CCITE

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CCITE Plan for Action 2019 and review Adrian Oldknow April 24th 2019

The first 3 months of this year have seen some very important developments related to our general area of interest called `Technology-enhanced STEM Learning Actions' **TeSLA**. This note is to highlight 5 of them which will form a significant agenda for the rest of the year and beyond.

1. **Micro:bits as a catalyst for cross-curricular STEM activities in primary and secondary schools**. By the end of July 2016 some 800,000 micro:bits had been distributed to secondary schools intended for 11-year old students. Shortly afterwards they went on general sale in the UK at around £15. In December 2016 we were donated 400 units by the Micro:bit Educational Foundation MEF for use by teams of 15-year old students on the Erasmus+ `Kids Inspiring Kids In STEM' **KIKS** project in Finland, Hungary, Spain and the UK. In December 2017 I was invited to join the Foundation as their first STEM Learning Ambassador. At BETT 2018 I met with the CEO, Gareth Stockdale, the CTO, Jonny Austen, and the Education Chief, Gareth James, to present my own suggestions for a UK educational strategy. One aspect of this, called `Robotics On Micro:bits' **ROM**, was to encourage schools to engage KS2 and KS3 students in developing group projects in `physical computing', bringing together aspects of the Computing and DT curriculum. The other, called `Micro:bits In Data Analysis for Science' **MIDAS**, was similarly aimed to support data-logging and modelling bringing together aspects of the Science and Mathematics curriculum. We are now beginning to explore larger scale implementation of ROM and MIDAS, as well as the development of a more ambitious educational Internet of Things **IoT** initiative.

2. **Digital Access For All DAFA, and micro:bits for `*Cinderella*' primary schools**. On February 24th the Learning Foundation and Nominet led the launch at the House of Lords of the new `Digital Access For All' **DAFA** initiative, supported by organisations such as Argos, BT, the Carnegie Trust, Intel, Lloyds Bank and Microsoft. This aims to significantly improve the ability of up to a million disadvantaged households to access the Internet, so that all learners have the same opportunities. I am STEM Adviser to the Learning Foundation which is already developing a STEM learning platform in partnership with Magpie Education. The Worshipful Company of Information Technologists WCIT, the parliamentary Digital Policy Alliance DPA and the National Educational Network NEN, are all supporting actions in line with DAFA's objectives. I hope we can find partners to work with to ensure that world-class STEM Learning resources and tools are made widely available to the new, and existing, digitally connected households. The Design & Technology Association DATA, where I am also an Ambassador, won a major Engineering Educational Grants Scheme EEGS award, supported by the IET and IMechE. This supports the `Bringing Design & Coding to Life' project, based on ROM, in which 11 primary school in Stoke-on-Trent, supported by 4 secondary schools, are introducing robotics projects to Y5/6 classes. We are building on the Stoke experience by developing micro:bit physical computing projects in a range of disadvantaged primary schools, starting in the Cambridge region, Fenland and the

East of England. The working title of `*Cinderella*' schools was to describe small primary schools which are aspiring to `go to the STEM ball' but don't have anything to wear or anyone to take them! Graham Hasting, a Computing At School CAS Master Teacher, is Head of Computing at St. John's College School SJCS, where micro:bits are in extensive use. He has been providing CPD for primary school STEM teachers in the Cambridge Teaching Schools Network and has designed a scheme of work for Y5/6 which is being introduced this Term. Graham's school is releasing him one afternoon per week to support the schools. The project is also being supported by Robert Leeman, Educational Solutions Manager at ARM in Cambridge. In parallel, a major project on similar lines is being planned for rural and coastal schools as part of KPMG's response to the government's Industrial Strategy, led by John Beer. This is starting in the region known as the Clackclose Hundred of parishes in and around Downham Market in South West Norfolk.
I gave a demonstration of ideas from the Stoke ROM project at a very well attended meeting of the Royal Academy of Engineering's `Connecting STEM Teachers' Sussex Network at the University of Chichester earlier this month. Following the event, I have been contacted by a group of 15 small primary schools in rural parishes in the Rother Valley area of West Sussex around Haslemere, Midhurst and Petworth. They are starting their own version of the ROM project which I am supporting with resources and professional development. Very many primary schools already teach *Scratch* in Computing, so the transition to coding in Microsoft's free *MakeCode* editor is very easy. It costs about £250 to equip a whole class with a micro:bit for each pair of learners, plus some other kits and components. In some cases, this has been found by the local Parish Council or community group. Organisations such as Rotary UK & Ireland and the IET's regional network can also help both with financial and human support. STEM Learning has £250 grants available for schools to bid for to equip STEM Clubs, as well as their own extensive local networks of Ambassadors.

3. **Data-logging, modelling and MIDAS**. The micro:bit already has on-board sensors for acceleration, light, magnetic field and temperature. External sensors can easily be connected to the input/output pins using crocodile clips, bare wire or bread-boards. At BETT 2019 I met Philip Meitiner, formerly International Program Manager at the Micro:bit Educational Foundation, who showed me a new project called XinaBox. Designed by a Dane who now lives in South Africa, it is an expanding collection of compatible units for data-logging, sensing, control and communication. On 21st March, Philip joined four members of our `Cambridge STEM Ring' (Graham, John, Rob and me – Nicholas Sample and Tony Houghton couldn't make it) to show us the basic XinaBox `Internet of Things' IoT kit, which he left with each of us. We are now working on an international STEM education project called `Schools Making Inspirational Learning Environments for STEM' **SMILES**. The XinaBox kit is already in use in schools in South Africa and the USA, and has some inspirational Space connections, including Virginia Space's ThinSat project and MEDO.SPACE. We also work closely with the developers of the free open-source *GeoGebra* software in UK, Austria and Hungary. They have already developed an Android application called `*Geomatech*' which streams data from selected sensors in a smart phone directly to *GeoGebra* for graphing and analysis over the Internet. The BBC micro:bit also has Bluetooth connectivity, so it can be used for data-capture by apps such as the *Bitty Data-logger* for Android and IoS. It can now also be used directly with *Scratch 3.* We are in contact

with colleagues in the Cambridge University Department of Engineering and its Dyson Centre about developing a range of sensors and science experiments for schools using micro:bits and Raspberry Pis.

