# O3: INTERNATIONAL COLLABORATION CHALLENGES REPORT


**20 – July – 2018**

**Santander, Cantabria (Spain)**

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# 1. International Collaboration

KIKS project's integral part was International Collaboration. This phase of the project had two differentiated aims: the first aim was to get students from the participant countries to know each other and to learn from each other's projects; the second aim, after getting to know others' projects, was to improve their own project with the feedback of their homologous and/or to work on a new agreed project internationally. That is, after finishing the local challenges, students started presenting their STEAM projects to their international homologous and receiving feedback to improve their projects or to start new ones.

The international collaboration took place in two different ways: through **virtual mobility** and through **face-to-face mobility**.

**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. In particular, for this project we used videoconferences through the Skype Software.

**Face-to-face mobility** has been defined as an activity that offers international collaboration by having students and teachers travelling and visiting their homologous in their own schools. Although more expensive that the virtual mobility, this activity allows sometimes warmer and more exciting collaborations than the virtual mobility.

## 1.1 International collaboration through virtual mobility

Two main types of international collaborations were undertaken through Virtual Mobility, and, in particular, through Skype Video-conferences: the presentation of the teams' projects from the local challenges, where students posed questions and gave feedback for further development, and the development of new projects through an international collaboration.

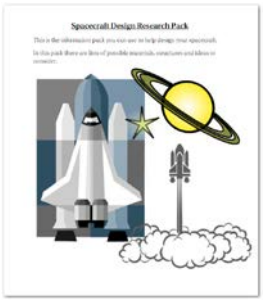
From Finland almost 50 KIKS participants took part in the international collaborations, mainly from Laukaa School and Viitaniemi Schools. From England Alton Covent Rainham and Westbridge schools participated with 25 students at least. From Spain more than 60 students participated in the international collaboration, from different schools: De Sar, Sánchez Cantón, San José, la Albericia y Lope de Vega, Sierra Sur. From Hungary, Budapesti Fazekas Mihály school participated with 15 students.

### 1.1.1 KIKS teams presenting projects, posing questions and receiving feedback online

Below are presented the first interactions of the KIKS teams. Students presented the projects elaborated during the local challenges phase of the project to motivate their international homologous, and to receive and give feedback aiming to improve their work, and to learn new concepts.

#### Spain and England collaboration

*Aerospace project; interaction between Alton Covent School, Sánchez Cantón School and Sierra Sur School*




The first interaction of the project took place between two countries: Spain and England. Two Spanish schools, Sánchez Cantón 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

Spanish students asked Lauren different questions about the project elaboration:

-Where did the project idea emerge from?
- How long did it take to complete the whole project?
- What were the trickiest parts of the project?

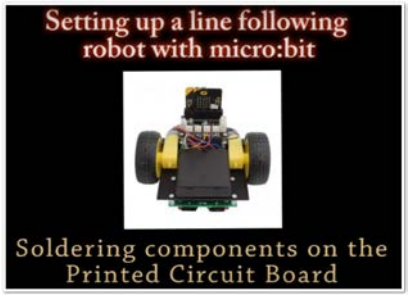
More specific questions about the mathematics and technology used in the project were also asked. After raising these questions, a collaborative interaction process started with regular on-line meetings. Apart from the above, Lauren talked about the award received as result of her participation in the TeenTech competition. This made a great impression on the Spanish students from Sanchez Cantón school who later took part in 2017 TeenTech finals in the UK, together with other KIKS school from Finland, the Viitaniemi school.

*Micro:bit KITRONIK and Wireless-Telegraph projects; interaction between Colegio San José and Rainham School*

The Micro:bit KITRONIK and Wireless-Telegraph projects were presented in a videoconference by the Rainham School and San José school respectively. First the team

from the San José school described the way they modify a traditional telegraph to set up a wireless telegraph using as main elements: one LED (Light Emitter Diode), one LDR (Light Dependent Resistance) and an electronic system conformed by one Arduino plate and one ProtoBoard plate. Further information of the activity here.

After the Spanish introduction, Rainham School described a Kitronik model car/buggy controlled by Micro:bit including use of the on-board accelerometer to change direction on impact.




Both teams made questions about the elaboration of the projects. The Spanish team got very interested on the KITRONIK Buggy and suggested some improvements which end up on an international project collaboration and subsequent online meetings between the two teams. That work was reflected in the KIKS Micro-bit Wikispace. Further information about the videoconference can be found at this link.

