UK KIKS Report Final June 2017

Abstract

This international Erasmus + KIKS project supported Kids Inspiring Kids in STEAM by a three-stage process of Hothousing (to creatively develop ideas), Local Challenges (to develop those ideas into projects and deliver them to other students) and International Collaboration (sharing and working together). The UK teams progressed through the different learning and development stages according to or in advance of the preset timeline. Each stage informed the following stage in the process. The target number of schools involved in each country was set at 5. In the UK the number of schools and teams rose from 5 at the start of the project to 10 by the end. This reflects the level of enthusiasm and interest schools have in STEM enrichment opportunities.

The real measure of success of the KIKS projects was the quality of the work produced by all teams, the diversity of the teams and school settings and the rich legacy of resources developed and shared with the international partners. There were many learning outcomes. Qualitative reports showed that this opportunity for an independent style of student led-work was enjoyed and valued by the students and teachers alike. All workshops designed and delivered and those produced by students had high levels of intellectual impact. Key figures are summarized here:

- *10 Schools completed projects (target 5)*
- *100% State Schools*

- *10 Hothousing Project Activities (target 5 – each developed by the UK KIKS project team and were diverse in scale and breadth of STEM/STEAM)*
- *10 Local Challenge Projects (target 5)*
- *21 On-line Collaboration projects/6 international collaborations*

- *Hothousing Process 88% completion rate (i.e. Hothousing teams carrying through to Local Challenge and International Collaboration)*

- *On-line collaboration Richness (400 unique visitors per month) and Reach (20% of visitors from US) Most popular projects 300 views per month on WIKI*

- *Dissemination: 3 major UK WEB sites and organisations, 2 events each with 1000 visitors, multiplier events 90 students or public visitors*

A summary of the salient features of the project for the UK team is available in this Prezi file:

UK KIKS Report Final June 2017

https://prezi.com/jnd6nez1oz11/kiks-kids-inspiring-kids-in-steam-uk/

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UK KIKS Report Final June 2017

Introduction

The **International Erasmus+ Project KIKS ref. 15/0100-KA2SE/136AA** is a collaboration between researchers in four institutions:

- Budapest Metropolitan University, Hungary
- University of Jyväskylä, Finland
- University of Cantabria, Spain
- STEM Team East, England

and the teachers and students of groups of schools in the four countries.

The project is interdisciplinary across the subjects of Science, Technology, Engineering, Art and Mathematics and comes under the acronym STEAM.
The basis of the project is to support the international effort to promote the STEAM subjects. Internationally the number of school students opting to study STEM subjects declined and has not recovered over the past four decades while the growth of Science, Technology, Engineering and Mathematics based industry, and a modern technology rich lifestyle has developed and gown. The needs of the present and future way of life relies strongly on a much greater supply of Scientists, Technologists, Engineers and Mathematicians. Therefore, we need to help many more young people achieve well in STEM subjects and to consider STEM based careers.

It has been recognised all research, development and innovation requires creativity and so it is that the importance of recognising a role for Art alongside STEM will develop the best employees of the future. Recent research by Kings College London has found that young people's interest and attainment in the STEM subjects needs to be developed, not just through the school subject curricula and traditional didactic methodologies of teaching, but also through acquiring a ***Science Capital.*** Science Capital is the everyday experiences which add to formal learning. These include, for example, trips to science centres, meeting and talking to scientists and STEM professionals, watching documentaries, relevant work experience. This build of capital yields subject confidence in students, confirms and consolidates their ability and aptitude to succeed in becoming STEM professionals in a myriad of careers.

The ASPIRES project describes Science Capital: (NB You may have to copy and paste these links into your browser☺

https://www.kcl.ac.uk/sspp/departments/education/research/ASPIRES/Index.aspxHYPERLINK
https://www.kcl.ac.uk/sspp/departments/education/research/ASPIRES/Index.aspx
https://www.kcl.ac.uk/sspp/departments/education/research/ASPIRES/Index.aspx

Therefore this supports the idea that STEAM is an important direction to achieve success in developing the abilities and interest in young people because Art is a familiar and strong media through which young people experience the world and hence STEM through STEAM.

This therefore was an aim of the project to produce workshops that developed creativity and improved learning and awareness in STEM with an element of Art, or creativity as recognised in Art.

In hand with building Science Capital, another consideration for the project was to

promote **Creativity Centred Learning.** Allowing space for creativity to grow required teamwork and a pupil centred approach. This lead to the criteria of **Peer to Peer Learning** and the project strap line **'Kids Inspiring Kids in STEAM' KIKS**

The KIKS objective was to have 'kids' developing STEAM activities for other kids in their schools and at large for the public. The following stages and features made the core of the project:

- Hothousing workshops
- Local Challenges
- International Collaboration

The project was set to school pupils as a challenge: *How would you get your schoolmates to LOVE STEAM?*

*In the KIKS TEAM Peer-to-Peer Learning Journey t*his report describes the work with different UK schools. The report is in five sections and highlights the follow-through along a 2-year time line:

1 Hothousing – an intensive, creative, structured session in which stimuli activities are used to fire the students' imagination, inspire and guide their projects.

2 Local Challenges – KIKS Peer to Peer learning journey - less structured activities in which students came up with their own project ideas and solutions. Support was provided by mentors and STEM Ambassadors as required.

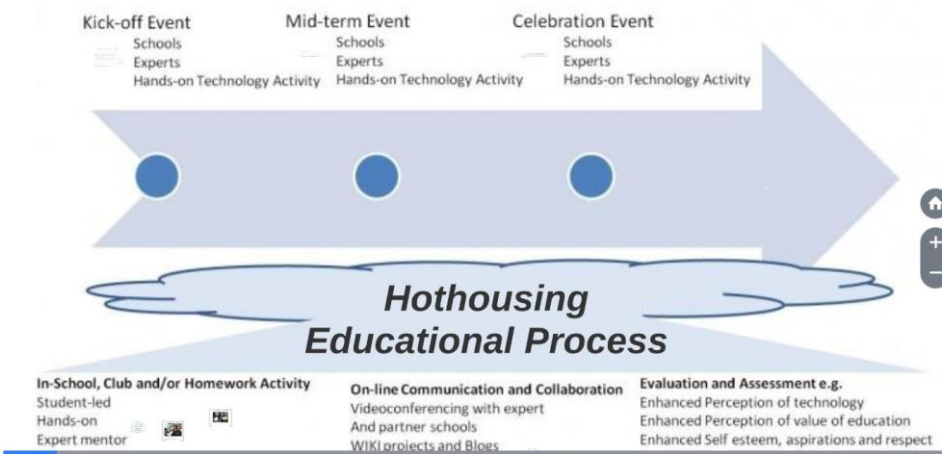
3 International Collaboration – students from each country worked together enhancing existing projects or new projects.

4 Measuring Impact, Dissemination and Sustainability – various methods are described. Quantitive and qualitative data are gathered and analysed.

5 Evaluation – feedback and "lessons learnt". As measures of impact and feedback were gathered in the latter stages of the project, this was used to inform the final stages. In this way the student skills were honed and the projects were enhanced. The best possible outcomes in learning and guides to best practice were determined.

1 Hothousing

Hothousing is an intensive workshop technique which can be used in KIKS to foster creative problem solving, communication and collaboration skills and build self-belief - on many projects. It's also...Fun! It usually has a kick-off, mid-term and celebratory activity. For KIKS, it starts with an intensive creative activity, hence the term HOTHOUSE, followed by Local Challenges then International Collaboration:



This version is a variant on a well-established business technique, originally developed by BT and adopted by many others. Information can be found at:

http://www.methodsandtools.com/archive/archive.php?id=43p2

The key is intensity:

- Student - led (teachers stand back :-)
- Working hard - under time pressure
- Active engagement – actually DOING something, undertaking a project and coming up with THEIR solutions
- Working with others – 'somebody who actually listens to them'
- 100% engagement within team
- Having Fun...

To attract and prepare schools, a ‘How to’ guide was created for both UK partner schools and institutions and also for the benefit of all KIKS partners: The document can be found at:

H1: KIKS Project Hothousing and On-line Description
http://kiks-microbit.wikispaces.com/About+KIKS+Hothousing+and+Student+Digital+Ambassadors

An accompanying presentation “Hothousing for KIKS” can be found at:

H2: Hothousing for KIKS
https://prezi.com/e78q3uha7-zn/hothousing-for-kiks/

1.1 Schools and Activities

There were four different events with different themes and activities. At all events the students worked with STEM Ambassadors - these Ambassadors were volunteer Scientist, Technologists and Engineers from university or local industry. They encouraged students to challenge their thinking and aim for more sophisticated designs. Importantly they tested the students understanding of STEM and helped them learn new concepts as well as inspiring them to careers in STEM. An excellent video recorded by Cambridge TV for the national UK television network BBC summarises the whole event and highlights the experiences of the students and their learning outcomes can be seen at the link below. Although this video was made at one of the four events, it does deliver the message for all events:

http://www.cambridge-tv.co.uk//?s=STEM+Fair+

1.1.1 Student Digital Ambassador with Bay House School and Park House School- London Area

Working with Bay House School in Gosport and Park House School in Newbury, the KIKS Student Digital Ambassadors Programme was developed to harness the energy and enthusiasm of students:

http://www.kiks.unican.es/en/inauguracion-inglaterra/

The KIKS Student Digital Ambassador Programme had two variant programmes BBC Micro: bits and iSTEM+: The strength of these two programmes was the foundation of using Technology to enhance learning. Technology Enhanced Learning

H3 KIKS UK SDA Programme.pdf

H4 KIKS UK SDA- BBC micro-bits One-pager (1) (1).pdf

They can be found on the KIKS site and also on the National STEM Learning Centre and Network for all UK secondary schools: https://www.stem.org.uk/:

1.1.2 Parkside School and Lindbergh Schools - Suffolk

We held Hothousing Kick-Off Activities with Parkside and Lindbergh Schools, and Sawston Village College at Duxford Aircraft Museum and the STEM Team East annual STEM Fair. This featured a set of workshops specially designed for the ERASMUS KIKS teams:

http://www.kiks.unican.es/en/inauguracion-inglaterra/

These were very challenging activities...undertaken by all.

