National Assembly for Wales

Enterprise and Business Committee

Follow-up inquiry into Science, Technology, Engineering and Mathematics (STEM)

Evidence from the Field Studies Council – STM 10

National Assembly for Wales - Follow up inquiry into Science, Technology, Engineering and Mathematics (STEM) Skills (April 2014)

Executive Summary

1. Fieldwork and outdoor learning is vital for an imaginative and contemporary education programme, especially for science. Through fieldwork, young people become more engaged in science education (continuing into higher education), gain better subject knowledge and practical skills demanded by higher education and businesses, and are better placed to understand the value, and support the needs, of the natural environment. Therefore fieldwork and outdoor learning must be more embedded within the education and training of young people and professionals.

Introduction

2. The Field Studies Council (FSC) is a pioneering education charity committed to bringing environmental understanding to all. We currently welcome 145,000 visitors every year on courses to our UK network of 17 Field Centres. These include groups from nearly 3,000 schools, colleges and universities. Established in 1943, FSC is internationally respected for our education centres and is the UK's leading provider of curriculum focused field courses.
3. FSC is also a leading UK provider of biodiversity and ecology related training courses for adult learners, with career development for professionals involved in ecology, natural history and landscape related disciplines and courses for leisure learners interested in discovering more about the world around them.
4. FSC provides informative and enjoyable opportunities for people of all ages and abilities to discover, explore, be inspired by, and understand the natural and built environment. We believe that the more we know about the environment, the more we can appreciate its needs and protect its diversity and beauty for future generations.
5. FSC has four centres in Wales: Margam Discovery Centre (Port Talbot), Rhyd-y-Creuau Field Centre (Conwy), Orielton Field Centre and Dale Fort Field Centre (Pembrokeshire). FSC is also a leading publisher in ecology and natural history, publishing nearly 150,000 identification guides and related resources every year, including Welsh translations of some of the popular foldout identification charts.

Information

6. FSC welcomes Wales' strategic agenda for science and innovation, and in particular the recognition it underpins Wales' aim "for healthy living in a resilient environment with more sustainable natural resources and valuing national culture and heritage" (p7). In this, we support and endorse the Grand Challenge priorities of Life sciences and health, Low carbon energy and environment, and Advanced engineering and materials.
7. More broadly, we welcome the focus on science education: the need for a "hugely stimulating" curriculum, improved continuous professional development (CPD) for teachers, outreach and real world experience for students; and Wales' 'green laboratory': the need for sustainable ecosystem management, and healthy habitats and species.

Added value of outdoor learning

8. Good quality day and residential fieldwork helps improve education standards and should be a vital element of an imaginative and contemporary education programme. Fieldwork helps students develop their understanding of subjects such as science as evidence-based disciplines, and acquire the hands-on experimental skills that are an essential part of those subjects.
9. It helps them gain a practical understanding of the world around them, builds self-confidence, test their abilities, take managed risks and develop a sense of responsibility and tolerance towards places and people. It also supports physical and emotional well-being.
10. Furthermore, and often more importantly, outdoor learning provides an exciting and memorable experience for young people which can enthuse and inspire them, and will help to transfer what they learn in school to their everyday lives through dealing with real world examples at first hand.
11. FSC experience has shown that teachers are frequently surprised by the abilities and interest shown by 'poorly performing' students in the outdoors, and by the extent to which outdoor learning has awakened their potential. Outdoor learning provides an interactive and highly visual arena for pupils to learn and this has translated into increased motivation, including for those that have poor attendance[i] .

