The Darwin Experience
Marten Lewis
The Darwin Centre
Pembrokeshire College
Haverfordwest
Pembrokeshire
Email:
Darwin@darwincentre.com

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Curiosity inspires, Discovery reveals

Synopsis

This article describes an education initiative, now based in Pembrokeshire, which has inspired thousands of school and College students, teachers, and members of the public, about cutting edge science and nature. The Darwin Centre is embedded in the education programme of Pembrokeshire, carrying out activities with all the schools there, and has had a major impact on student choices in STEM (Science, Technology, Engineering, and Mathematics) at University, and as a career. It is a model of how to develop and fund such initiatives outside the system that work with the system.

Origins

The Darwin Centre for Biology and Medicine (Darwin Centre) is a registered charity in the UK (No.1038170). It was original established in Penarth, in 1994, by Professor Anthony K Campbell, School of Medicine, Cardiff University, (now in the School of Pharmacy and Pharmaceutical Sciences), under the Chairmanship of Alec Webster, Chair of British Gas Wales, to provide a bridge between the University sector, schools and the public. The charity initially combined a research and public engagement in Biology and Medicine platform. During the 1990's The Darwin Centre supported school student projects through the national CREST scheme, held public lectures, glowworm hunts, and scientific meetings between schools and the University. Carrying out international class research, The Darwin Centre delivered expert led lectures and workshops, intended to build relations and understanding between researchers and the public. In 1999 Professor Campbell and his wife Dr Stephanie Matthews, relocated the Darwin Centre to their property, the Welston Court Science Centre, Milton, Pembrokeshire (Figure 1). After obtaining a grant from the Millennium Festival Fund, the first Pembrokeshire Darwin Science Festival was held throughout 2000, with public lectures, field trips, the Great Millennium Glowworm Hunt, debates on genetic engineering and evolution and religion, and a concert, bringing science and music together. This enabled The Darwin Centre to develop into a broader Science, Technology, Engineering, and Mathematics (STEM) engagement charity with the annual festival for schools and communities running alongside the research and engagement output. Between 2001 and 2005, The Darwin Centre was hosted by Pembrokeshire Business Initiative (PBI), and subsequently by Pembrokeshire College (its current headquarters). During this time

the Darwin Centre successfully developed small scale schools Science, Technology, Engineering, and Mathematics (STEM) programmes, with funding from such bodies as Barclays Bank, COPUS, Welsh Government, and the National Park Authority. A Research Laboratory is currently operated in partnership with Milford Haven Port Authority at Milford Haven Docks. For more detail on the Research and Engagement programme please see www.darwincentre.com

Figure 1 Invertebrate diversity in the Welston pond

The Darwin Experience

With over a decade's experience, a new education programme within the Darwin Centre – The Darwin Experience - was developed by Marten Lewis FRSA, in 2005. A proposal for which was submitted to the Milford Haven based Natural Gas Importing/regasification company, Dragon LNG, for consideration under its Corporate Social Responsibility community fund. The successful bid has yielded 13 years of continuous funding to date, forming over 85% of the total output of the Darwin Centre's education programme. Pembrokeshire County Council contribute around 10% of the costs, directly supporting the remuneration of the Project Officer, which enables the project to offer all schools in Pembrokeshire free access to the activities. Other funds from local grant providers include the Bluestone Foundation and the Sustainable Development Fund. Two fulltime members of staff, the Darwin Centre's Executive Director, Marten Lewis FRSA, and the Project Officer, Samantha Williams, develop and deliver the Dragon LNG Darwin Experience (Figures 2 and 3). Support from local STEM experts, who co-deliver around 10% of the output is paid for from the projects core budget. A team of volunteers, mainly from Pembrokeshire College's Science A Level students, support the programme.

A standard format comprises a field trip, followed by an in-class workshop widening context, linking back to the curriculum (cross curricular), and wider Global Citizenship and Sustainability.

Figure 2 Marten Lewis with pupils looking for life in rock pools

Rocky Shore Studies (Figure 2)

Field trip

- At a local beach, to study the physicality of rocky embayments, and a subsequent ecological exploration.
- Handle and examine rock types – discussing the rock cycle. Linking to ice ages and tectonic activity, that have influenced the sediments, rocky erratic's, cliffs and bays of Pembrokeshire.
- Historical, cultural and industrial links of Pembrokeshire's Geology – Limestone (Agriculture/house building), coal, slate, dredging etc).
- Identifying the broad diversity of flora and fauna on the rocky shore – expert knowledge dissemination, keys, previous research etc. links to climate change, invasive/alien species (aquiculture/shipping etc).
- Adaptations, food webs, life cycles, habitats.