H5 Design a Bridge

There were two Bridge Design workshops: both workshops took place at Imperial War Museum Duxford as part of the STEM Fair Erasmus entry: one workshop tasked the students to design a bridge with a mechanism to lift the bridge beam: Students could use a manual lifting mechanism or design a geared motorised mechanism. Alternatively, KIKS students worked together to design a bridge from lightweight expanded polystyrene with a fixed span and able to support a heavy load. The photograph shows their design under test.

H6 Cable Car

The Cable Car workshop was particularly challenging. Students worked as a team with Engineers. They considered the problem of designing a motorised cable car which could travel along a horizontal cable and deliver a load to the other side. Students produced schematic diagrams and had to demonstrate that they had understood the physics and engineering principles in their design before making and testing the cable car.

H 7 Science of Butterflies – Embracing STEAM

This activity had a strong Art element. Its purpose was to show how approaching a topic from the angle of Art could bring the students into an appreciation of STEM. The workshop started with a

presentation and discussion on the colour of butterfly wings. The information related to the areas of physics, biology, technology and art: It explains why butterflies have beautiful colours - not due to pigments, but to the properties of white light that reflects in the scales of butterfly wings. Through an investigative approach students learnt about the life cycle of butterflies and the importance of butterflies for pollination and crops, and therefore environmental science. Research on the flight of insects as well as the future science of colour could provide technological advances. Students used mathematics to produced circles, isosceles triangles and squares on coloured paper which were then folded and assembled to produce very pretty butterflies. Using their understanding on moments then could then produce butterfly mobiles and displays.

http://www.kiks.unican.es/en/the-science-of-butterflies/

1.1.3 Linton Village College and Sawston Village College – Cambridge

We held individual in-school sessions with Linton Village College and Sawston Village College with the same workshops as above. Since STEM enrichment and STEM opportunities are readily available in Cambridgeshire these two schools built on the workshop experience with a direct view to incorporating the learning from these workshops into their own projects as part of the local challenges – see later

1.1.4 Rainham School and Westbridge School - London

These schools were keen to exploit the opportunity offered by the recent UK wide introduction of the BBC micro:bit. Students worked with STEM Ambassadors to learn how to use the Micro bit – which is a credit card size computer. They used the open source software and learnt how to Code. These Micro bit workshops were particularly important in the drive to teach more young people to code and to have an appreciation of Technology. They would have a significant part to play in the Local Challenges and International Collaboration as the project evolved. Since three of the core requirements of the Erasmus + proposal were to make use of Open Educational Resources OER online; to Collaborate and Share Good Practice and to engage with Virtual Mobility then these Micro bit based workshop supported all three

Support material and a WIKI site were developed:

https://kiks-micro:bit.wikispaces.com/

Support material included:

H8 First steps in Computing with the BBC micro:bit

H9 First steps with micro:bits for data logging and modelling

H10 First steps with micro:bits for control and physical computing

These can be found at: **https://kiks-micro:bit.wikispaces.com/First+Steps+with+Micro:bit**

1.2 Lessons learnt

The four different events were undertaken sequentially. This gave us an opportunity to improve for the next stage. In particular, to keep the attention of both students and busy teachers throughout the process, a WIKI was produced. The development of the Wiki helps us to engage with our schools. The wiki was an effective way to demonstrate the strength and opportunities in the KIKS programme to teachers and so they came on board. In developing the Wiki we started with two schools, led to continued participation and indeed further participation by other schools and organisations. Open the link below :

https://kiks-micro:bit.wikispaces.com/

2 Local Challenges – in school KIKS projects developed by students

In the next phase of the project, called Local Challenges, students were asked to deliver projects that could be undertaken by other students. The choice of activity was obviously influenced by the previous Hothousing experience and was a natural follow-through.

Here the students chose their own STEAM topics of interest and designed their own workshops and practical sessions. Students took full control of the projects and recruited the team members, researched the topics, designed and developed any practical work, delivered the workshops to their peer groups or younger students in schools. They then evaluated, made changes and launched their workshops

NB We will also see a clear follow-through to the international collaboration activities which featured working together on enhanced versions of some of the projects:

The projects broadly fitted into two groups: micro:bit related and other STEAM project/workshops.

2.1 Schools and Micro:bit Projects

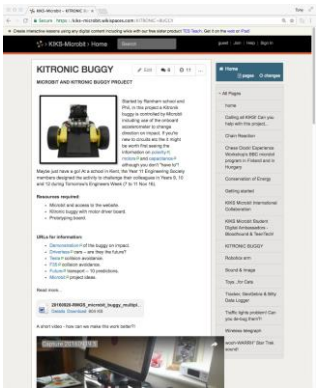
2.1.1 Conservation of Energy

This project was undertaken by Rainham Mark Education Trust and IET (Institute of Engineering and Technology) Phil Moffit. Three sixth formers (Rory, Oscar and Michael) designed, prepared and delivered. As a theme, they decided on the conservation of energy; a fascinating and relevant challenge. The team also posed a further challenge for the KIKS team: Could we use Tracker, GeoGebra, Bitty or anything else to get Micro:bits to track the balls?! This meant that the team had to learn about free online software and some electronics with modern electronics - they used the BBC Micro:bit computers for control

https://kiks-micro:bit.wikispaces.com/Conservation+of+Energy

2.1.2 Kitronik

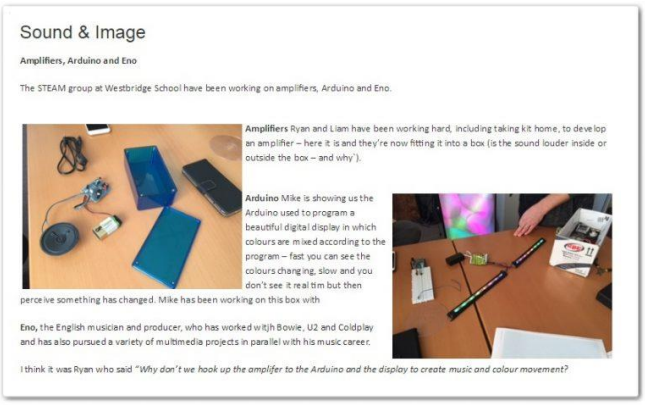
In this project a Kitronik buggy (electronics and mechanical assembly kit) is controlled by a Micro:bit including the use of the onboard accelerometer to change direction on impact. The Year 11 Engineering Society members designed the activity to challenge their colleagues in Years 9, 10 and 12. This is a very good example of using an existing STEM resource and enhancing it by adding on the Micro bit as new technology. – Again this was stated in the proposal. Adding this technology also enhances the learning out comes for students but most important it increased their self- directed learning, increasing the challenge level but also making the activity much more enjoyable. The intellectual impact was high and transferable skills were acquired



https://kiks-micro:bit.wikispaces.com/KITRONIC+BUGGY

2.1.3 Merging Sound and Image – More clever Technology

The STEAM group at Westbridge School worked on amplifiers, Arduino and Eno. Again another clever use of the latest Technology. This requires a lot of new experiences for the students with high intellectual learning outcome. This picture shows the Arduino used to program a beautiful digital display in which colours are mixed according to the program. The challenge set is “Could we do this with micro:bit?


Sound & Image

Amplifiers, Arduino and Eno

The STEAM group at Westbridge School have been working on amplifiers, Arduino and Eno.

Amplifiers Ryan and Liam have been working hard, including taking kit home, to develop an amplifier – here it is and they're now fitting it into a box (is the sound louder inside or outside the box – and why').

Arduino Mike is showing us the Arduino used to program a beautiful digital display in which colours are mixed according to the program – fast you can see the colours changing, slow and you don't see it real tim but then perceive something has changed. Mike has been working on this box with

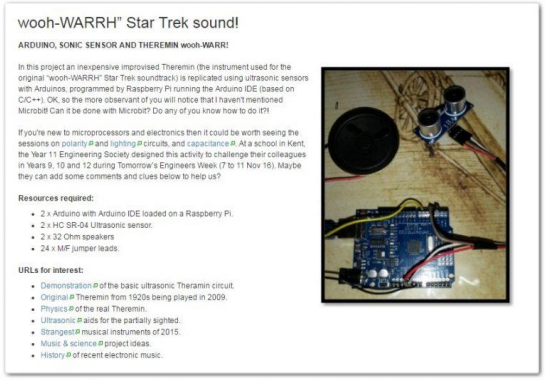
Eno, the English musician and producer, who has worked with Bowie, U2 and Coldplay and has also pursued a variety of multimedia projects in parallel with his music career.