**Spain and Finland collaboration**

*Arches in our City and The Shadow of Theater projects, collaboration between Sánchez Cantón and Sydan-Laauka Schools*

On February 15th Sydan-Laukaa School from Finland and IES Sánchez Cantón from presented to each other The Shadow of Theatre and Arches in our City projects. The videoconference had several aims:

1. Share "feelings" of each team doing their activities.
2. Share "feelings" when each group see and study the work of the foreign team.
3. To formulate questions to the foreign country about their project and the project of the foreign team.

From the point of view of the "international collaboration", the most important part of the videoconference was the moment each team proposed questions related their project and the project of the other team. After the presentation of students and teachers who took part in the videoconference, the Finnish and the Spanish teams asked their colleagues the following questions:

- Why did you choose this project?
- What did you like the most in your project?
- How much time did it take to make your project?
- Did you do everything in the school time?
- Are the arches similar also in other cities?

After addressing these general questions, the Finnish students asked Spanish students these specific questions about their project:

- What did you think of the play?
- How did you feel about the play?
- Do you like acting?
- Did the play surprise you somehow?

Once Spanish students answered the Finnish students, the Spanish students asked again their homologous: Do you think this kind of arches, built with *voussoirs*, are useful in the present day? Then, they sent Finnish students the image on the right side.

Next, they asked Finnish students whether they think the *voussoirs* angles of the ArchLock system is the same that the obtained in their KIKS activity. After this question, Spanish students sent out the image on the left side to show the past and the present have similarities. Further information about this international collaboration can be found at this link.

**Spain and Hungary Collaboration**

*Recycling, Simons Says and Star Wars Robot projects; collaboration between La Albericia School & Budapesti Fazekas Mihály School*

KIKS teams from La Albericia School presented their outstanding work (the Recycling, Simons Says and Star Wars Robot) to Hungarian students. These projects integrated technology, Micro-Bits and Arduino software in different ways. Hungarian students, rather interested in Micro-bits, raised several questions about the functioning

of this software and their application for an educational purpose. Also specific questions about the particularities of each project were done. A short video about the informal part of the videoconference can be found at KIKS website.

**England and Finland Collaboration**

*Rocket engineering project and geometry and arts project; collaboration between Alton Convent School and Viitaniemi School*

The first English and Finnish interaction took place between the Viitaniemi KIKS group and Lauren Shea /Arkwright Scholar / TeenTech Ambassador / A-level Student, and Alton Covent school who has participated in the UK KIKS team as a student mentor. Lauren has told about her TeenTech Award project on rocket engineering and Viitaniemi students have introduced their KIKS project on connecting geometry and art. Lauren and the Viitaniemi students have agreed in further meetings, then they have posed some questions to each other and a collaborative problem-solving process has been started with regular on-line meetings. Lauren made a great impression on the Finnish students and many of them have decided to participate in the TeenTech Award Competition. As a result of this, a TeenTech team from Viitaniemi, Finland has been also invited to the TeenTech finals in the UK. Additional information about this collaboration can be found at this link. The photo on the right side (20 December, 2017) shows Viitaniemi KIKS students are discussing with Lauren Shea, Arkwright Scholar/TeenTech Ambassador/A-level Student, Alton Convent School.

*Mike Challis' KIKS project and shadow theatre project; collaboration between Mike Challis' KIKS School and Laukaa School*

In 2017 February, a series of on-line conference calls have been started with an on-line discussion with UK KIKS researcher Tony Houghton and UK KIKS teacher, Mike Challis. The UK KIKS members have introduced students of Mike Challis' KIKS projects to the KIKS team of Laukaa School. Laukaa KIKS team have also introduced their KIKS project and telling about their KIKS experiences to the UK KIKS team. The on-line

discussion with the UK KIKS team was a great experience for the Finnish students, as most of them have never interacted with native English speakers before and they found UK KIKS projects very interesting. Houghton and Challis have commented Laukaa School's KIKS project on scientific shadow theatre in details and there were many questions to each other during the discussion. The photo on the left side (February 2017) illustrates Laukaa students discussing on-line with the UK KIKS researcher Tony Houghton and the UK KIKS teacher Mike Challis.

### 1.1.2 KIKS International projects emerged and developed through the online interaction

#### Spain and Finland Collaboration

*SoccerBalls Project, collaboration between De Sar and Laukka Schools*

De Sar School (Santiago de Compostela) received a proposal to participate in a 'Math and Arts' activity designed by the Finnish school Laukaa. The material needed to carry out the activity was sent by mail. The material consists of some packages of a 4Dframe, a geometric toolkit, which was used by the Laukaa school to build truncated icosahedra, and the 3D models of the Buckminsterfullerene. In addition, the Finnish coordinator sent questions and comments concerning the work. The Spanish students had to put together these models in a collaborative problem-solving process and make a research on the role of the truncated icosahedral shape in mathematics, chemistry, art and real life.