Workshop

- Hands on Microscopy session. Learning new skills. Stereo microscopes to study plankton samples.
- Extending learning on life cycles, adaptations, and photosynthesis.
- Ocean currents, and the influence of weather and climate on the oceans.
- Understanding the massive influence that microscopic organisms have on the balance of life on Earth.
- Raising awareness of the relationship between terrestrial and aquatic exchange – the influence land based actions can have on the marine environment.
- Increasing knowledge on the interconnectedness of all life and systems on Earth.
- Global citizenship.
- Sustainability.
- Pollution (Figure 3)

Figure 3. Way ahead of the game - secondary school pupils making a film about marine plastics back in 2010 with Kirsten Hintner and the Sea Watch Foundation

Renewable Engineering

Field Trip

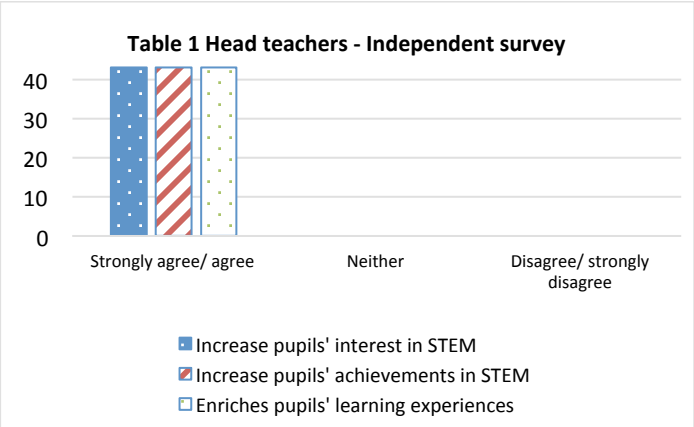
- Visit to Carew Tidal Mill to see first-hand large scale 16th century engineering. Carew is an intact tidal mill, which originally serviced a Castle and surrounding community's flour, oat and barley needs.
- Followed by a visit to a renewable energy company based in Pembrokeshire (there are several), to see devices that are being tested in tidal waters around the coast. Meeting engineers and experts in electricity production and renewable engineering.

Workshop

- Building wind turbine blades and testing them for efficiency
- Understanding the similarity between historic milling and electricity production.
- Electricity generation
- Understanding the need for renewable energy now and in the future.
- Understanding the current energy mix in the UK and other countries
- The debate around nuclear, the pros and cons of fossil fuels, the importance of gas in the UK's current mix.
- The impact on Pembrokeshire's economy and society – 2 gas terminals, a gas power station, a major international oil refinery, gas and oil storage facilities etc..
- Sustainability
- Innovation
- Careers

The outcome

In 2015, after a decade of delivering STEM field trips and workshops, a review was carried out on the impact of the Darwin Experience programme. A consultation with the Director of Children and Schools at the Local Education Authority, Head teachers, and Teachers produced much anecdotal evidence for the Darwin Experiences' impact on raising engagement, interest, pupil outputs, teaching, and aspiration. This was supported by an independent survey of Head teachers by Pembrokeshire County Council (2015) (see Table 1). Many events are being published in The Young Darwinian.



The consultation revealed that Head teachers felt the impacts were more substantive when pupils had the opportunity to engage with the Darwin Experience multiple times over consecutive years. Most often pupils had one experience during Primary schools. Increased impact through multiple contacts with Darwin Experience was tested with a cohort of male pupils at Ysgol Dewi Sant (St David's School). Over 2 years, a randomly selected group took part in field trips and workshops around STEM themes with the Darwin Experience - 6 events in 2 years. The cohort raised their attainment of predicted grades from 74% (Control group) to 94%, therefore closing the gender gap between boys (Darwin Experience cohort) and girls at the school. This was a key element on which the school had been asked to improve at their recent inspection by ESTYN (Wales OFSTED).

This statistical evidence led to the development of a larger 3 year case study 2016-19, which sets out to test the Darwin Experience model over 3 academic years with an entire cluster of Primary schools feeding into Milford Haven Secondary school, involving around 200 pupils. The pupils will take part in Darwin Experience led preparatory lessons (teacher guidance packs have been created), field trips, and follow up sessions, and guided (teacher packs) extension lessons in each academic year, from year 4 until the end of Primary school (Year 6). Local Government is monitoring the attainment levels of all pupils, and will be comparing past data with current data from other school clusters in order to evaluate the impact. Alongside this monitoring, there is an independent study being carried on the attitudinal changes towards STEM as pupils move through each of the 3 years.
The engagement of all relevant teachers in the primary schools and the secondary school is essential to the relevance of the programme, in terms of transition to secondary education. The Darwin Experience works directly with the primary school liaison officer from each secondary school, and engages with secondary school STEM teachers as part of the development of the primary programme.