I think it was Ryan who said *"Why don't we hook up the amplifer to the Arduino and the display to create music and colour movement?*

http://www.kiks.unican.es/en/merging-sound-and-image/

2.1.4 Wooh-WARRH Star Trek Sound

In this project, another two Technology platforms were used. The Arduino is a microprocessor board and the Raspberry Pi is the hand-held computer which was developed by Cambridge University to allow students to learn to Code on a need to know basis. It is a prerunner of the Micro bit (Raspberry Pi has a much-extended range and uses a range of programming languages).


wooh-WARRH" Star Trek sound!

ARDUINO, SONIC SENSOR AND THEREMIN wooh-WARR!

In this project an inexpensive improvised Theremin (the instrument used for the original "wooh-WARRH" Star Trek soundtrack) is replicated using ultrasonic sensors with Arduinos, programmed by Raspberry Pi running the Arduino IDE (based on C/C++). OK, so the more observant of you will notice that I haven't mentioned Microbit! Can it be done with Microbit? Do any of you know how to do it?!

If you're new to microprocessors and electronics then it could be worth seeing the sessions on polarity and lighting circuits, and capacitance. At a school in Kent, the Year 11 Engineering Society designed this activity to challenge their colleagues in Years 9, 10 and 12 during Tomorrow's Engineers Week (7 to 11 Nov 16). Maybe they can add some comments and clues below to help us?

Resources required:

- 2 x Arduino with Arduino IDE loaded on a Raspberry Pi.
- 2 x HC SR-04 Ultrasonic sensor.
- 2 x 32 Ohm speakers
- 24 x M/F jumper leads.

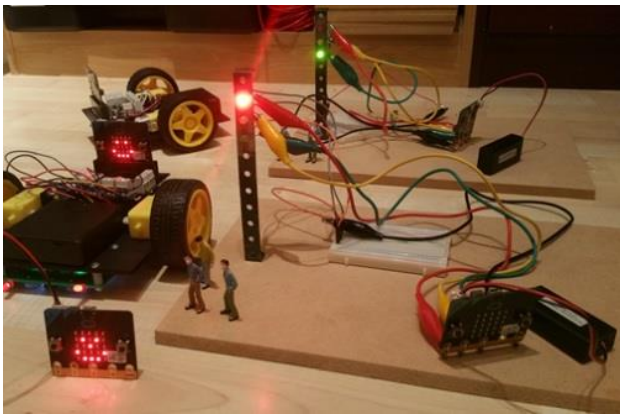
URLs for interest:

- Demonstration of the basic ultrasonic Theramin circuit.
- Original Theremin from 1920s being played in 2009.
- Physics of the real Theremin.
- Ultrasonic aids for the partially sighted.
- Strangest musical instruments of 2015.
- Music & science project ideas.
- History of recent electronic music.

In this project an inexpensive improvised Theremin (the instrument used for the original "wooh-WARRH" Star Trek soundtrack) is replicated using ultrasonic sensors with Arduinos, programmed by Raspberry Pi running the Arduino IDE (based on C/C++). The challenge set to future students is: Can it be done with Micro:bit? Do any of you know how to do it?!

http://www.kiks.unican.es/en/wooh-warrh-star-trek-sound/

2.1.5 Traffic lights problem



In a STEM club kick-off meeting with teacher Matt Wells at Rainham School for Girls, the discussion was the "grand challenges" for future engineers, one of which is future cities. We explored future transport and driverless vehicles, and the girls in the STEM club wanted to explore the wider challenges of driverless cars for society: imagine the cross-curricular potential of that! So we're making a fleet of line following buggies and a small town road system of Micro:bit controlled traffic lights.

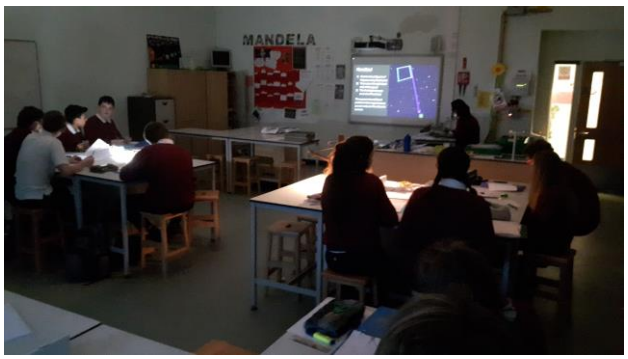
https://kiksmicro:bit.wikispaces.com/Traffic+lights+problem%21++Can+you+de-bug+them%3F%21

2.2 Student-Led Workshop Projects in Cambridgeshire at Sawston Village College and Linton Village College

These projects were particularly interesting for their mix of content and student learning described in their own words as seen in Section 5 Evaluation. Students from both schools also organised a showcase event for the Spanish students and the teachers from Spain and Finland as well as the whole Erasmus research group (described later). Students in both schools worked through their lunch times to do project work

The Sawston School chose to do four different projects and focused mostly on peer to peer learning in their own year group and for younger students. Their approach was to test how well they could communicate their own excitement for favorite topics in STEM to other students.

2.1.6 Constellations and Pointer Stars



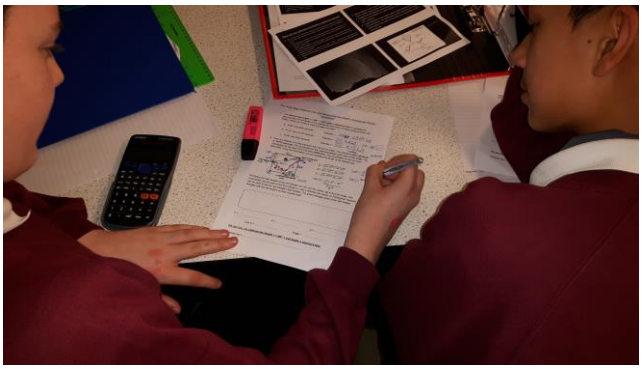
The GCSE astronomy course is an extra-curricular activity, which runs each Monday after school, normally taught by Mr. Whitten. A student who had completed my GCSE astronomy course decided to design and teach a lesson to the current GCSE astronomy pupils. This student enjoyed public

speaking and was very enthusiastic about astronomy. She approached to the topic from the perspective of Peer-to-Peer Learning and Presentation and PowerPoint skills to assess if she could inspire fellow students.

The lesson was 1 hour long, to an audience of pupils ranging from 12 to 14 years old. The lesson was focused on the specific skills required for that part of the course, which is to use so-called 'pointer stars', which enable to astronomers to find their way around the night sky.

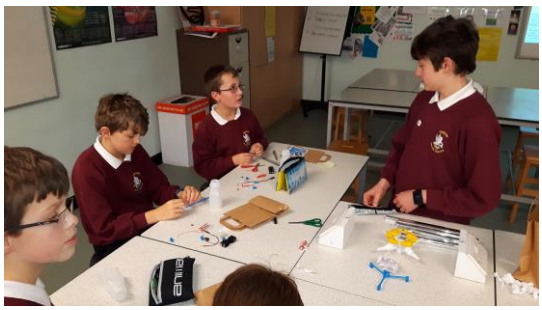
2.2.2 Circumpolar Stars

A second student followed the same aims; also on astronomy. This presentation was important because Circumpolar Stars had been chosen as the controlled assessment for the 'Aided Observation' part of the GCSE Astronomy course.



This student found the challenges of teaching when using mathematics – believing that the interesting subject of plotting Circumpolar Stars would make the mathematics more interesting and less challenging. She thought that the students would be able to handle a complicated, but highly reliable method of measuring the angle, and so I constructed a worksheet which uses the Cosine Rule. The student fed back that they found this quite challenging, as some had not done this yet in their maths lessons. It was challenging to try and help pupils who needed extra help, without just giving them the answer. The workshop needed to be evaluated to see if student led teaching was a positive benefit to more fellow students.

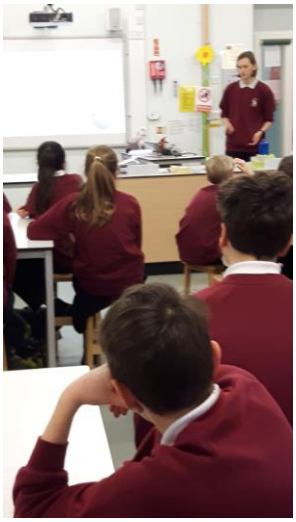
2.2.3 The Philae Lander - Learning By Design – How to design and develop your own STEM workshop



Based on previous workshop experience this team worked together to design and deliver a STEM workshop to year 7 pupils in junior STEM club,
Their approach was to deliver the workshop in the form of a mystery, because the Philae Lander was a very complex mission, which did not go to plan at the start. This would engage the learners to think creatively and use evidence and their imagination to come up with some conclusions. The team worked to help the pupils build their own model Landers, including soldered circuits. They introduced a 'production line' where pupils went from one station to the next. Feedback from the students was very positive and pupils were all happy to take home their working Lander with a flashing LED light!.

