INtroducing Science in PrImary schools through Learning by DiscovEry
(INSPIRE)

1.1. Concept and approach, quality of the coordination and support measures

1.3.1. Concept & Motivation

It is an acknowledged fact that Europe has an aging population and while Eurostat analysis shows the numbers of students graduating university with STEM qualification has remained stable across the EU in recent years (22.3% of all graduates in 2006 and 22.8% of graduates in 2012) this has not been sufficient to overcome expected shortfalls in industry in the medium to long term. The Eurostat analysis shows that in Germany for example in 2012 (arguably the leading country in terms of STEM graduates in the EU) despite nearly 30% of all graduates having a STEM qualification there was a shortage of 200,000 STEM graduates (mainly engineers) costing the economy 20 billion Euros a year. It is interesting to note that this trend is the same for the US with the added worry that the number of students who enter engineering programmes is actually projected to drop; a projection that many believe will have a negative impact on the U.S. workforce in the future (Christian D. Schunn, 2009).

Indeed research by the European Centre for the Development of Vocational Training (CEDEFOP) found that despite the recession and high unemployment across the EU since 2008 that demand for Science and Engineering Professionals in the EU has remained resilient with employment is the sector 12% higher in 2013 than in 2000 with 6.6 million Science and Engineering professional employed in the EU28 in 2013. This employment growth is forecast to continue until at least 2025 with an increase of 6.5% forecast between 2013 and 2025.

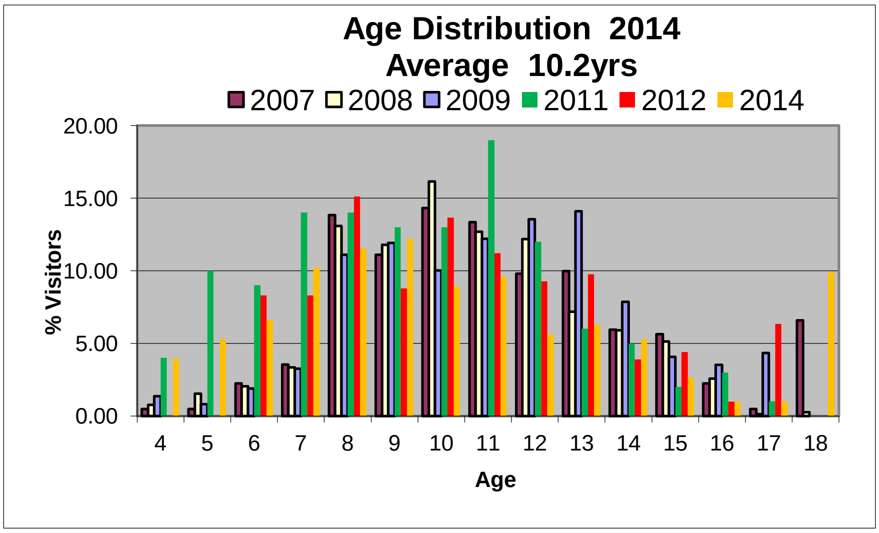
The shortfall between the demand for qualified STEM professionals and the number of EU students studying and graduating with STEM qualifications has many ramifications for the well-being of the European competitive position, particularly considering that the new emerging economies such as China, India and Korea are surging ahead at an astonishing rate. It is also well-known that many engineering graduates, especially the brightest ones, are gravitating to financial and commercial professions due to better salaries and working conditions. The UK Government Department for Business Innovation and Skills in a 2011 report titled 'STEM Graduates in Non STEM Jobs' found that about only one in 8 University final year STEM students did not want to pursue a STEM career, yet this employers cite students higher salary expectations from Non-STEM jobs as a major factor for students not entering STEM jobs upon graduation along with poor STEM career pathway awareness among students as despite student intentions more than the above 1 in 8 end up not working in a STEM field after graduation. As well as poor tale up of STEM qualifications, the fact that STEM graduates have poor career awareness and often choose to enter non STEM jobs is another cause for concern for the engineering sectors which are starved by lack of science and engineering graduates.