STEM education and outdoor learning

12. There is much evidence highlighting that higher institutions and employers are increasingly concerned with students' lack of practical and fieldwork experience, critical thinking, independent learning, and confidence. Outdoor learning has a significant role in supporting these wider skills and can include inquiry skills such as making connections, drawing contrasts, analysing trends, framing questions, creating accounts and narratives. With the development of technology, this can also be enhanced with their use out of the classroom and in the real world. FSC welcomes the Wales' literacy and numeracy framework as it provides an important vehicle through which these skills can be developed through outdoor learning across all key stages, and thus support the development of STEM skills.
13. NFER's 2004 review of research on outdoor learning found substantial evidence that fieldwork and outdoor learning – provided it was properly conceived, adequately planned, well taught and effectively followed up – not only improves students' knowledge but also skills that add value to their everyday experiences in the classroom.[ii]
14. Wales risks missing out on a pool of potentially thousands of new scientists as a result of school students not pursuing STEM subjects even if they have an initial interest post-16. Young people at secondary school generally see less relevance in science to the real world, find it less inspiring, are less able to enjoy practical work, and feel they have less opportunity to use their imagination. Students are "turning off" science and this has created a shortage of core skills needed (academically and vocationally) in STEM-related and environmental disciplines and industry.
15. Recent PISA secondary science data from schools in 33 OECD countries has shown that in most countries, fieldwork and science-related extracurricular activities at school are related to better student performance, a stronger belief by students in their abilities to handle science-related tasks, and greater enjoyment of learning science. And, in many countries, this is true event after accounting for the socio-economic background of both students and schools[iii] .
16. English students performed highly in further PISA research on problem-solving skills (of the type greatly valued by higher education institutions and STEM employers). Students had developed these skills through schools' use of a variety of teaching and learning methods, including outdoor learning and cross-curricular activities. This variety of methods must be protected and further developed.[iv]

Progression within STEM subjects and outdoor learning

17. Outdoor learning is a core tenet of Wales' Foundation Phase education. Estyn's evaluation of outdoor learning highlighted the benefits, with children gaining high levels of engagement and enjoyment in the outdoors, and expanding their knowledge and understanding of their environment.[v] This mirrors FSC's own experience of working with primary students. However, this enthusiasm dissipates for many by the time they reach GCSE level.
18. While the Welsh government is right to focus on increasing student uptake of STEM subjects at GCSE and A-level, this issue will never be fully resolved if the important shift in student attitudes to STEM subjects between primary level and GCSE is not addressed. Particular attention must be directed to maintaining students' positive attitude to science through all key stages, and in particular the negative impact of the Key Stage 3 'waiting room' period must be tackled. FSC welcomes the strong focus of the recent curricular review (phase 1) on increasing work with external partners and project work at KS3 which has huge potential for the development of STEM skills and fieldwork and for redressing this worrying disengagement.

Teaching and outdoor learning

19. Wales is currently failing to produce sufficient numbers of primary and secondary teachers and support staff with the competence, confidence and/or commitment to meet the modern day challenges of teaching fieldwork to the next generation of children and young people.
20. FSC research and significant on the ground experience has shown that any reversal in the decline in fieldwork will have to be led by teachers. Practitioners must be equipped with the knowledge, skills and experience to deliver effective fieldwork, and therefore should be supported and encouraged to go beyond the classroom through appropriate initial teacher training and quality CPD.
21. Estyn's 2011 evaluation of outdoor learning during the Foundation Phase underscores the importance of practitioners having the necessary skills and training to be able to effectively assess students' development in the outdoors, along with the need for appropriate monitoring systems and the active support of school leaders. Estyn outlines a number of recommendations, which FSC fully endorse.

Natural environment, professional skills, and outdoor learning

22. FSC wholeheartedly endorses and supports the agenda's theme of Wales as a 'green laboratory'. With this comes the recognition that much of the natural environment and sustainable development policy is dependent on a knowledgeable, appropriately skilled and supportive community. We support the desired outcomes for the environment (percentage of habitats and species that are stable or improving, number of lakes, rivers and coastlines achieving good ecological status).
23. To achieve this, Wales must address the critical skills gap in fieldwork (e.g. practical monitoring and data gathering, including taxonomic and identification skills), as identified within Wales' STEM agenda, the Institute of Ecology and Environmental Management,[vi] and the Environment Research Funders' Forum.[vii]
24. FSC has previously run a biodiversity training project where 5,000 volunteer training days resulted in over 70,000 biological records being obtained. The success of these training days highlights the fact that appropriate training programmes can significantly increase the involvement in, and profile of, ecosystem management. This would ensure that Wales has access to a wide range of individuals who have the interest, knowledge and competency to develop and deliver key activities such as area management and biodiversity monitoring/recording in areas such as biological corridors and marine processes.

