feedback. There is not yet any direct evidence that the Oxford Discovery programme has provided the sort of links between formal and informal education discussed elsewhere in this paper, but Oxford does use the opportunities provided by the QM2 to make information about its Oxford based programmes available to those who might be interested and through this it might be expected that there will, in due course, be some formal recruitment resulting from what the informal activities that take place on this extraordinary ship.

Conclusions

The success of outreach activities by the OU, EISF and OUDCE show the enormous public thirst for informal education in the physical sciences.

The activities of these bodies have been highlighted in this paper, but they are, of course, just examples of informal education.

The flow of students from these informal activities to the more formal teaching available from Oxford, the OU and elsewhere, illustrates the important links that exist between informal and formal education in physics and astronomy.