The introduction of a Craft, Design and Technology (CDT) programme in UK secondary schools (including a prior teacher training provision) in the 1980s has had a positive impact on encouraging pupils to apply for science and engineering courses in UK universities. CDT was pioneered by the C4FF, the lead partner in this project, was based upon the following principles:

- opportunities for embedding academic content into authentic 'design and make' situations, thus generating secondary school pupils interest in mathematics and science;
- training teachers for teaching CDT before introducing the CDT modules in schools.
- Attracting more women and minorities to engineering careers as Science and Engineering is a male dominated field with women currently accounting for approximately 24% of the workforce
- Linking national projects such as Women in Science and Engineering (WISE) and Girls in Technical Education (Gate) to the CDT development in Schools.

Whilst CDT has been introduced into 70% of UK secondary schools experiments carried out by Imperial College London and recent research in Europe and the US (Superhuman, The Secret Life of Twins, Child of Our Time, Human Instinct, and the BAFTA award-winner The Human Body) have found that the formation years of "discovery by learning" take place in primary school and that if the projected shortages of science and engineering graduates and poor career awareness among graduates are to be overcome it is the pupils at primary schools which need to be engaged.

Recent initiatives to explore and inspire young people into science and engineering through practical technical experiments have proved that young people are interested in technology subjects early in their primary education. Over the last 15 years, Imagineering fairs, which is organised and run by project coordinating organisation (i.e. Imagineering Foundation), have attracted approximately 225,000 visitors so far and the numbers are increasing each year. In these fairs youngsters can discover the exciting world of engineering and experience the technology behind our everyday lives. From the analysis of visitor data of Imagineering Fair 2014, it has been noted that Imagineering fairs were successful in attracting children and young people. A chart demonstrating age distribution of visitors visiting Imagineering fair is presented below:



Imagineering is currently run 145 clubs, reaching around 1,740 children each week[1]. The increasing interest from children and your generation is evident that primary students do get engaged with practical learning. The idea of developing a curricula for training the teachers in primary schools to deliver CDT (now referred to as DT), and formulating a curriculum for DT for primary school pupils using a series of "leaning by discovery" practical laboratories is a novel concept which should be taken seriously by education bodies as it is already a technique that Industry supports. Some of these companies[2] can be named as Airbus UK, Nissan, Caterpillar, Delcam, Denso, Rolls-Royce, Jaguar Land Rover and so forth, who are proud supporters of Imagineering concept and fairs across UK. The choice for Europe is stark, compete or die!

[1] https://imagineering.org.uk/about-us/statistics/
[2] https://imagineering.org.uk/partners/supporters/

In a recent study supported by one of the partners (C4FF) and the lead partner the view of several prominent academic and industrialists were taken into consideration. The following is the view of Babcock International boss Peter Rogers. Babcock international is the UK's leading engineering support services company and has had a growth from sales from £200-300 million a year to £4-5 billion. Pre-tax profits have hit £313.1 million, a rise of 51 per cent on 2014.Despite his own company's success, Rogers is deeply sceptical about the UK Governments "March of the Makers". 'The recognition that manufacturing and engineering are crucial for the UK is a big step forward,' he says. 'Engineering is more valued. Technical apprentices are more valued.' However he thinks the UK are a long way off having a manufacturing renaissance partly because in his view the **<u>average primary school teacher knows as little about engineering as the rest of the population</u>**. 'It is not that they talk down engineering or are negative about it. They just don't mention it because they have no idea of what it is,' he says, a situation he'd like to change.

Rogers identifies two ways to boost domestic demand and manufacturing growth. One is what he calls 'that terrible phrase' of re-onshoring. This means the manufacturing of goods currently being made in India, China or Taiwan returning to the UK and Europe and the development of new products. The situation is not helped, he protests, by the skills gap and lack of qualified engineers or science graduates in the UK and in Europe, a problem Rogers thinks is down to the education system. Together, he says, by ending political turf wars between the myriad professional bodies and work as one. Second, **<u>industry needs to get to primary schools and teachers</u>.**

The study by the applicant also sought the view of several prominent academics. The following is the view of Professor John Flower based at Warwick University.