4. **The Educational Internet of Things IoT**. The micro:bit was originally designed to help introduce learners of all ages to the basic ideas of the IoT, and for them to develop their own projects and artefacts. The wifi connectivity of the XinaBox components now makes the connection of devices like micro:bits and Raspberry Pis to IoT platforms much more practicable and economic. See, for example, this project using Ubidots. XinaBox are designing compatible devices for the popular LoRaWAN and Sigfox networks. We are exploring collaboration with partners, such as ARM, the IET and Oracle in taking this further in the near future.

5. **Technology-enhanced STEM Learning Activities TeSLA**. While much of the current activity has been focused around coding, physical computing, sensing and data-logging we have recently been approached by several schools asking for help with STEM enrichment during school hours. This term I am running a Masterclass series of eight 90-minute practical sessions of STEM enhancement for the 20 most able STEM Learners across Key Stage 2 (7-11) in Rose Green Junior School close to Bognor Regis. The pupils will undertake a range of tasks across Science, DT, Computing and Maths working in five teams of 4 learners. They will develop a portfolio of their work and plan a display for the end of term. I am developing a book of activities to support such STEM Masterclasses. The materials are available from the iSTEM+ group at STEM Learning here. We will use free STEM software tools including *GeoGebra, Tracker, Scratch 3, Algodoo, MakeCode* and *TinkerCAD* as well as capturing data with video clips, micro:bits and sensors. This could equally be offered at Key Stage 3 as well. With the collaboration of Science Education, Computing Education and STEM outreach colleagues at the University of Chichester's Institute for Education, we will also develop supporting video resources. Such Masterclasses could be supported by STEM Ambassadors from local employers, as well as through the local IET Sussex Network. Such a system could be developed nationally working with partners such as the ARM, the British Science Association, Enthuse, the IET, Microsoft and/or the RAEng. It could also be offered internationally as a major STEM education initiative.

As a footnote I was delighted to be asked to talk on the `*Seven pillars of STEM inspiration for the modern polymath'* at Uppingham School in Rutland earlier this month: "Curiosity, Creativity, Invention, Aspiration, Resilience, Communication, Collaboration". The talk was to a large group of science sixth-formers at the termly meeting of the `59 Club of Heads of Science' from leading independent schools. It is now posted on the iSTEM+ group at STEM Learning. Other recent resources are posted in the BBC Micro:bit Group.

A brief review of CCITE development.

(a) Our initial iSTEM+ local hubs were set up in Newbury and Gosport. They have since been joined by others in Banbury, Reading, Malmesbury, Dover and Medway. Others are in development such as Bordon, Chichester, Guildford, Fareham, Harwell and Portsmouth. Last June, Microsoft UK hosted our first iSTEM+ national conference at their Thames Valley Park HQ for learners, teachers and STEM organisations. Gomer Junior School's gSTEM won the TES STEM Team of the Year award. The Gosport & Fareham Multi-academy Trust GFM, won two prestigious STEM Learning Enthuse Tomorrow's Engineers Partnership awards (primary and secondary). GFM was visited by both the DfE Skills Minister, Anne Milton, and the DfE Schools' Minister, Nick Gibb. On March 1st the Secretary of State for Education, Damian Hinds, opened the new Gosport STEM Centre within Bay House School's Sports centre. This is the first of its kind, a community resource sponsored by local employers such as BAE System, the Royal Navy and the Solent LEP, based in a school.

(b) The Worshipful Company of Information Technologists WCIT, adopted the iSTEM+ approach in 2015 as the core of its STEM education and skills policy. I now represent the IET on the parliamentary Digital Policy Alliance DPA 21st C Skills Network which is seeking to broker STEM collaborations in strategic sites around the UK, starting with Plymouth.

(c) Through our recent links with ARM Education, the Norfolk ESTEAM Centre, the Cambridge Teaching Schools Network, the Cambridge CAS Community, the Raspberry Pi Foundation and XinaBox, CCITE is now more active in and around Cambridge than it has been for the last couple of years. We now have a core team of international STEM learning experts, including John Beer, Mark Dorling, Graham Hastings, Tony Houghton, Zsolt Lavicza, Pete Marshman and me, as well as fruitful collaborations with important organisations such as ARM Education, BCS, CAS, DATA, DPA, IET, IMechE, the Micro:bit Educational Foundation, the Learning Foundation, Microsoft, Oracle, RAENg, the Raspberry Pi Foundation, STEM Learning and WCIT. We are partners in a recently submitted proposal for an Erasmus+ KIKS2 project (with Finland, Greece, Hungary and Spain).

(d) One of the key challenges facing technology-enhanced STEM learning is spreading the word widely so that teachers of all Key Stages make use of the wide range of free and powerful tools now available. The recent announcement by the DfE on the current state of Edtech reveals the extent of ignorance of the opportunities at the highest level – and that gives a clear focus for a challenge. Professional Development PD for STEM teachers is key. Fortunately we already have good connections involved in the PD currently being developed for the National Centre for Computing Education NCCE. The Teaching Schools Alliances already provide an extensive network of good practice in leadership, PD, school to school support, initial teacher education and R&D. So our challenge is to inject STEM, digital and 21stC Skills into that existing infrastructure.