In collaboration with the Department of Mathematics of the Sar School the activity was carried out following the instructions included in the work kit received, and we did a brief study of the article in English (Soccer Ball Symmetry) that from the Finnish collaboration was suggested and another article in Spanish (Mathematics, papiroflexia and soccer balls).

The didactic purpose of the activity was concretized in the following three objectives:

1) Establish a collaborative action with a School from other country belonging to the KIKS Project. Some of the indications of the Finnish coordinator were considered during the course.

2) This activity was used to work in English, mainly in reading texts.

3) A multidisciplinary action was introduced to be present in the activity contents of Physics, Mathematics, English and Arts.

Students of De Sar School in response to the proposal of work of the School Laukaa did the following video: link. The Finnish students were impressed by the impact of their gift on the Spanish students.

*Solar Car Project, collaboration between De Sar and Laukka Schools*

Several on-line video conferences took place between Laukaa KIKS groups in Finland and Sanchez Cantón KIKS groups in Spain, to work on the Solar Car project The Spanish KIKS team sent solar cars to the Laukaa KIKS students to carry out some experiments on determining the Finnish team's geographical location based on various measurements of sunrays' angles.

In particular, the project aimed two main steps:

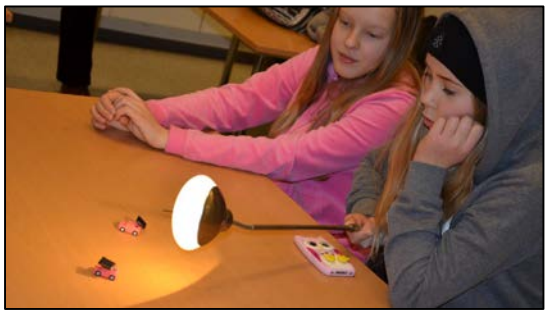
*First step:* Each team record videos of the movement of the car at the same solar hour (at the noon in each place of the school, for example). The students have to record two different movements. The solar car has a small piece to paste the solar cell to the car. If we use the small piece to paste the solar cell, the solar cell will be in the upper part of the car, parallel to the ground:

Students record a video of the movement of the car (with a tripod) and a mobile or a camera). In a second video, students have to record the movement of the car, but with the solar cell in a position which receive the solar rays vertically. They have to measure the inclination angle of the solar cell:

Students import to the Tracker program these two videos and obtain two graphs: one for each situation or video. The movement should be a linear movement (constant velocity), but the velocity will be different in each situation. In the second situation (solar cell receiving the solar rays vertically) the velocity will be more than the first situation (solar cell parallel to the ground).

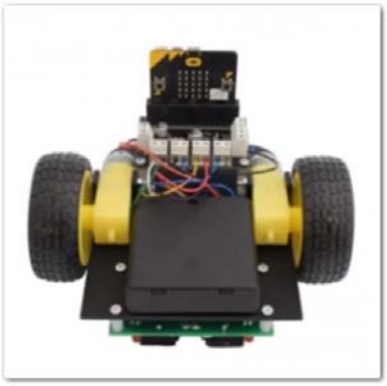
*Second Step:* in a videoconference, each team exposes their data, to compare the velocity is different in each country. They have got to debate what is the reason of these differences: it was the same model of car and the data were obtained at the same solar hour.

Funnily, the Finnish KIKS students were unable to perform the experiment, because the Nordic sunlight in the beginning of March still was not strong enough to make the solar cars running. Nevertheless, the Finnish groups have tested the solar cars with artificial light and have learnt about the physics of solar energy with the help of the solar cars. Further information in the following link.



**Spain and England Collaboration**

*Micro:bit KITRONIK project; collaboration between Colegio San José and Rainham School*



After a first videoconference where students from the Rainham School and San José school presented the Micro:bit KITRONIK and Wireless-telegraph projects respectively, the two schools started their collaboration on a further Micro:bit KITRONIK project.

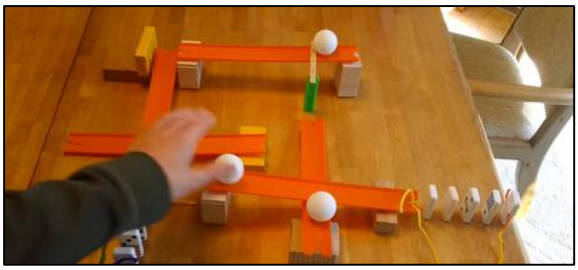
The aim of this collaboration was to improve the performances of the Kitronik model. The Kitronik model is car/buggy controlled by Micro:bit, that includes an onboard accelerometer to change direction on impact.