In the UK if we are to encourage kids to get enthusiastic about Science, Technology, Engineering or Mathematics (STEM) subjects, and encourage them into jobs that rely directly on these subjects, then we have two big cultural problems to overcome. One is the academic/vocational dichotomy that produces a sort of apartheid mentality among the "better-educated" classes, and secondly the gender issue where young ladies do not do hard sciences, and thereby do not become professionals in currently male-dominated industries.

The second problem is the easier one to address. What is needed here is role-models for the girls. If the genders of hard-science teachers in schools were there in more-or-less equal numbers, then the problem would solve itself in time. The old prejudice in, for example, the engineering industry against employing women, other than as operatives, seems to be dying rapidly judging from the eagerness we see from companies recruiting bright young women engineering graduates from this university. After all medical schools, even in this country, now recruit a bigger percentage of girls than boys--a situation that has existed for years in the ex-communist countries. We just cannot go on effectively discarding half the population from seriously studying STEM-type subjects. I have no data, but from observation in my travels to other Western-European countries, that they have a bigger percentage of female engineers working than we have.

Returning to the first problem it seems to me that young children, once through the demolition stage, become remarkably creative and seem to do this by way of a mixture of observation (copying) of their peers and seniors, and exploration. They seek to build, draw and play imaginatively with toys, sand and almost anything else they can lay their hands on. And yet somewhere along the way this creativity urge seems to diminish. This seems to happen as they reach the stage where they are exposed to discipline formal learning. If this is the cause of the formal educational experience then what are the short--comings of this experience? Is it an over-weaning academic exposure together with this governmental edict of incessant testing, or is it due to the wrong diet of theoretical and practical aspects of the things being taught, or is there a lack of explanation as to the relevance of these things to life, as the children know it, at their stage of general development? Or is something-else getting in the way?

Pre-university and college teaching of subjects as purely academic objects seem to me to be a big turn-off for a large body of able students. Whereas on the other hand just rolling out fact after fact is not much of an educational experience either. It does not add up the acquisition of a systematic body of knowledge to exploit as life's problems, professional or personal, need to be overcome with the application of rigorous analysis and synthesis. I guess what this all boils down to is that working-life consists largely of problem-solving in a myriad of situations that require, normally, the application of knowledge of a combination of topics, e.g. technical, financial, managerial, personal, and selling them to the customer. In the end these problems are always of a practical type; however, a mixture of theory and practical knowledge is normally required for at least adequate solutions to emerge. The quote, usually attributed to Einstein, is so apposite. "There is nothing as practical as a good theory."

So somehow we need to go smoothly from an initially unfetter, raw enthusiasm to a disciplined, knowledge-based education that does not smother creativity. Also we need the process, along the line, to be flexible enough to encourage individuals to develop any innate aptitude (musical, artistic, design of various sorts, unusual mathematical gift, etc.) that they may then exploit eventually to everyone's advantage.

There exist all sorts of schemes to encourage youngsters in projects such as Imagineering, design competitions and so forth, all very laudable in their way. Mostly they have grown-up by an individual or a small group feeling that that they have a good idea. But these schemes do not seem to develop in an environment where they might learn from one another, or feed each other, or lead from one to another as a child develops. This is somewhat analogous to the situation of schemes to assist industrial development of companies (particularly small ones). There seems to be a multitude of schemes mostly operating independently and without reference to each other.

I think what is needed, if the above is in anyway correct, is a systematic study of what is available, not only in the UK but in Europe, and how schemes can be brought together to exploit them in a coherent way to improve the educational process, indeed make it suitable for an educational process fit for the modern world.

