SPANISH KIKS FINAL REPORT

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Santander, Cantabria (Spain)

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1. Introduction

KIKS, Kids Inspire Kids for STEAM (Science, Technology, Engineering, Arts and Mathematics) is a European Erasmus+ Project, which has involved four European countries: UK, Finland, Hungary and Spain. The main aim of the project was to promote secondary education students' interest on the STEAM areas, by fostering the constitutions of different teams of secondary education students, aiming towards the design and development of interesting STEAM activities and presenting them to other student teams, locally and internationally.

It is quite apparent that STEAM subjects are, along the past decades, becoming less and less popular, followed by fewer and fewer students in schools and universities. On the contrary, students' STEAM-related knowledge and skills are becoming more and more necessary for European economy and society. Spain, its society and its educational system, are not an exception regarding this statement. In fact, the recent educational laws in Spain include, implicit or explicitly, a clear reference to the theoretical importance of STEAM. Unfortunately, these laws do not include a concrete proposal on how to act in practice.

KIKS long-term goal is to help towards solving this contradictory situation, by presenting STEAM subjects to students with a new, interdisciplinary, inquiry-based, collaborative methodology, in which students become more and more motivated to the point of motivating others.

This report describes the different activities of the Spanish KIKS team and, more importantly, the dedicated work of so many teachers, in many different Spanish schools, and of so many teams of students, all of us working towards achieving the goals of the project.

2. KIKS Members of the Spanish Team

The Spanish team was comprised of university professors, researchers, scientists and technologists, as well as teachers and volunteers from other educational institutions. Below it is provided a list with a profile of the most significant members of the Spanish team, who worked as coordinators, researchers, graphic-designers and STEAM Ambassadors.

Dr. Jose Diego-Mantecón received his M.Phil. and Ph.D. degrees in mathematics education from Cambridge University (UK). He is currently working from University of Cantabria and he has large experience on developing and working on international projects for example: Millennium Mathematics Project (MMP) of the University of Cambridge. Jose has an extensive background on the evaluation of comparative studies as well as on the design of methodological instruments for

cross-cultural studies. In his last research project he has developed a valid instrument to evaluated student mathematics-related beliefs in Mexico, Spain, Slovakia, Ireland, England, and Cyprus (Diego-Mantecón, 2013). Nowadays, Jose collaborates on TIMSS. He was the Spanish representative on the last meeting of the project in Amsterdam (2012) for designing the mathematics items for TIMSS 2015. Jose has worked in KIKS project as main researcher.

Prof. Tomás Recio is a senior mathematics professor at the Universidad de Cantabria, currently working in the crossroad of computer algebra, algebraic geometry and its applications to automated theorem proving in elementary geometry (for instance, using the GeoGebra software). He has been for about a decade, the chair of the Consejo Escolar de Cantabria (Regional School Board) and member of the Consejo Escolar del Estado. At the international level, he has been the Spanish representative at the ICMI (International Commission on Mathematics Instruction) and has been involved in the ICMI-promoted Klein Project, as well as in the EU-funded projects Intergeo and Fibonacci, both related to Dynamic Geometry and Mathematics Education. Tomás has worked in the KIKS project as a coordinator.

Dr. María José González-López is professor at University of Cantabria with 29 years of experience in the teaching and learning of mathematics. She holds a PhD in Real Algebraic Geometry and a Master Degree in Mathematics Education. She has a large experience on Mathematics Education Research, mainly focused on Mathematics Teacher Knowledge and Information Technology (IT). Since 1995 she has published more than 50 articles related to Mathematics Education in several international journals and congress. She has also been president of the Cantabrian Society of Mathematics Teachers, vice-dean of the Faculty of Science at University of Cantabria, and treasurer of the Spanish Society for Research in Mathematics Education (SEIEM in Spanish). María José has worked in the KIKS project as a researcher.

Professor and researcher Irene Polo Blanco received her PhD from the University of Groningen (The Netherlands). Her doctoral thesis deals with models for the teaching of geometry combining didactic, historical and mathematical aspects. Currently, her research focuses on these three lines, presenting her works in numerous national and international congresses. From 2011 she enjoys a permanent position in the area of Didactics of Mathematics at the University of Cantabria from where she has published numerous articles with international impact. Irene has worked in the KIKS project as a STEAM ambassador.

