POSTNOTE

Number 382 June 2011

Informal STEM Education

What is Informal STEM Education?

Informal STEM education takes place outside the classroom environment. It aims to inspire students through hands-on, experience-based activities that can enrich and add value to their school experiences. Initiatives range from those at national level, to more localised ones often made possible through small public engagement grants. Informal STEM education takes place in many contexts, from universities, learned societies and science museums, to after school and local nature clubs, as well as in the home. This POSTnote describes the informal sector's links to formal STEM education and its contribution to the national STEM learning agenda. It complements a forthcoming note on STEM education for 14-19 year olds.

Goals of Informal STEM Education

The informal STEM sector, working in partnership with schools, can provide many opportunities to complement and extend students' formal education. Informal STEM initiatives can help **improve students' attitudes to science**; access to rare objects or large-scale scientific instruments can boost their enthusiasm. Meeting practising scientists can help to **change students' pre-conceived ideas about scientists and scientific careers**. For example through 'Researchers in Residence', funded by Research Councils UK and the Wellcome Trust, young researchers are placed in schools. Informal environments can help to **improve students' behaviour**; students experience team work, responsibility and communication with adults and peers. Informal STEM initiatives also **allow students to understand how science works** by conducting their own experiments. For example, 'Citizen Science' projects, such as lottery funded Open Air Laboratories, bring scientists and the public together to explore environmental issues and to generate data on the state of the environment. Such initiatives can also help improve students' confidence in their ability to 'do' science.

Background

The UK has a diverse informal STEM (Science, Technology, Engineering and Mathematics) education sector. The 2004 *STEM Mapping Review*, commissioned by the then Department for Education and Skills (DfES), reported over 470 STEM initiatives run by government and external agencies. Further reports[1] have highlighted the importance of informal STEM education, but identified various issues such as the need to improve access, increase coordination and measure impact. This POSTnote describes the UK's informal STEM sector, its progress in recent years and debate over its future.

Box 1. Examples of Informal STEM Initiatives.
A wide range of informal STEM activities take place in the UK, managed and funded by diverse sources. Selected examples are given below.

Many activities take place at **museums** and **science centres**. Each year, about 6 million school children take part in workshops and activities organised by the 50 member centres of the Association of Science and Discovery Centres (ASDC).[2] Unlike national museums, science centres receive no ongoing government funding. Their largest funding injection was in 2000, when the Millennium Commission awarded over £450m to 18 science centres in the UK (see POSTnote 143). However many have struggled to secure long-term funding, and centres in Ayrshire and Doncaster have closed.

Award schemes are also popular. One example is the CREST awards scheme for research projects in STEM subjects, run by the British Science Association (BSA). It reached 25,000 11-19 year olds in 2009-2010 and has funding of £1million for 2010-2011 from the Department of Education (DfE) and the Department for Business, Innovation and Skills (BIS). The BSA also runs **science festivals** and a **national science competition.**

STEMNET is an organisation which aims to help young people achieve their potential in STEM. It has three core areas of activity:

- STEM Clubs: in 2010 there were 1,469 **after-school STEM clubs** funded by the DfE at £9.1m for four years up to 2010-2011.
- STEM Ambassadors: act as positive **role models** for students in schools. There were 24,315 in 2010. The scheme was funded by BIS at £10.7m for six years to 2010-2011.
- STEM Brokerage: provides schools with **impartial advice on accessing STEM activities**. It is funded by BIS at £12.7m for six years to 2010-2011.[3]

Informal STEM initiatives can also allow students to **improve their knowledge of science**; they can gain a better understanding of facts by participating in discussions and having the freedom to make mistakes. Students can also choose to learn more about a topic of personal interest than the curriculum allows. For example, schemes such as 'Time-for-Nano' go beyond what is possible in the classroom. The scheme, run by the ASDC (Box 1) and

funded by the European Commission, has provided 100 trained teachers with "Nano-kits" so students can learn about nanotechnology through hands-on activities.

Practitioners say greater use could be made of the informal sector's expertise and infrastructure. To encourage teachers to engage with the informal sector, an increasing number of initiatives contain explicit links to the curriculum. Also, the growing use of digital and virtual experiences enables more personalised and mobile learning. For example, the Natural History Museum's NaturePlus card allows visitors to save exhibition content, such as images or interesting facts, and view it online later. In addition, increasing numbers of informal education institutions offer professional development for STEM teachers.