The time is right to do this since a number of universities are instrumental in setting-up school-age colleges. If the UK or Europe is going to survive to compete with the putative industrial BRIC countries then we need to harness every person to be well educated/trained effectively and efficiently.

1.2. National and international research and innovation activities

The introduction of Craft Design and Technology as a subject in secondary schools in the UK in the early 1980s and the Engineering K-12 (12 years in primary and secondary education, from Kindergarten to graduating from a secondary school) initiatives has had a positive impact on the numbers who opted to study science or engineering in universities but falls a long way short of what is needed in the future (Ziarati, 2014). In fact It is interesting to note that after the passing of some 35 years when the first CDT's were introduced in the UK more work needs to be done as the Eurostat figures show that in the UK the number of STEM Graduates fell between 2006 and 2012. To this end since 2010 the UK Government Department of Education has focused on encouraging pupils to take traditional academic subjects. As a result it has been reported that students are flocking back to take ''tougher science and maths'' subjects (Daily Mail 7th July 2015). The UK exam regulator, Ofqual, said that more school pupils are taking biology, chemistry, physics and computer science at both A-Level and GCSE, with a higher proportion also taking "further maths" as a subject option at A-Level. The next step in the Government program to encourage STEM studies is that from September 2015 all pupils starting secondary school in the UK will have to take GCSEs in the so-called 'EBacc' subjects – made up of English, a foreign language, maths, science and history or geography. To pass an EBacc, pupils have to achieve a grade of C or above for all five subjects. This shows that the Governments can help to balance the shortfall in numbers studying engineering in Europe that has not matched the numbers needed in future years (Ziarati, 2013) but there is still more work to be done in primary school years to lay the foundation for secondary school studies.

In a similar manner, in 2000, Imagineering (www.imagineering.org.uk) in the UK commenced its work to encourage young people to learn about engineering through making, building and experimenting with

Engineering artefacts, systems and materials. Imagineering engages with primary school aged children through its Imagineering Fairs the “ Inspirational” activity to awaken the creative interest in children. The Fairs have brought over a 100 companies as collaborators (e.g. Jaguar Land Rover, Airbus UK, Rolls-Royce, Nissan, Caterpillar, Delcam, EDF Energy, Royal Air Force, GE Oil & Gas etc. More detailed list can be found at https://imagineering.org.uk/partners/supporters/). Imagineering also runs Imagineering Clubs. These are the "sustaining" activity to sustain and develop the interest and STEM skills. The clubs are after school clubs that run an hour a week for an academic year (30 weeks) and each club is based around a progressive set of make and take home project kits which have inbuilt curriculum features including:

a. Maths
b. Science
c. Design and Technology
d. Personal Health and Social Education
e. Development of personal development

Imagineering Clubs are currently running in the UK, Switzerland, Spain and Australia and so the transferability of the concept is proven. The project will be looking closely at Imagineering practices and seeing how they can be developed and implemented on a wider scale across the EU whilst incorporating best practices from partner countries. There are many papers and articles (Yager, 2015, Katehi. 2015 and Kurt et al, 2008) on the importance of encouraging pupils at the young age to have an understanding of Engineering and expose them to the world of ‘learning by discovery’. It is for this reason that this proposal has been prepared.

In the UK despite growing effort to address primary school aged children with STEM activities, and require secondary school students to study Science and Maths subjects a main challenge of implementing CDT and wider STEM education still remains, and this is that very few primary or secondary teachers are prepared to teach engineering (Rodney L. Custer and Jenny L. Daugherty. 2009), this is despite that fact that since CDT was introduced in the 1980s all CDT teachers have had to undergo a training programme; the first of these was introduced by the one of the INSPIRE partners (C4FF) in Swansea in 1980, involving teachers from some 40 secondary schools in Wales. It was important that teachers were trained for introducing DT in their schools on a formal basis with support from the local and national authorities. Later the scheme was introduced in Hampshire and then throughout the UK.