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 links: https://kiks-micro:bit.wikispaces.com/KITRONIC+BUGGY
https://www.kiks.unican.es/en/rainham-school-colegio-san-jose/

**England and Finland Collaboration**

*Micro:bit Chain Reaction project: collaboration between Sydan-Laukaa and Westbride Academy*

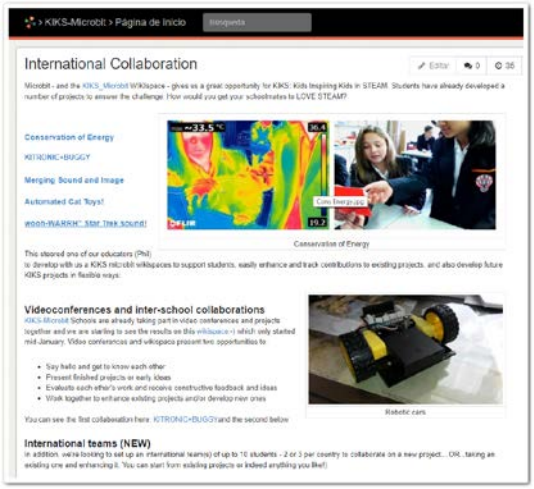
During a successful videoconference with Sydan-Laukaa and Westbride Academy, in which each school presented their work, a joint idea for collaboration presented itself: Chain Reaction – in which, for example, a ball rolls down a slope, hits a domino which in turn triggers another event and so on. The 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. The ongoing collaboration can be seen on:
https://www.kiks.unican.es/en/sydan-laukaa-westbride-academy/
https://kiks-micro:bit.wikispaces.com/Chain+Reaction

**England, Finland, Hungary and Spain Collaboration**

Apart from the pair country-projects described above, we undertook a KIKS Micro:bit many-to-many project, involving the four countries— England, Finland, Hungary and Spain. This project was supported by the Micro:bit foundation that kindly supported and supplied us with 400 Micro:bits.




The idea was to develop small projects in which all the four countries will contribute, and to expound them in the WikiSpace to interact. The power of the WIKI alongside the KIKS WEB site and the Facebook Closed User group can be seen in the projects contained in this web space. 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

**1.2 International collaboration through face-to-face mobility**

Face-to-Face Mobility implied the journey of KIKS students (and, also, of teachers) to other countries to present their projects in coordinate events and to collaborate with other in person. Normally this activity involved students and teachers from the four participant countries and, also, a mix of physical and virtual working— Face-to-Face & Many-to-many Projects.

*Collaborative event in Castro Urdiales (Spain)*

Spanish teams from several schools in Cantabria including Lope de Vega, San Jose and Vega de Toranzo presented their projects to several English, Finnish and Hungarian teachers as well as the international KIKS members. Several projects were presented as for example **Memory**, **Golde Ratio, Update your Torch, Dark Camera** among others. The presentations were continued by questions and suggestions from the international teachers and by an exchange of ideas which enriched students' knowledge.

*Collaborative event in Cambridge (England)*

The March 2017 Cambridge event gave an opportunity for UK, Finland, Hungarian and Spain KIKS people to come together face-to-face. Spanish teams from several schools in Cantabria including Lope de Vega, and San Jose schools presented their projects to several English students at Sawton Village and Linton Village colleges. Spanish teams presented five projects: (1) Arduino Robot to solve the Rubik Cube; (2) The Memory and the $\pi$ number experiment; (3) The Golden Ratio, (4) The Dark Camera, and (5) the Led Focus lights.

Sawston teams presented their 3 Erasmus projects: 1) Constellations and Pointer Stars-Peer to Peer Teaching – A presentation; 2) Circumpolar stars – Peer to Peer Teaching - A Mathematics Workshop; and 3) The Philae Lander – Learning. Students from the Linton College presented The Wind Tunnel Aerodynamics Project. In particular, they did several demos of their experiments in the wind tunnel.

The presentations took place during a period of two days. After each team presentation, Spanish and English teams asked questions about each other's projects and exchanged ideas to further develop their work. Spanish, English, Hungarian and Finnish teachers— as well as other KIKS members— also present during this event, collaborated in the discussion, suggesting ideas for new international collaborations. From this discussion, several ideas came up to develop international projects including teamwork between Linton College and San Jose School. Spanish students used their knowledge on Micro-bits and programming to help to improve the original wind tunnel designed by the Linton College team. Another collaboration between Lope de Vega School from Spain and Laukaa School form Finland emerged from this two days' event. Spanish and Finnish students collaborated in several ideas related to geometry and art.