Dr. Jose B. Búa received his Ph.D. in mathematics education from Santiago de Compostela University. He has an extensive experience in European collaborative projects (Xplora, Comenius and eTwinning). He took part in the eTwinning project Goal!, receiving the Spanish eTwinning National Award in the year 2012. He is also a Mathematics' teacher in a Secondary School (IES Sánchez Cantón, Galicia, Pontevedra). At the moment, Jose is closely collaborating with the University of Cantabria. Jose has worked in the KIKS project as a STEAM ambassador.

Dr. Teresa Fernández is a professor at University of Santiago de Compostela. She holds a Bachelor Degree in pure Mathematics, and a Master Degree in Education. She also holds two PhDs: one in Numerical Methods in Partial Differential Equations and a second one in Didactic of Experimental Sciences. She is a known researcher in geometry and modelling, having supervised several PhD thesis in this area of research integrating STEM. Since 2006, she is secretary of the Department of Didáctica de las Ciencias Experimentales at the Faculty of Educational Sciences, University of Santiago of Compostela. She is also member and coordinator of the SEIEM (Sociedad Española de Investigación en Educación Matemática) Scientific Committee. Apart from the above, Teresa has collaborated and led a large number of national and international projects in mathematics education. At the moment, she is closely collaborating with the University of Cantabria. Teresa has worked in the KIKS project as a researcher.

Maitane Pérez-Isturiz received her degree in Mathematics in 2013 from the University of Cantabria. In 2014 received her Master in Teacher Training in Secondary Education in Mathematics. In her master thesis she analyses why 12 to 16-years-old-students make mistakes when they solve linear equations. In 2014 she started her PhD in Mathematics Education in the University of Cantabria under Jose Diego-Mantecón and Irene Polo's supervision. Maitane has been always interested in Mathematics Education and she has worked in some Spanish Schools as a support teacher. Nowadays she works as associate professor and she is a PhD student in the University of Cantabria. Maitane has worked in the KIKS project as a STEAM ambassador.

Ignacio González-Ruiz holds a Bachelor degree in Mathematics (University of Cantabria, 2013) and a Master degree in Didactics of Mathematics (Universiy of Granada, 2014). Since he began his research activity, coinciding with his last year of college, he has worked in several topics linked to Mathematics Teachers' Knowledge and Practice, advanced mathematical thinking, didactics of algebra and statistics education. Nowadays, he is a PhD student in statistics education and associate professor at the University of Cantabria. Ignacio has worked in the KIKS project as a STEAM ambassador.

Juan José Sáenz de la Torre Lasierra received his Physics degree from University of Zaragoza in 2014. In 2015 he graduated from his degree in Teacher Training in Secondary Education, specializing in Science Education. He also holds a Master in Science Communication. Until recently he has worked as an assistant researcher at the University of Cantabria and collaborates at Principia Science Magazine. Juan José has worked in the KIKS project as a graphic-designer.

3. Schools Sample Selection

In Spain, KIKS began with two announces of the project in two different conferences: The first talk was in Madrid, undertaken by Maitane Pérez (on the 5th of March, 2016) at a seminar of Spanish Federation of Mathematics Teachers. 30 teachers from different parts of Spain attended the conference (evidence about this event can be found at https://www.kiks.unican.es/en/seminario-federal/).

The second talk was undertaken on the 31st of March of the same year at the University of Santiago de Compostela. 35 teachers and professors attended the meeting (evidence about this event can be found here). After these two preparatory events, announces of the Spanish Kick-off session were sent out through the Mathematical Society of Teachers of Cantabria (see announce) and The Spanish Federation of Mathematics Teachers (see announce).

The Kick-off session took place (on the 21st of April) at University of Cantabria. 62 teachers from about 30 schools attended the session (see attendance sheets and photos undertaken during the event: https://www.kiks.unican.es/charla-inaugural-uc-2/). The event included a project presentation that was video recorded (https://youtu.be/K_VHMhhhjUo), and a workshop about STEAM, also video recorded (https://youtu.be/7UxBWO9PGMg). Nine schools showed interest to participate in, at least, one of the two rounds of the project: either in the first round (academic year 2015-2016) or in the second round (academic year 2016-2017).