While the focus is on Imagineering experiments it is also intended not only to learn from the project listed in section 1.6 but also from several ongoing initiatives and expose the pupils in the primary schools to science and engineering concepts to underpin the planned experiments and in the development of new ones. One of the initiatives of interest is by Warwick and Coventry University Fab Lab (www.fabfoundation.org). The Fab Lab Network is an open, creative community of fabricators, artists, scientists, engineers, educators, students, amateurs, professionals, ages 5 to 75+, located in more than 40 countries in approximately 200 Fab Labs. From community based labs to advanced research centres. Link to this community would enrich the intended implementation of the ISNPIRE project. Another of their initiative a program in digital fabrication who are interested in digital fabrication methods like 3D printing/3D scanning and creating their own prototypes. Kids can be some of the most ingenious inventors which is of particular interest to INSPIRE project. The Coventry University’s UNESCO UNITWIN network concern with the Humanitarian Engineering and Computing which aims to place cultural diversity and understanding at the heart of engineering and computing education could also be of interest the work with Massey University in New Zealand, Arusha University in Tanzania and Malta University, the Network aims to provide a platform for information sharing and policy dialogue on humanitarian engineering. The University’s Engineers Without Border initiative focuses on clean water, sanitation, shelter, energy and transport are the ideas for the future development of INSPIRE project. The Coventry University also is very active in the European Network of Living Labs. The network has grown with some 400 historically recognised Labs and a community of more than 170 active today. Last but by no means least, is the University of Warwick which is leading a number of initiatives for the National STEM centrE in the UK which feed into SCIENTIX directly. The National STEM Centre is working closely with several partners to provide online guidance materials and planning tools for schools that are developing their whole-school STEM ethos and activities - the 'STEM Schools' project. They can bring many schools into the proposed INSPIRE during the project's exploitation phase. Discussions have taken place to link INSPIRE with SCIENTIX,

It is interesting to note that the partner in Turkey (BAU) is a leading group of primary. Secondary with university campuses in several country including Germany. They recently establish a centre based at C4FF in the UK and keen to implement the INSPIRE project. Turkey has become increasing aware of, and active in promoting, STEM education in recent times. In the last 13 months the Turkish Partner to the project has hosted two conferences on STEM, the first being the International Conference on New Trends in Education - STEM Education: Establishing a bridge cross Contexts in May 2015, some 300 people from some 60 countries participated in the event, and the 2nd conference was the International Conference on New Trends in Education - Early Childhood Education in August 2014 http://nteconf.bahcesehir.edu.tr/, which attracted around 400 participants worldwide. Both events focused on STEM and its place in education and show the increasing commitment of Turkey to this issue as well as the growing International profile and attention being given to understanding and improving STEM Education in schools.

1.3. Current State-Of-The-Art (SOTA)

UK wide initiatives

National STEM centre[3] holds the UK's largest collection of teaching resources for STEM subjects for use with students from early years to post-16. This collection in the National STEM Centre e-Library brings together all the STEM-focused resources that were created by practitioners and the leading organisations involved in STEM Support: the National Science Learning Centre and the Royal Academy of Engineering.

Another example of support provided to STEM teacher is **Project ENTHUSE**, which is a partnership supported by the Wellcome Trust, the Department for Education, AstraZeneca, AstraZeneca Science Teaching Trust, BAE Systems, BP, General Electric Foundation, GlaxoSmithKline, Rolls-Royce, Vodafone and Vodafone Group Foundation. These organisations have come together to provide the ENTHUSE Award to help schools send teaching staff on world-class Continuing Professional Development (CPD) courses at the National Science Learning Centre.

The **Wellcome Trust's Education Strategy for 2010–2020** focuses on three priority areas: **1)** reinvigorate the teaching of science in primary schools, improve the expertise of teachers and strengthening the continuity of science education within and between phases; **2)** work with their partners to explore and understand in depth ways in which young people's engagement with science outside of school can be exploited more effectively; **3)** look into ways in which neuroscience is being used to inform teaching and learning, and where possible develop further investigations to evaluate the strength of the evidence and how it can support and improve the quality of education.