Apart from the above, this face-to-face event gave us an unanticipated opportunity to compare collaboration started with a physical meeting then WIKI, compared to a purely on-line interaction. The following video is a summary of the whole face-to-face event taken place in Cambridge, as well as the participation of the Spanish and English teams in the Cambridge Science festival: link.

*Collaborative event in Budapest (Hungary)*

Two collaborative events took place in Budapest (Hungary). The first one was between La Albericia School & Szent II János Pál school. A Spanish teacher (Ángel Cuesta) from La Albericia school visited the KIKS students led by the mathematics teacher Tóth Ildikó at Szent II János Pál school. Angel met the Hungarian KIKS students and participated in the bilingual Mathematics classes given by Ildikó. The Spanish teacher gave a workshop about the use of Micro-bits and Arduino for the construction of robots. He also proposed several collaborative projects between students from the two schools, this first interaction concluded in posteriors online meetings.

After Ángel workshop, the Hungarian students and him interchanged information about the peculiarities of the Hungarian educational system and characteristics of the Spanish educational system, talking, in particular, about the profile of subjects such as Technology, which in Hungary do not exist in secondary education.


The second collaborative meeting at Budapest took place at Metropolitan University between Ángel (the Spanish teacher) and Gary Whitton teacher in Sawston Village College, as well as other KIKS members as Adrian Oldknow from England and Kristof from Finland. They discussed about the collaborative work doing at that time with Micro-Bits and talked about other potential projects incorporating both MicroBits and Arduino software.

### 1.3 Lessons learnt

There was a great interest in the teams, which were participating in the international discussions, to get into dialogue and to develop international contacts and projects. In addition to questions related to the KIKS project, students were interested about student life in each other's country. The discussion was a great way to all students to develop their communication skills and practice English. After the first moments of shyness, real discussions have evolved and real exchanges have been happened.

The potential of virtual mobility for in-depth collaboration has been demonstrated by all these examples we have previously described – 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 several international projects as, for example, the *SoccerBalls Project,* the *Chain Reaction project, the Solar Car project*, and the *KITRONIK* enhancement *collaboration* among others, plus the subsequent elaboration in the WIKI.

The face-to-face mobility was another productive activity, which helped to formalise projects' ideas that had been developed online. It was also an enriching experience where

students got to know better to their homologous and their way of thinking, as well as creating a stronger relationship between them and the project as single and strong learning community.

### 1.4 Guidelines for others to begin international STEM collaborations

According to our lessons learnt during the project life cycle, there are several important points that educators, researcher's and teachers should acknowledge for successfully carried out international STEM collaborations.

First a pool of STEM projects or activities should be designed and proposed to the participant schools. A large call should be made preferably through the local governments or institutions to invite schools to participate in the project in each country. Once schools have accepted to participate in the project, coordinators should offer, to teachers from each school, the proposed activities. Teachers and students should also have the opportunity to come up with ideas or activities they would like to developed. That is, we should Not put any restriction concerning the activities to be developed. It is important having teachers and students embarking themselves in activities in which they feel motivate and comfortable. All this will increase the opportunities of success during the international collaborations.

Once we know teachers' preferences concerning content areas or specific activities, we should put them in contact. It is important to connect teachers who have similar objectives or preferences, but they should also complement themselves. For example, if we have teachers interested in the activity 'Measuring the Concentration of Gas in Carbonated Beverages' we should connect at least teachers from two different areas Mathematics and Chemistry. This will increase the probability of doing complementary work and effectively completing the activity in an international collaborative environment, having students learning from two experts in the area who will successfully lead the project.

Teachers should be in contact first (before involving students) and have several virtual meetings to organise and plan the future work on the activity. Then, after teachers have a clear idea of the steps to follow, they can start forming the student groups willing to participate in the activity. We have observed that other strategies as for example trying to put students in contact by e-mail or other ways is not effective, if their teachers had not organised and planed the work beforehand.

Once the students' groups have been created, students should organise the time and distribute specific and well programmed tasks among the students. Everyone should have assigned a particular mission and a deadline. At that time students can start collaborating with each other presenting their progress, sharing particular information or ideas. All this information will have to be integrated by means of a collective approach to come up with the final product. The final product or solution will have to be analysed by other members of the team to ensure validity. This analysis should be shared with all team members. Student may collaborate through virtual mobility or face to face mobility depending how far they are from each other. Important to successfully undertake International Student Collaborations teachers should supervise the whole process from the being of the activity; (planning its resolution, distributing tasks, controlling timing, etc.) to end of the activity (supervising collaborations, validating outcomes, etc.).