2.2.4 Chaos Theory – Presentation and Hands on

This was another example of a particularly enthusiastic and bright student, keen to share his love of Chaos Theory with students his age but for who the mathematics and concepts could be challenging. The student felt that the mathematics which interested him a great deal, especially the idea that simple functions can have stunningly varied outcomes, and how much chaos theory appears in real life, could be conveyed to other students.



He took an example of simple systems to show how their behaviour became very unpredictable quite quickly. He had built a Lorenz Wheel at home, and then demonstrated this to the pupils. This was a lot of fun with carriages collecting water and displaying erratic swinging motion. It was useful to show how something so apparently simple could begin to behave in a way that did not follow a simple pattern. He also showed videos of a compound pendulum.

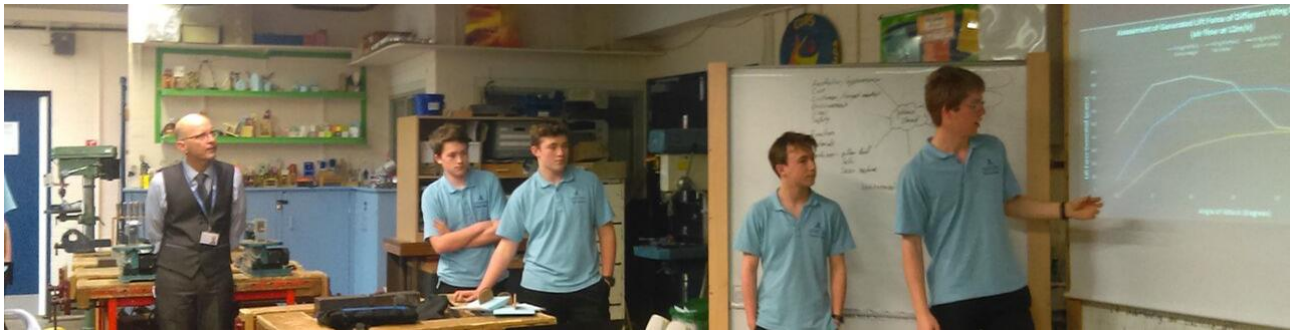
Students were involved in the learning with iPads and a spreadsheet loaded with an iterative function. This way pupils could have a hands-on experience and explore the effect of trying different variable, which they reported that they enjoyed a lot.

2.2.5 Linton School – Wind Tunnel Aerodynamics study

The Linton Village College Team took a more practical approach and designed an Engineering project. For this they used a Wind Tunnel. This Wind Tunnel had been built in school by a school technician who had since left the school. It had not been used by any students before so they had to learn how to use the Wind Tunnel and understand the aerodynamics before designing sets of aerofoils to test for lift. See later for their Learning outcomes. Linton students took advantage of the UK scheme of STEM Ambassadors and invited in Prof Harry Marsh as a senior engineer to discuss their designs for Aerilon aircraft wing profiles and testing conditions in a wind tunnel. They also called on a young engineer from a local aeronautics company The Marshall Group. This gave them good communication opportunities and also the chance to take on expert knowledge- in effect they had the opportunity to experience working as engineers in a work based format.

A video was produced by the students – this shows how they have embraced the use of technology for communication. Their youthful style of presentation with music is very appealing to other students. The presentation in the link below is excellent and captures not only the how the students set about their project , the skills and engineering involved but also describes how they valued the experience and their view on “Lessons “learnt”:

https://1drv.ms/v/s!AoWEMkqxwLDMhiI7ctNA9eUj76pp



As well as learning how to use the wind tunnel and taking on board expert advice, the team also got to grips with some high level engineering and physics concepts. The developed the model for airflow in the wind tunnel and produced airflow graphs to compare the different wing profiles. They produced a PowerPoint presentation which included their results and narrated their learning outcomes. This was presented to the whole Erasmus + team and visitor student and teachers. This was a true international communication and a great learning experience for these students. A 360 degree recording of their demonstration to the international team can be viewed in this link:

https://youtu.be/nJYhXfWjEjI

The international team engaged with the student presentation.

2.3 Lessons Learnt

Based on the experiences of the above Local Challenges we observed differences in the teaching/learning/classroom leadership style both within the UK and also country by county. This ranged from large group activity to very small group work, with different appropriate levels of support, and differing use of virtual mobility. To cope with this variety, we identified four types of international collaboration, described next.

3 International Collaboration

Virtual mobility has been defined as an activity that offers access to courses and study schemes in a foreign country and allows for communication activities with teachers and fellow students abroad via the new information and communication technologies. To deliver this, we can distinguish at least four types of activity:

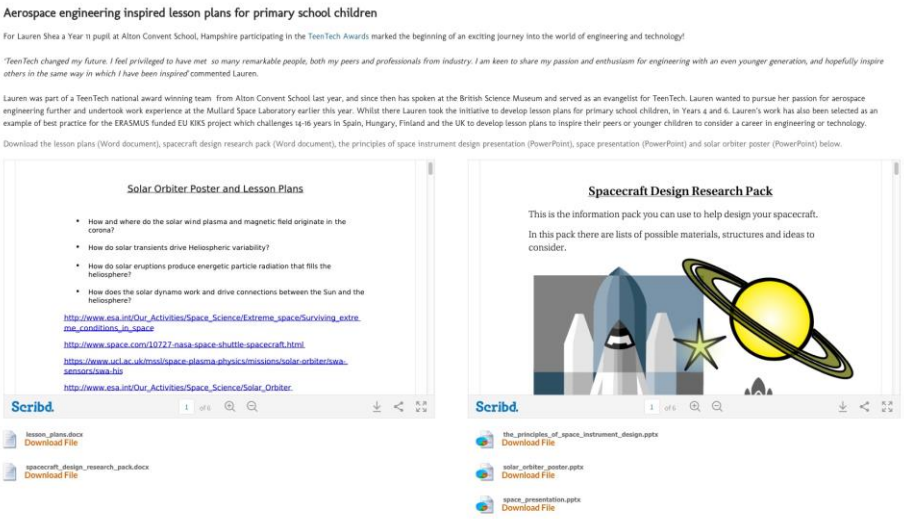
- **Video Conferencing:** well directed/controlled team work using video conferencing
- **Video Conferences & Team Collaboration Projects:** national teams work with other international teams
- **Video Conferences & Many-to-many Projects:** mixed international teams
- **Face-to-Face & Many-to-many Projects:** mix of physical and virtual working

3.1 Video Conferences

Mixing the requirement for a well directed/controlled teamwork using video conferencing with the KIKS requirement for Kids Inspiring Kids in STEAM, Alton Convent student Lauren had already developed an excellent project.

3.1.1 UK Spain: Alton Covent School, Sánchez Cantón School and Sierra Sur School

The first videoconference was between two countries. Two Spanish schools, Sanchez Canton School and Sierra Sur School, participated in the videoconference led by Alton Convent student Lauren. Lauren presented her excellent aerospace work (developed pre-KIKS and used as a best practice example) which can be seen at: http://www.sparxx.org.uk/resources.html



http://www.kiks.unican.es/en/videoconferencias/

3.1.2 UK Finland Alton Convent School and Viitaniemi School

A Skype meeting was then organized between Lauren Shea from Alton Convent School, UK and KIKS-team of Viitaniemi School, Finland.

http://www.kiks.unican.es/en/videoconferencia/

3.1.3 Lessons learnt

Laura's presentation can be seen in the following video. In addition to the excellent quality of the presentation, of equal interest was the quality of the Question/Answer session which covered technical, career and personal interests.

This demonstrated that, with appropriate preparation, considerable depth of interaction is possible.

https://youtu.be/DMFzk3ED93E

3.2 Video Conferences & Team Collaboration Projects

In these examples, the videoconference exchange of presentations was continued with exchange of ideas for further work between terms from different countries.

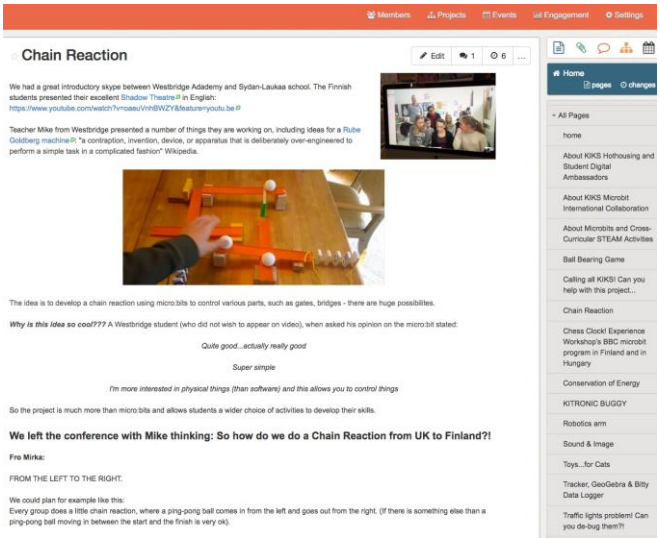
3.2.1 UK Finland VC & Micro:bit Chain Reaction project

During a successful videoconference with Sydan-Laukaa and Westbride Academy, in which each school presented their work, a joint idea for collaboration presented itself: Chain Reaction – in which, for example, a ball rolls down a slope, hits a domino which in turn triggers another event and so on. The idea is to develop a chain reaction using micro:bits to control various parts, such as gates, bridges – there are huge possibilities. Indeed, the target is to develop a chain reaction in and across as many schools/countries as possible.

http://www.kiks.unican.es/en/sydan-laukaa-westbride-academy/

The ongoing collaboration can be seen on:

https://kiks-micro:bit.wikispaces.com/Chain+Reaction



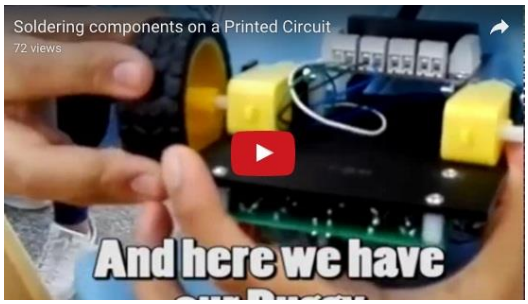
3.2.2 UK Spain VC & Micro:bit KITRONIK project

Coilegio San Jose presented their excellent work including Wireless Telegraph:

http://www.kiks.unican.es/en/wireless-telegraph/

Rainham School then described a Kitronik model car/buggy controlled by Micro:bit including use of the onboard accelerometer to change direction on impact.