The National Science Learning Centre runs a residential programme of professional development for teachers, lecturers, teaching assistants and technicians involved in science teaching in schools and colleges in the UK. The programme is designed in collaboration with teachers, scientists and education researchers. All courses are led by experienced practitioners who have expertise in science teaching, leadership and supporting change in classroom practice. They draw on best evidence of what makes effective professional development and produce interactive courses that aim to support and challenge participants in improving the learning of science.

In order to bring some of the most creative research talents in the UK into secondary schools, a project called **Researchers in Residence** has been initiated in 1995. The aim of this project is to send PhD students and post-doctoral researchers in STEM to secondary schools with a aim to spend four to five days voluntarily. They give classroom support or presentations, arrange visits or attend field trips. Since it began in 1995, the Researchers in Residence project has recruited, trained and placed around 3500 researchers in over 2000 schools, working with about 2000 teachers and 300, 000 students.

[3] http://www.nationalstemcentre.org.uk/stem-in-context/what-is-stem

Europe-wide Initiatives

As a part of science promotion strategies, strengthening teacher competences is considered to be of particular importance in European countries. Where national strategic frameworks for the promotion of science education exist, they normally include the improvement of science teacher education as one of their objectives. France, Austria and the United Kingdom, in particular, focus their attention on this issue. Nearly all countries report that specific activities for science teachers form part of the official continuing development programmes for serving teachers.

For example, in Sweden, the programme for continuing professional development for teachers is the largest part of the 'Boost for Teachers' government initiative for raising the status of teachers. During the period 2007-2011 some 30 000 teachers were able to take part in this initiative. In Estonia, Greece, Cyprus and Latvia, training initiatives for prospective and serving teachers are linked to on-going curricular reforms. In Estonia, linked to the curricular reform and its implementation in 2011, there are on-going discussions regarding science teachers' initial education. Greater focus is being put on training in education research for all concerned (teacher educators, teachers, members of professional organisations, etc.) including for science teachers[4]. In Latvia, as part of the current curriculum reforms, a teacher professional development programme is being developed for all science subjects by the National Education centre. The programme is module-based. The modules include general guidelines on contemporary science at school; multiple methods of teaching and learning; scientific inquiry in the laboratory; and use of ICT. The length of the programme is 54 hours for basic school teachers; 36 hours for secondary school teachers with experience; and 72 hours for upper secondary teachers. These training courses are being phased in until 2012. They are directed at all science subject teachers responsible for implementing the new curriculum. This programme is organised and financed as a part of the curriculum reform. Hungary, Portugal and Slovenia have particular projects running to improve the teaching of practical science skills. In Hungary, the main activities of the National Talent Programme[5] include supporting the continuing professional development of science teachers and talent development in the field of science education. Short training courses are offered to teachers and psychologists as well as to staff members of the talent network in schools, NGOs, etc. It is based on a network of a range of organisations such as schools and NGOs. In Portugal, the national programme 'Experimental Science Work in Primary School' was conceived to develop primary school teachers' knowledge about different types of practical work and its role in science education. The aim is to implement these activities in the classroom with a teacher trainer coaching. The Programme has been funded by the Ministry of Education and European funds since the 2006/07 school year and will continue until 2010/11. Attendance is not compulsory. In Slovenia, the project 'Development of Science Competences'[6] was launched for 2008 - 2011 with the aim of developing and testing expert guidelines to raise the level of science literacy in schools. The objective was to develop teaching strategies and approaches especially in those fields of natural sciences which might have a significant impact on society in the future. As part of the project, strategies, methods and techniques have been developed that will ensure a successful adaptation of scientific findings to school purposes and, at the same time, make natural sciences more popular among students.

The issues of recruitment and the specialisation of science teachers are tackled through programmes in Denmark and the United Kingdom and within the Norwegian science promotion strategy.