The Model

The Darwin Experience's success owes much to the model the Darwin Centre has created. The long termism of the Darwin Experience programme has been crucial, enabled by the reliability of core funding, which has allowed the project to build a rapport around excellence, winning the commitment of local schools and the local Education Authority. The direct links to cutting edge scientific research (Darwin Research and Engagement) gives great credibility.
The main elements are:

- An expert led autonomous third sector group. Autonomy mitigates mistrust that can arise from a private sector sponsor which may be assumed to be influencing the development of programme.
- Direct links to research, and international scientists.
- A STEM industry sponsor, with a long term vision around STEM education. Private sector funding removes many layers of bureaucracy around Public monies, which allows greater efficiency and value on the funds.

- Time. It takes years to build the relationship with local education sector, before you can attain full take up of a comprehensive programme.
- A base at the local FE College, with access to labs, technicians, resources, and exhibition spaces.
- Continuous dialogue with schools and education experts in order to understand the needs of the schools.
- A relationship with the local education sector built on Trust; Loyalty; Commitment; Shared Value; Empathy; Communication; and Satisfaction - See www.darwincentre.com for a Masters Dissertation on this business approach through the Relationship Marketing paradigm (by Marten Lewis FRSA).
- The engagement of high quality mutually aligned partners e.g. National Park, National Trust, local industry etc., is essential.
- A teacher guidance pack to accompany the practical field/workshop based activities, maximising the impact of contact with the expert provider.
- An ongoing database of shared best lesson/experiences from teachers, as they develop their own resources around the guidance (shared between all teachers in cohort).
- Support of the 'parent' secondary school when working with feeder Primary's

The Darwin Centre hosts a range of lectures by international scientists (Figure 4).

Figure 4 Lecture on cancer to 6th formers

Recognition from Education bodies:

- 2018 - Sector Leading Practice: Education through Regional Working (ERW) - Welsh Government.
- The tripartite partnership between Voluntary and Private Sector, supporting the Public Sector

Some comments from teachers:

Michele Thomas, Headteacher, Pembroke Dock Community School:

"Pembroke Dock Community School is within a Communities First area. 36.7% of pupils are on Free School Meals (FSM). Llanion and Central ward are ranked as Pembrokeshire's 1st /10th most deprived areas. Townsend Deprivation Index rates Pembroke Dock Central and Llanion as among 'Most Deprived' electoral divisions in

Wales. The Centre for Economic and Social Inclusion reports 69.2% low income families and 45.5% workless families (P Dock). We highly value the Dragon LNG Darwin Experience, a high quality programme dovetailing into the curriculum, further enriching experiences. It is always popular with pupils, with high levels of engagement and participation. It provides access to additional resources and experiences that otherwise would not be available, providing opportunities that widen horizons, raise aspirations and expectations of our pupils. The expertise of the team supports schools and assist pupils gaining high outcomes. Activities that pupils remember as some of their fondest memories of primary school".

Kate Evan Hughes, Director of Children and Schools, Pembrokeshire County Council:

"Inspirational in raising the aspirations of young people, tailoring the project to engage their learning at their level. The team's passion only outweighed by their commitment to securing best outcomes, and a willingness to engage those around them to secure this, including the Local Authority! All schools in Pembrokeshire see the project as an integral part of the school curriculum; many Head teachers describe the project as 'inspirational".

Pupils comments

*"Such an **amazing experience** and something **unforgettable"***
*"It has **changed my aspect on science in our daily lives"***
*"I mostly enjoy that they **show you what they are talking about** as well".*

Private Sector recognition:

Core sponsors Dragon LNG, have been recognised by industry for their sponsorship of the Darwin Experience many times:

- Winner: 2017 UK Business in the Community, Responsible Business Award for Education (Figure 5
- Winner: 2016 South Wales Chambers of Commerce, Community Award
- Winner: 2016 Business in the Community Cymru, Responsible Business, Award for Education
- Finalist: 2015 Sustain Wales Awards
- Finalist: 2015 Business in the Community Cymru, Responsible Business, Award for Education

Figure 5 UK National BiTC Responsible Business Awards at the Royal Albert Hall with Karen Wood Dragon LNG

Imagine a private sector sponsored, autonomous 'Darwin Centre' in every education region. An inspiration for the future. The Darwin Centre has a close link with The Young Darwinian, which will publish regularly student projects and events.

Acknowledgements

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