Building on this original work from Rainham School, Colegio San Jose has contributed to the KITRONIK Buggy project with a soldering activity to be followed by coding. The video can be seen at the periodically updated:



https://kiks-micro:bit.wikispaces.com/KITRONIC+BUGGY

http://www.kiks.unican.es/en/rainham-school-colegio-san-jose/

3.2.3 Lessons learnt

The potential of virtual mobility for in-depth collaboration has been demonstrated by these examples – in many different and sometimes surprising ways. For example,

In the “Chain Reaction” collaboration a very shy student refused to appear on the video, stood by the side of the camera but nevertheless made a valuable contribution.

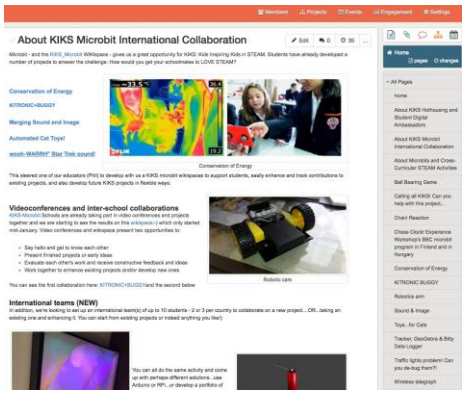
Also, the power of the videoconference was demonstrated in the real time exchange of ideas culminating in the “Chain Reaction” idea, plus the subsequent elaboration in the WIKI.

The KitroniK collaboration showed the potential for enhancing an existing project between two countries. This would serve as well for the next stage.

3.3 Video Conferences & Many-to-many Projects

We developed a UK Finland Spain Hungary KIKS Micro:bit project in which the micro:bit foundation kindly supported and supplied us with 400 micro:bits.

The power of the WIKI alongside the KIKS WEB site and the Facebook Closed User group can be seen in the projects contained in the WIKI. The projects illustrate the degree of collaboration. Unique visits to each project can be seen. Also, the overall and unique visits by visitors from different countries shows the developing impact of the WIKI:



https://kiks-micro:bit.wikispaces.com/International+Collaboration

3.4 Face-to-Face & Many-to-many Projects

The March 2017 Cambridge event gave an opportunity for UK Finland and Spain KIKS people to come together face-to-face. This also gave us an unanticipated opportunity to compare collaboration started with a physical meeting then WIKI, compared to a purely on-line interaction. The discussion centred on a Wind Tunnel presentation and how to enhance the tunnel with micro:bits.

4 Impact, Dissemination and Sustainability

To maximise the impact, dissemination and sustainability, to "multiply" the effect, our approach is to embed our work into existing mainstream initiatives both on-line and face-to-face:

4.1 Key Impact Organisations & WEB Sites

We have embedded the project in national, long-term organisations and web sites. Our overriding, long term project iSTEM+ (STEAM by any other name) takes KIKS as its current international arm. We have created collaborative WIKIS for both iSTEM+ and KIKS:

- https://istemplus.wikispaces.com/
- https://kiks-micro:bit.wikispaces.com/

UK STEM TEAM EAST is part of a much wider national organisation STEMNET – and KIKS has been adopted by STEM Ambassadors (Ray Buckland on our team) and feature on their site:

- https://www.stem.org.uk/community/groups/99628/istem
- https://www.stem.org.uk/community/groups/99628/kiks-kids-inspiring-kids-steam/233443

UK IET (Institute of Engineering and Technology), one of the world's largest engineering institutions, have ambassadors on our team (Phil Moffit):

- https://communities.theiet.org/groups/blogpost/view/31/329/4839

DENDRITE is a national collaboration site and we currently reach 49 educational communities:

- https://www.dendrite.me/collection/view/collectionid/583d713e07d734889b066609#description
- https://www.dendrite.me/community/view/communityid/581202a307d734968da6bcaa#tab:regional-hub-communities

Micro:bit Foundation supported us with micro:bits and expertise. They feature heavily in KIKS in all countries:

- https://kiks-micro:bit.wikispaces.com/

4.2 High Visibility Physical Events

4.2.1 KIKS Big Bang Discovery Park

With teacher Matt Wells at Rainham School for Girls, we discussed the "grand challenges" for future engineers, one of which is future cities. We explored future transport and driverless vehicles, and the girls in the STEM club wanted to explore

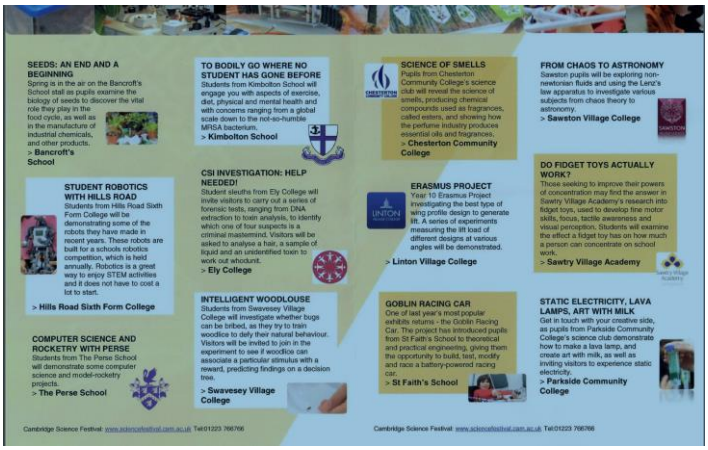
the wider challenges of driverless cars for society: imagine the cross-curricular potential of that! This was presented at the IET stand 2017 “Big Bang @ Discovery Park” in Sandwich, Kent, where 1000 students visited:

- https://communities.theiet.org/groups/blogpost/view/31/329/4839

4.2.2 Cambridge Science Festival

Linton Community College work featured alongside the 2017 Cambridge Science Festival consisting of over 300 events :

http://www.sciencefestival.cam.ac.uk/



4.3 Cambridge KIKS Multiplier Schools Events

The Cambridge KIKS event brought together both KIKS team members and others, including teachers from Finland and Spain, and also Spanish students.
The event attracted a wide number of community visitor young and old, STEAM experts and not…during a six-hour open day, which attracted 70 visitors (non KIKS).

The UK Student Presentations featured student experiences on what makes a KIKS project. They presented:

- Constellations and Pointer Stars- Peer to Peer Teaching – A presentation
- Circumpolar stars – Peer to Peer Teaching - A Mathematics Workshop
- The Philae Lander - Learning By Design – How to design and develop your own STEM workshop
- Chaos Theory – Presentation and Hands on workshop for the students

This gave an opportunity for teachers, students and others to get to know each other

Then Spanish Students made excellent presentations described elsewhere on

- Dark Camera:
- Memory
- Golden Ratio
- Wireless telegraph
- Led focus

In an event the same day, Linton Village School demonstrated and presented their Wind Tunnel Aerodynamics project - with a demo of their experiments in the wind tunnel. This attracted thirty visitors.

Wind tunnel - Challenge: How can we use micro:bit to accurately control the experiment. See the wind tunnel

https://youtu.be/nJYhXfWjEjI

The event featured in:

http://www.cambridge-news.co.uk/news/cambridge-news/cambridgeshire-school-students-turn-tables-12776521

Leading a lesson in science

ASTROPHYSICS and chaos theory were on the agenda at one village college as students turned the tables and tried their hands at teaching.

Youngsters at Sawston and Linton village colleges have been leading from the front, as they took part in an international project that saw them heading their own lessons on a scientific topic of their choice.

After working through their lunchtimes to prepare their lessons, the schoolchildren were joined last week by students and researchers from universities in Spain, Hungary and Finland, as part of the international Erasmus scheme.

The project was led by Elizabeth Crilly, director of educational charity Stem Team East.

She told the News: "The students in each school came up with activities they wanted to do themselves and totally self-managed it to inspire other children, so it's peer learning.

"It worked brilliantly well. And they have been leading the way on it."

After working in the two schools the international teams also took in events at the Cambridge Science Festival.