Research Excellence Framework (REF) and outdoor learning

25. We understand the agenda's focus on the REF and its impact on Welsh research, funding, and international standing. However, FSC is concerned by the impact of the Research Excellence Framework (REF) on responsiveness within Higher Education. There appears to be a narrowing of postgraduate courses – at all levels including Certificate, Diploma and Masters – on offer to prospective students

because of the focus on REF research areas. This has led, and will continue to lead, to a loss of environmental courses which are essential for environmental sector businesses.

Recommendations

STEM education

- Outdoor learning and fieldwork be better embedded into the learning and assessment systems to ensure that students get real world experience. Fieldwork, fieldtrips and outdoor learning are used within the curriculum to inspire students' enthusiasm for science. High quality 'field experiences' can help to define life choices, tipping the balance in favour of post-16 science.
- Importance of practical fieldwork in areas such as biological recording and environmental monitoring are recognised, especially within the education system.
- Students are better informed of the wide range of opportunities and careers available to them by pursuing STEM subjects. Currently, there is a large gap between reality and pupils' perception of the skills needed for different careers.

Progression within STEM subjects

- The importance of outdoor learning should expand from Foundation Phase to all key stages. Schools should take this opportunity to increase work with external partners to ensure students remain active and engaged with their surrounding environments, interested in STEM subjects, and strengthen their practical and problem-solving skills.

Teaching (Initial teacher training, and continuous professional development)

- Fieldwork training to be mandatory and trainee teachers should: attend, and have an active role, in a school visit as part of their training; plan and lead a lesson with pupils outside the classroom as part of their training; and receive at least 4 hours of training in out of classroom learning as part of their Initial Teacher Training.
- Fieldwork to be a vital part of practitioners' quality (and accredited) professional development.
- All recommendations from Estyn's 2011 Outdoor Learning Foundation Phase evaluation report should be implemented.

Natural environment and professional skills

- A green economy's skills and capabilities is developed within Wales, strengthening the links and continuity between education and sustaining Wales' natural resources.
- Training in biological recording and environmental monitoring for professionals and volunteers should be implemented and promoted to ensure enough expertise and capacity is available for areas to be properly managed and monitored to support Wales as a green laboratory.
- A national facility – with public access – is developed which becomes the knowledge and information base which underpins ecosystems management
- Welsh Government carries out an audit of skills and knowledge gaps which need to be filled.

Research Excellence Framework (REF)

- The diversity of postgraduate courses on offer should not be driven by the REF alone. There should be a strategic framework and targets which are sufficiently focussed to ensure that the range of HE institutions maintain a capacity to be responsive to businesses and skills provision, including maintaining sufficient staff and resources to meet such postgraduate needs within an acceptable time frame.

For further information, please contact Dr Steve Tilling (Director of Communications, Field Studies Council) – steve@field-studies-council.org

[i] Field Studies Council (2012). *New views: lessons learned from the London Challenge residential courses*.
[ii] Rickinson, M, et al. (2004). *A review of Research on Outdoor Learning.* National Foundation for Educational Research
[iii] PISA in Focus (July 2012). *Are students more engaged when schools offer extracurricular activities?* OECD
[iv] National Foundation for Educational Research (2014). *Achievement of 15-Year-Olds in England: PISA 2012 National Report (OECD Programme for International Student Assessment)*. Department for Education. [Wales did not participate]
[v] Estyn (2011). *Outdoor learning: an evaluation of learning in the outdoors for children under five in the Foundation Phase.*
[vi] Institute of Ecology and Environmental Management (2011). *Ecological skills: Shaping the profession for the 21st century – Phase 1 research report.*
[vii] Environment Research Funders' Forum (2010). *Most wanted: Postgraduate Skills Needs in the Environment Sector*.