In 2006, the Danish government set aside a total of DKK 230 million for the continuing education of teachers in public schools. The funds were predominantly intended to provide teachers with a specialisation in science or mathematics, although other subjects were included in the initiative. The initiative ran for the period of 2006 to 2009. During the period, more than 800 teachers acquired a specialisation in a science subject. A further 430 finished courses to become science guidance counsellors.

[4] http://eduko.archimedes.ee/en
[5] http://www.tehetsegprogram.hu/node/54
[6] http://kompetence.uni-mb.si/oprojektu.html

In Turkey there have been several publications on K-12 education initiatives (Kurt et al, 2008; Goktas et al 2008; Alcan, 2005). The Kurt et al (2008) paper concerns the evaluation of the skills of K-12 students regarding the national education technology standards for students (NETS*S) in Turkey. The standard, they claim, is accepted throughout the world.

Although their paper focuses on computing and computer based technologies, it concludes that the students are not proficient enough in technical issues, they do not pay enough attention to health issues, they are not successful in carrying out cooperative-based learning activities in online environments, and that they do not often benefit from technological devices in overcoming the problems they experience in daily life. This situation demonstrates that the course of Computer and Technology Literacy that the K-12 students have taken in the project reported in their paper, does not fully achieve its goals although the course predominantly covers basic skills. In addition, it was observed that students have problems in their skills regarding online education, which is a future concept of education. When students' skills regarding educational technology are taken into consideration, it is seen that no difference occurs with respect to gender; in other words, both male and female students have the same level of skills. On the other hand, it was found that being able to use a computer at any time develops students' skills regarding educational technology standards. Furthermore, the internet was found to be another factor that helps develop these skills.

In order to help improve the skills of K-12 students regarding educational technology standards, first of all, certain subjects related to overcoming the problems that students may experience using technological devices should be included in the curriculum of education programmes. Moreover, students should be provided with the opportunity to do practical applications regarding how to use education technologies in daily life and how to solve the problems they face. Students should be taught how they will make use of technology in their education process so as to search for the projects and papers they are assigned, to analyse the information they get and to interpret and report the results. Considering the fact that students had the lowest skill-level in using technological devices for the purpose of group work, online education should be introduced to students not at university level but rather at primary school level. Also, there should be activities that will help students gain experience in working in groups and in searching and learning during online education. In this way, students will be more likely to become more successful and more conscious about online educational applications during their university education and their later life.

Many of the initiatives in the United Kingdom focus primarily either on attracting more candidates into science teaching or on secondary education. The former is aimed at those who want to change career to teach mathematics, science or information and communication technology (ICT) in state secondary schools in England; to be eligible for the programme, candidates must have a degree in science, technology, engineering, maths or a related subject and be recommended by an employer. The latter, focuses on encouraging students at secondary schools to op to a subject in science or engineering. The INSPIRE proposal, focuses on formalising the teaching of science and Engineering in primary schools by bringing most such related initiatives in UK and internationally together, and building on meaningful and proven strategies and methodologies.

In the UK The national STEM centre is the contact point for SCIENTIX. Coventry University, INSPIRE partner, runs an accredited National STEM centre programme through their own staff and STEMNET ambassadors, working with local schools, colleges and industry such as Jaguar Landrover. They also employ a West Midlands regional co-ordinator for the Nuffield Research Placements scheme to provide over 1,000 students with the opportunity to work alongside professional scientists, technologists, engineers and mathematicians each year.