Elizabeth added: "In Sawston they were more theoretical, looking at astrophysics, space travel, and chaos theory, and a project on the Philae space lander and the Rosetta project.

"But Linton was much more hands-on with a more practical approach.

"They did an an investigation using a wind tunnel built by the school technician a couple of years ago, but these students are the first to use it, with a smoke machine to show the aerodynamics at work."

The next stage of the ongoing project will see the students incorporate the Microbit computer system into their projects, while some of the Sawston pupils will also be travelling to Budapest to continue their work.

Elizabeth said: "They have been self-motivated and self-taught and they were teaching their peers working at an extremely high level.

"Afterwards they were really quite delighted with themselves, they all realised how much they had learnt and were all quite pleased, and I think they appreciated how hard it is to be a teacher!"

For more about the charity and the work it does across the region encouraging students to take up Stem (science, technology, engineering and maths) subjects, see *www.stemteameast.org.uk*.

TURNING THE TABLES: Educators from universities in Spain, Hungary and Finland and school students from Spain are coming to Sawston and Linton village colleges to see work on their international Erasmus projects. Picture: Keith Jones

A video by the Spanish team can also be seen at: https://youtu.be/FtUws8iEmIw

For their work, the students received CREST Awards. This award is UK-wide and accredits attainment in STEM:

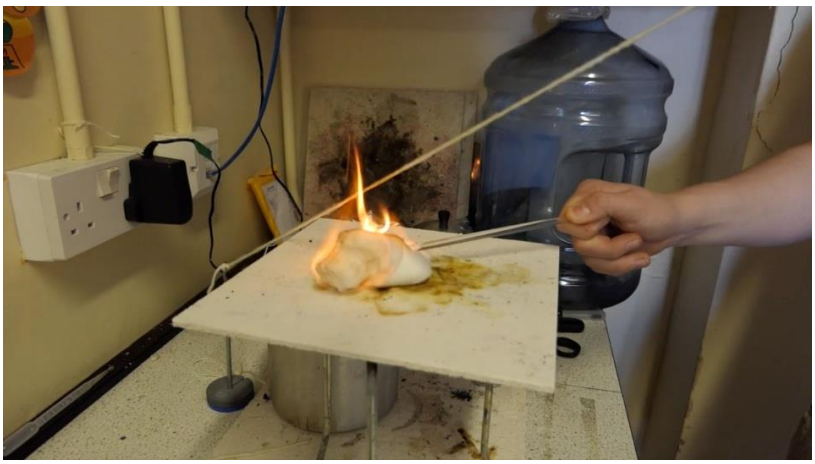
4.4 Ipswich KIKS Multiplier School Event

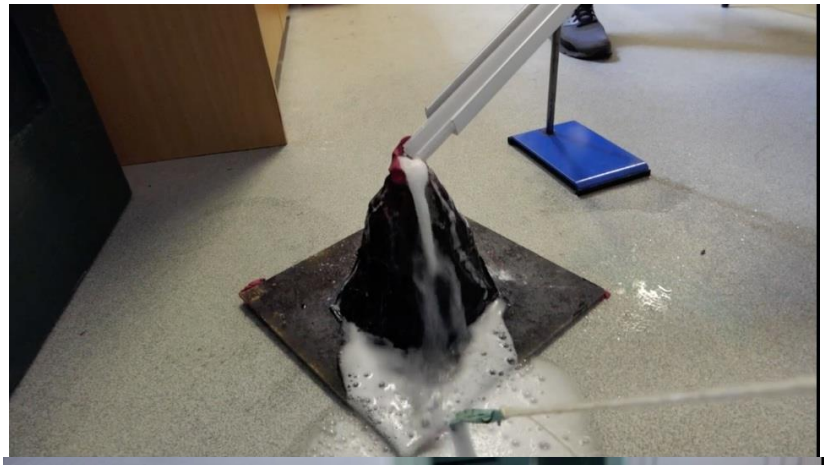
Westbridge Academy has a maximum of 32 students with special educational needs. They received 20 visitors.

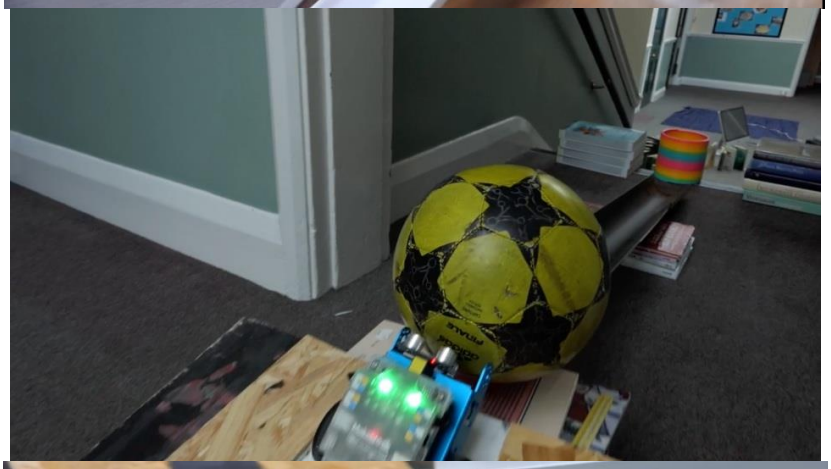
The Raedwald Trust Westbridge Academy has created a Chain reaction featuring chemical reactions, robots, Arduino, Micro bit and much more. It is a remarkable creative mix of science, technology, engineering, ART and maths (STEAM), which has to be seen:-). It is clear best practice in demonstrating the collaborative problem solving project approach advocated by PISA (Programme for International Student Assessment) and IB (International Baccalaureate).Their STEAM team developed a remarkable Chain Reaction which can be best seen in the video:

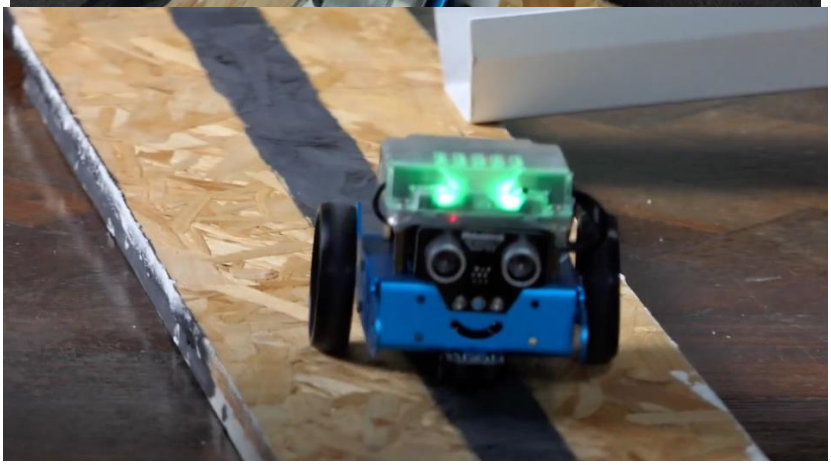
https://vimeo.com/222487526

However, here are a few stills from the above:









5 Evaluation

We have a mix of quantitative and qualitative data including informal feedback from teachers and students plus observations that we can make from lessons learnt.

5.1 Quantitative Analysis

Our summary quantitative data is:

- *10 Schools (target 5)*
- *100% State Schools*

- *10 Hothousing Project Activities (developed by UK KIKS project team)*
- *10 Local Challenge Projects (developed by KIKS students)*
- *21 On-line Collaboration projects/6 international collaborations*

- *Hothousing Process 88% completion rate (i.e. Hothousing through to Local Challenge and International Collaboration)*

- *On-line collaboration Richness (400 unique visitors per month) and Reach (20% of visitors from US) Most popular projects 300 views per month on WIKI (NB Only micro:bit projects)*

- *Dissemination: 3 major UK WEB sites and organisations, 2 events each with 1000 visitors, multiplier events 90 students or visitors*

5.1.1 Hothousing Process; 88% completion rate

Taking the Hothousing process as a three-stage Hothouse (to come up with ideas), Local Challenge (to develop a solution(s)) and International Collaboration (On-line and/or face-to-face): 7 of eight schools completed. 1 school was unable to start for management/time reasons. 2 schools joined during the project for specific activities only. The 88% completion rate compares favourably against, for example, a UK national similar educational engagement programme which obtains 40% engagement.

From the above we can say ”Hothousing works’ for mainstream and excluded students. The activities prepared for the Hothousing stimuli worked, as evidence for the subsequent achievements in developing Local Challenge student-driven solutions. There was also a wide range of schools including two schools for excluded pupils, who performed very well at the Duxford event as described above.