Challenges for Informal STEM Education

In its *STEM Programme Report* in 2006, the Department for Children, Schools and Families (DCSF) set out an aim to make the informal STEM system more coherent for both policy-makers and teachers. A National STEM Director and a ministerial steering group were appointed to coordinate STEM policy. In 2008, the 'STEM Directories' were launched, supported by BIS and DCSF, to provide teachers with information on the range of informal activities available. STEMNET (Box 1) is a further example of a national initiative to improve coordination between schemes. However, several challenges still remain, including measuring the impact and improving the reach of informal activities; these are discussed below. The Wellcome Trust is proposing a major review of the field during 2011-12.

Measuring Impact

Measuring the impact of informal STEM education is not straightforward. Since students are often exposed to a variety of experiences, impact is difficult to attribute to specific activities. Moreover, any improvement in academic understanding or attitudes towards science may not be seen immediately. Much of the research on measuring impact has focused on science centres. The Scottish Government commissioned a two year study on government-funded science centres in Scotland. It found that 29% of visitors left with an improved attitude to science, and that the science centres were effective in demystifying science and helping visitors to understand its relevance to their lives.[4] Several reports demonstrate a correlation between childhood informal STEM education experiences and STEM interests later on in adulthood. However, proving direct cause and effect for particular experiences would require long-term follow-up studies, making such research resource intensive and difficult to achieve for every initiative.

Unequal Access to Informal STEM Education

Beyond the classroom, the inclination of families to take part in activities is a key factor in determining access. For students, several additional factors result in unequal access:

- the willingness and experience of each teacher. Lack of expertise, especially with primary science teachers, can result in them maintaining a classroom structure instead of promoting a more interactive learning environment.
- informal activities do not always lead to easily measurable academic success and therefore may not be a priority for teachers already struggling to deliver the curriculum.
- teachers may be deterred by logistical or administrative challenges such as health and safety issues, risk management, cost (both to the school or to the individual students), location of venues, and providing teacher cover.
- the individual school's commitment to STEM education, as well as the attitudes of department heads towards informal STEM education. Schools with science specialism are often able to appoint STEM coordinators. These are generally non-teacher posts funded through the Specialist Schools and Academies Trust. However, some teachers have also taken on the role part-time or managed to raise enough money to pay their own salary.

Student access to informal learning is dependent on teachers and schools. As a result, practitioners find that the same schools tend to engage with the informal sector year on year. A 2010 report found that 12 percent of secondary schools did not use any core STEMNET activities (Box 1). It also found considerable regional variations, indicating the need for targeted incentives to improve uptake.[3]

Future Prospects for the Sector

The current government has acknowledged the strategic importance of STEM and the need to encourage more students to choose STEM subjects and careers. In May 2011 the Minister for Universities and Science acknowledged the importance of engaging the public with science and highlighted the government's commitment to renewing the £6.3m support for STEMNET (Box 1).[5] The 2011 review of the National Curriculum and the Education Act aim to increase schools' and teachers' freedom in deciding how to teach, which could mean the informal sector will have an increased role to play in science education.

However, uncertainties over funding within the sector remain. For example funding challenges faced by universities may affect their outreach activities. Funding constraints at Local Authority level may affect activities such as STEM Brokerage (Box 1). This involves working with Local Authorities and schools to ensure resources are targeted at schools with greatest need of improvement in STEM subjects. A recent report by the Commons Science and Technology Committee raised concerns over the future of the National Schools Observatory. The report highlighted the importance of outreach activities by research councils and pointed to a need for more joined-up thinking in this area between research councils and government.[6]

Endnotes

1 DfES, 2006, *STEM Programme Report* and Lord Sainsbury, 2007, *The Race to the Top: a Review of the Government's Science and Innovation Policies*.
2 The ASDC, May 2010, *Assessing the Impact of Science and Discovery Centres*
3 National Audit Office, 2010, *Educating the Next Generation of Scientists,* HC492.
4 Morris Hargreaves McIntyre, 2011, *Final Visitor Research Report 2008-2010: Scottish Science Centre Evaluation,* Scottish Government.
5 http://www.stemnet.org.uk
6 House of Commons Science and Technology Committee, May 2011, Fourth report of 2010-11, *Astronomy and Particle Physics,* HC806.

POST is an office of both Houses of Parliament, charged with providing independent and balanced analysis of policy issues that have a basis in science and technology. POST is grateful to Seil Collins for researching this briefing and to all contributors and reviewers. For further information on this subject, please contact the co-author, Dr Chandrika Nath on nathc@parliament.uk.