Situation in the US

In 2003, the Engineering is Elementary (EiE, *www.mos.org/eie)* project in the US was initiated to take advantage of the natural curiosity of all children to cultivate their understanding and problem-solving in engineering and technology and according to Teaching Engineering in the US, research around effective learning in K-12 classrooms demonstrates that an engineering approach to identifying and solving problems is valuable across all disciplines and the ‘TeachEngineering’ digital library (www.teachengineering.org) provides relevant, standards-based curricula from a range of engineering disciplines to bring engineering into the K-12 classroom for a single day, a unit, or even an entire course

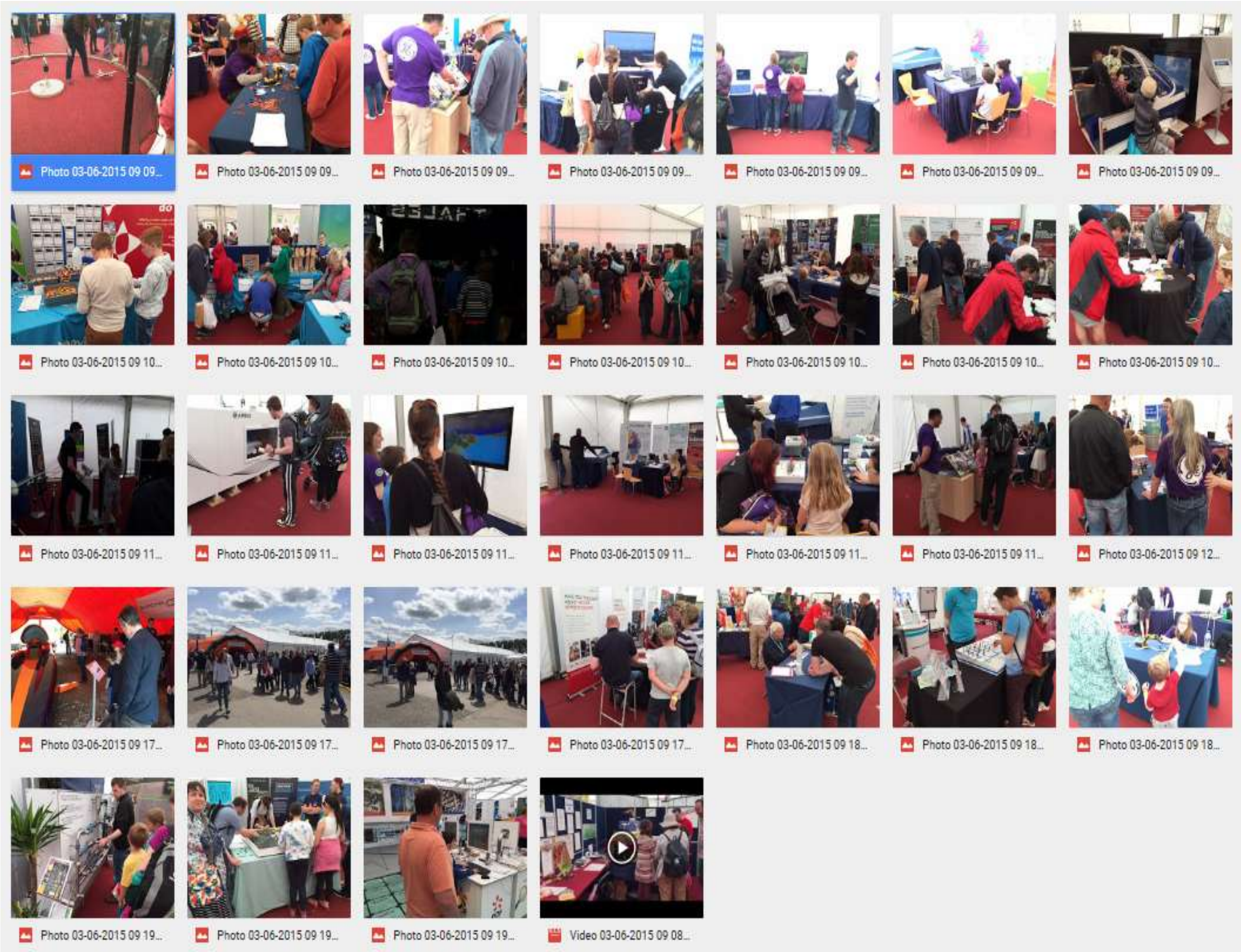


Figure 1 Imagineering Fair