5.1.2 On-line collaboration: richness (400 unique visitors per month) and reach (20% of visitors from US)

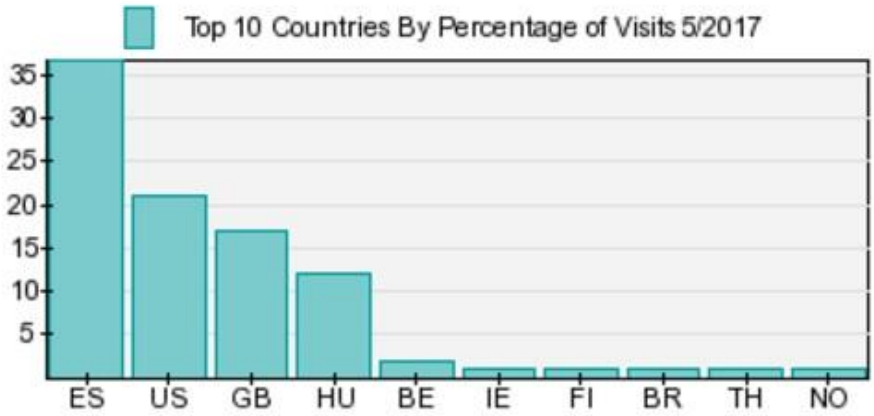
Videoconferencing as previously described provided an unanticipated richness of experience in the quality of the videoconference presentation and also the Question/Answer sessions, which covered technical, career and personal interests. A one-hour session typically featured 20-minute presentation and 40 minute Q/A.

The KIKS Face book Closed User Group attracted 119 members.

The KIKS WIKI on-line collaboration introduced new projects and new participants. It was created for the BBC micro:bit projects only but its potential can be clearly seen. The on-line projects contained those from Local Challenges PLUS new ones – at the time of writing 21. The on-line "Unique Visitors" were around 20 per day taking May 2017 as an example:

This compares favourably with, for example, the UK on-line PREZI report for the KIKS project which attracts on average 10 per month (versus 600 for the WIKI).

The WIKI also attracts 20% of visitors from US:



(ES = Spain, US = United States, GB = Great Britain, HU = Hungary, BE = Belgium, IE = Ireland, FI = Finland, BR = Brazil, TH = Thailand, NO = Norway)

5.1.3 Kids Inspiring Kids: Most popular projects 300 views per month

The potential of virtual mobility for in-depth collaboration has been demonstrated in many different and sometimes surprising ways. For example, in the "Chain Reaction" collaboration a very shy student refused to appear on the video stood by the side of the camera but nevertheless made a valuable contribution. Also, the power of the videoconference was demonstrated in the real time exchange of ideas culminating in the "Chain Reaction" idea, plus the subsequent elaboration in the WIKI. The Kitronik collaboration showed the potential for enhancing an existing project between two countries.

The February 2017 Project snapshot shows “Views” for each project. In contrast to “Unique Visitors”, the figure includes return views: the more popular ones for the month can be clearly seen:

About KIKS Hothousing and Student Digital Ambassadors	97
Ball Bearing Game	0
Calling all KIKS! Can you help with this project...	73
Chain Reaction	144
Chess Clock! Experience Workshop's BBC microbit program in Finland and in Hungary	295
Conservation of Energy	82
Dragsters, Rockets and Gliders	0
First lessons with microbit	0
First Steps with Microbit	0
home	28
International Collaboration	321
KITRONIC BUGGY	290
Microbits and Cross-Curricular STEAM Activities	67
Robotics arm	56
Sound & Image	81
Toys...for Cats	33
Tracker, GeoGebra & Bitty Data Logger	43

It is important to note that the project numbers per month vary according to how long they have been on the WIKI. So the Ball Bearing Game was a new project not yet viewed. The Chess Clock project was in its first month and attracted considerable interest. Also some of the excellent non-micro:bit projects are not included.

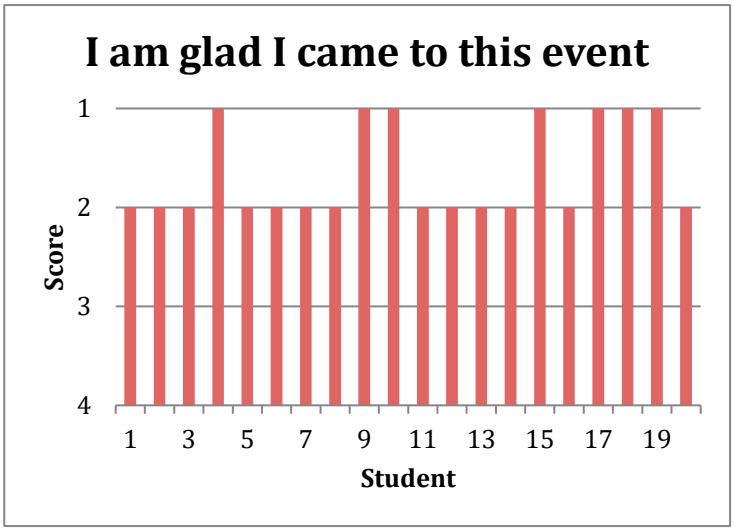
5.1.4 Teachers and Schools: 100% State Schools

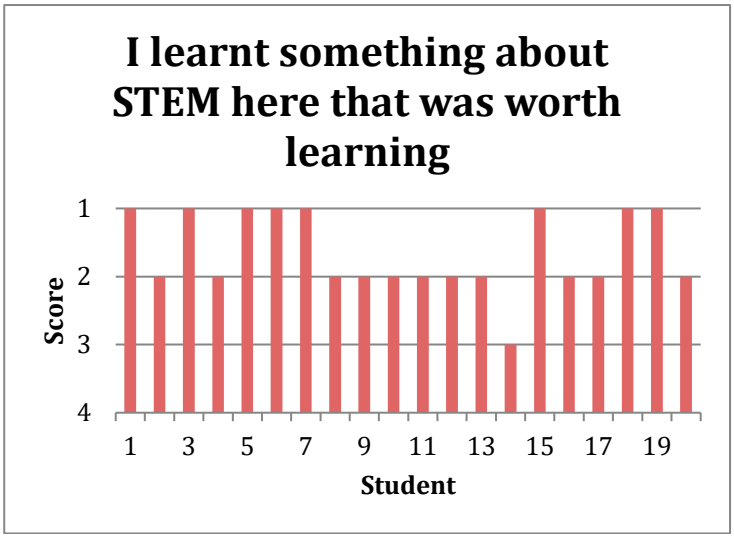
The project attracted both STEAM specialist and non-specialist teachers. Similarly, the schools ranged from local community colleges (2) to special needs schools (3).

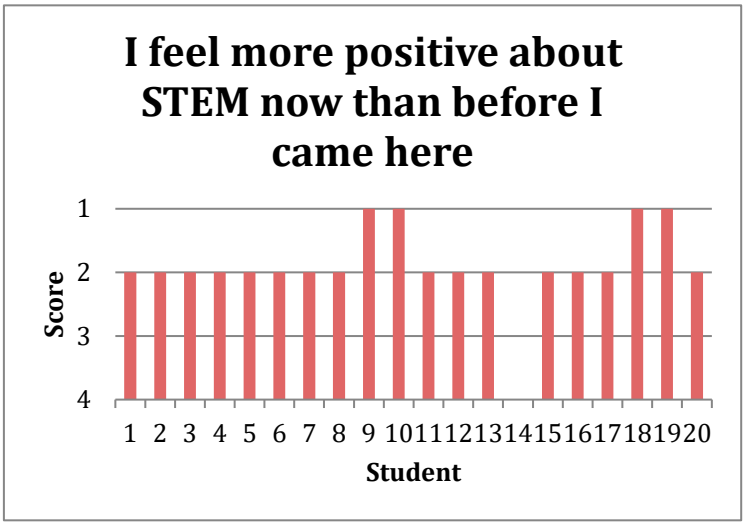
This is in contrast to many similar STEM or business projects aimed at schools, which attract perhaps 50% or more private schools.

5.2 Hothouse Physical Events

The Hothousing physical events were much as expected. These activities are well-proven and the feedback shows that this positive reaction is maintained for various activities within the project (Scores: 1 = Highest 4 = Lowest). Student responses were:







Teachers:

This is the best event ever. Quite amazing to have so many workshops and so many students thoroughly engaged. Cambridge College Teacher

This event is amazing: such smoothness and high level of organisation. Everyone is so friendly and willing to answer questions. The companies are so generous in giving out information and offering to come into schools or arrange visits for us. And the workshops, all top quality leading edge material, terrific -Bedfordshire Teacher

Students:

“I vividly and thoroughly enjoyed this eye opening and truly exasperating/ wonderful experience.”

“It was extremely enjoyable and interesting.”

“You got freedom and independence to choose what to do.”

“I enjoyed this because it gave us lots of information. It also gave us a chance to see what affects the product and the extremes they can go to.”

“I learnt about a lesser covered field of science.”

“I enjoyed it because we actually got to do it and see the results. It was explained well and clearly.”

“I like that it was to do with real life situations and had visual aid.”

“I liked this workshop because it was something new for me and everyone was very helpful.”

“Really cool – very educational. I really enjoyed coding, it was great.”

“This workshop has been really fun and educational. I enjoyed coding very much and would like to do more in the future.”

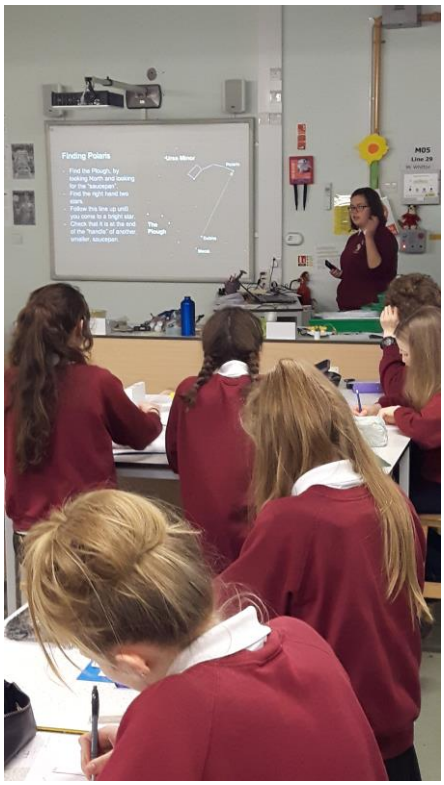
"It was very fun; it was worth going to this trip as you learn a lot and it's interesting at the same time."

"I liked how informative the activity was. I also enjoyed the quiz which kept you engaged.

5.3 Student Experience as a KIKS deliverer

A wide range of student learning took place, which can be grouped into:

- Students as Teachers
- Meta Learning – or learning how to learn
- Personal and Career Learning as well as technical



5.3.1 Students as Teachers

Of great interest is the experience of students as KIKS deliverers:

Student 1: When designing the lesson, I decided to focus upon the myths and stories surrounding each of the constellations and asterism. This proved successful, as the students were able to understand how knowledge of constellations would be communicated using stories in ancient times.

I enjoyed the experience so much, that I decided to teach a further lesson on a very difficult aspect of physics, Cephied Variable Stars, to my peers in year 11 for the GCSE Physics course. Although much more nerve-wracking than teaching the astronomy group, this was more rewarding, as I received lots of positive feedback from my peers, who felt that I had managed to explain a challenging process to them in way which they understood.

Student 2: I thought that the students would be able to handle a complicated, but highly reliable method of measuring the angle, and so I constructed a worksheet which uses the Cosine Rule. The student fed back that they found this quite challenging, as some had not done this yet in their maths lessons. It was challenging to try and help pupils who needed extra help, without just giving them the answer, and I know that some of them used the cosine rule method in the controlled assessment

I had very useful and positive feedback from the class, who took lots of notes and asked many questions.

Student 3: We were very surprised by the range and inventiveness of their answers to our questions. It was clear that they enjoyed the idea of science as a puzzle to be solved.

We had very positive feedback from the pupils, and they were all happy to take home their working Lander with a flashing light.

Further detail can be found at:

https://kiks-micro:bit.wikispaces.com/file/view/sawston%20summary%20erasmus.doc/613650031/sawston%20summary%20erasmus.doc

5.3.2 Meta Learning

The video below shows that a three level learning took place. Students were reflecting on the Wind Tunnel project described earlier.

Students initially described a first level which we might call:

- "Learnt more about" – in this case the wind tunnel technology

Then the second was:

- What could have been improved? – many ideas for improvements were forthcoming

And the third:

- Different skills to solve problems and deliver solutions – learning about learning

These can be seen at:

https://1drv.ms/v/s!AoWEMkqxwLDMhiI7ctNA9eUj76pp

5.3.3 Technical, career and personal interests

In the below video, the quality of the Question/Answer session in the UK – Spain videoconference described previously covered technical, career and personal interests.

https://youtu.be/DMFzk3ED93E

5.3.4 Key Requirements for KIKS Projects

Student feedback gave a succinct requirements statement showing a balance between freedom/creativity and practicality:

- Freedom/ Creativity
    - More creative workshops that allow you a choice
    - Include freedom, encourage creativity
    - Include freedom to make your own decision and problem solving

- Practicality
    - Clear instructions,
    - Hands-on-practical,
    - Understandable and
    - Fun,
    - Useful and related to possible career routes
    - Explain uses in daily life,
    - Repeatable at home,
    - Make sure children understand why they are doing something

5.4 Teacher Experience

At the international KIKS project meeting in Budapest, the UK KIKS Cambridge teacher and the Santander teacher discussed their experience (comments in bullets):

5.4.1 Inspiration Impetus

The KIKS process provided:

- Very good inspiration
- Wide learning experience
- The KIKS process was valuable – without the impetus we wouldn't have got going

5.4.2 Curriculum contribution

The activity was judged to provide specific national curricular contributions and also international benefit:

- Befits students teaching students and programming
- Students improved especially. micro bit and programming
- International component is very important – it sets the school apart NB especially with increasing interest in International Baccalaureate.

5.4.3 Manageable Workload

The project did NOT require extra work from the teachers, on the contrary:

- V positive – little workload for teacher because Students did the work
- KIKS Organized workshop for local primary students – teacher told students to 'get on with it'
- V good outcomes and manageable
- Challenge for able students to work with less able ones and learn from it

5.4.4 Cross-Discipline & Employability

- Diversity of projects made me think about cross- disciplinary working if students are employable in the future it is vital that they have these skills

5.4.5 Overall KIS (Keep it Simple)

The KIKS process was judged successful with interesting observations

- Improvement required Not in KIKS per se but about the teacher getting more out of it
- Students used basic methods of teaching and much independent learning from videos

In addition, The Westbridge Team response captures the importance of the project:

5.4.6 Team teaching and Professional Development

A multidisciplinary, cross-curricular team which in addition to inspiring the students also provided an opportunity for weekly professional development and to inspire the students- to engage - involve - and undertake curriculum relevant activities

5.4.7 Student participation

Kieran programming, Liam Arduino, Ryan micro bit actually started to collaborate and work creatively together, a big achievement in itself, culminating in a "Well done" from one of the students (a first from this student)

5.4.8 Proven STEAM plus curricular contributions

Liam's work will contribute to GCSE Computing portfolio and Ryan and Kieran to GCSE Art portfolios.

5.4.9 People skills development

The project supported the development of (amongst others):

- Building up resilience
- Student-centred creativity
- Presenting and talking
- Seen during the project and above all collaborating in creating the video in a five-hour session.

5.5 Lessons learnt

We can group lessons learnt at various stages of the project:

5.5.1 Hothousing works

From the above we can say ”Hothousing works’ for mainstream and excluded students with a completion rate of 88%.

The activities prepared for the Hothousing stimuli worked, as evidence for the subsequent achievements in developing Local Challenge student-driven solutions.
There was also a wide range of schools including two schools for excluded pupils, who performed very well at the Duxford event as described above.

5.5.2 WIKI – opportunity of on-line experience

To keep the attention of both students and busy teachers, for the fourth and final Hothousing experience, a WIKI was produced. Started with two schools, this has led to continued participation and indeed further participation by other schools and organisations. The power of the WIKI alongside the KIKS WEB site and the Facebook Closed User group can be seen in the projects contained in the WIKI.

5.5.3 Need for and power of different types of virtual mobility

Based on the experiences of the Local Challenges we identified a need for four types of international collaboration ranging from well-structured videoconferencing to large-scale participation in a multi-project WIKI.

The power of the different types of virtual mobility can be seen in the quality of the videoconference presentation and also the Question/Answer session which covered technical, career and personal interests. The potential of virtual mobility for in-depth collaboration has been demonstrated in many different and sometimes surprising ways. For example, in the “Chain Reaction” collaboration a very shy student refused to appear on the video stood by the side of the camera but nevertheless made a valuable contribution. Also, the power of the videoconference was demonstrated in the real time exchange of ideas culminating in the “Chain Reaction” idea, plus the subsequent elaboration in the WIKI. The Kitronik collaboration showed the potential for enhancing an existing project between two countries.

5.5.4 Balance of physical and virtual

The power of the WIKI alongside the KIKS WEB site and the Facebook Closed User group can be seen in the projects contained in the WIKI. The Hothousing physical events and on-line are mutually supportive as can be also seen in the 88% completion rate.

5.5.5 International Comparison: Euro student?

Based on the experiences of the above Local Challenges we observed differences in the teaching/learning/classroom leadership style both within the UK and also country by county. This ranged from large group activity to very small group work, with different appropriate levels of support, and differing use of virtual mobility.

However, not to deny the existence of national differences, perhaps because the teachers and students were self-selecting, no significant differences between countries were detected – similar kids in similar classrooms.

Very tentatively, this perhaps is good news for Euro/Global collaboration, which on the evidence is not as difficult as might be thought hitherto.

6 Conclusion and Next Steps

As a legacy we provide:

- Hothousing process which works, within and across schools and countries
- Student Digital Ambassador Programme to help students deliver projects

- Project Library consisting of both KIKS project team and student-developed projects

- Interactive WIKI

- KIKS embedded into other national organisations and sites

The future clearly lies in enhancing the power of Mobile Virtual Learning. We already know how to provide very effective physical events.

In our two Cambridge physical events and Ipswich events reached 90 students and others (target 50).

In two physical single events – we had potentially 1000 visits each, but clearly the interaction was weaker.

With on-line collaboration we reached perhaps 600 per month – at the time of writing 3000 and counting, with repeat collaboration and visibility in countries not involved in the project.

However, the on-line collaboration had to be tightly controlled by teacher request but clearly shows the opportunity when we can develop:

- Safe and secure (in reality and perception) on-line solutions including remote access for both mainstream schools/students

And also

- Disadvantaged students for example with SEN (Special Educational Needs) and /PRU (Pupil Referral Unit for expelled or otherwise excluded) students.

END