As emphasized in the proposal, we worked with a group of heterogeneous schools (state and semi-public schools), with different backgrounds and also with different experience on STEAM activities. Some of them never worked on STEAM, while others reported to

be familiar with this teaching/learning practice. Finally, the collection of Spanish teams accounts with more than 25 teams— from nine different schools— working in the project. Each team is composed by five/six students, and is led by, at least, one teacher from the STEAM areas. A description of the schools, teachers and (the majority of) the teams can be found on the website. Most students have recorded and edited videos presenting themselves as a team, as well as the STEAM activity they were intending to develop (see examples in the following links— Link 1, Link 2, Link 3 and Link 4 — and find more on the website).

4. Hothousing

After contacting the schools through different events, the Spanish KIKS members designed a number of STEAM activities, and undertook several Roadshows for executing them with our students or teachers.

STEAM Activities

Several STEAM activities were developed by the Spanish KIKS members, and offered to the students on our website. Often a power point (or PDF) was provided to describe each activity together with a video-tutorial. The power point was giving information about the body of the activity and the analytic part of it (example). The video tutorial was offering practical examples about the development or resolution of the activity (example). We tried to offer a large variety of activities incorporating the use of innovative software as, for example, Tracker, Geo-Gebra, Logger Pro, and Flow 3D. We have also described in our activities the use of technology tools and electronic components like Micro-bits, Arduino boards, PCB boards Leds, Erlenmeyer Flask, LDR sensors and so on.

Each activity was involving at least two STEAM areas of knowledge, and one innovative software or technology tool. We were, for example, proposing activities connecting: Maths and Physics using the software tracker (Modeling movements); Physics and Technology using focus led (Construction of Led Focus Lights); Chemistry and Maths, employing Geogebra (Measurement of C_{02} in cola); Astronomy, Cinematic and Maths, using tracker and a solar cell (Solar Car); Technology and Maths, using an Arduino board (Practices to start programming in Arduino), etc. Please see further examples in Annex I.

Roadshows

As suggested in the project proposal, Roadshows were carried out to stimulate teachers and students on the development of STEAM activities. More than 15 roadshows were undertaken, exposing different themes and activities, as can be seeing in the following link. Spanish Roadshows were normally video-recorded and uploaded on the web to motivate and stimulate our audience.

By contrast to other KIKS participant countries, three different types of Roadshows were carried out in the Spanish context. (1) The first type of Roadshow was conducted by KIKS members of the Spanish Team and was given to in-service teachers from the five STEAM areas. These events were undertaken at University of Cantabria (UC) or at the Cantabria teachers' Centre (CEP), where teachers were invited to gain knowledge about the development and guiding of STEAM activities. The CEP is a training institution, reliant on the Ministry of Education, Culture and Sport of Cantabria, whose purpose is to develop and revitalize the Regional Plan of Permanent Teacher Training determined by Spanish Ministry of Education. These Roadshows were normally given to teachers who wanted to participate in the project but were unconfident with STEAM and required help to guide their students in STEAM activities. These teachers were not happy with us carrying roadshows at their classrooms and interacting with their students. We were training them in STEAM at UC or at CEP, and then they were guiding their students in the development of these activities. These Roadshows had two main parts: in the first part we presented the project to the teachers and the way to participate in it with their students. In the second part, we were elaborating STEAM activities with the teachers as if they were students. We wanted them to experience the same things that their students would experience when developing the same activities. In the following links can be found roadshows about Tracker and CO2 at CEP, LED focus lights and Solar Car at CEP and BBC micro:bit at CIEM. In these roadshows participated teachers from more than 25 schools from different parts of Cantabria. See different attended sheets in these links: link 1, link 2, link 3.

(2) The second type of Roadshows was conducted by KIKS members of the Spanish Team and was given directly to students in their schools. These Roadshows were conducted in those schools that allow us access to their students. Roadshows were given to big groups of 25-30 students or to small groups of 5-6 students depending on school's requirements. As in Roadshows 1, two parts were differentiated in each event: in the first part, the project was presented to the students and in the second part students elaborated different STEAM activities with the Spanish KIKS members. Open activities were normally presented to the students to be modified and further developed in the local challenges. Students also built on these activities to get ideas from which to

develop slight different activities for the local challenges. All roadshows encouraged students to challenge their thinking and aimed for the elaboration of more sophisticated activities than the ones proposed. In the following links we provide the roadshows undertaken at Lope de Vega school, Zapatero Dominguez school, Sánchez Cantón school and Lope de Vega, where students worked on activities related to Springs and Physics, Geographical North and Tracker and Golden Ratio respectively.

(3) The third type of Roadshows was different to the other two in the sense that they were undertaken by students who had already participated in previous roadshows and also in local challenges. That is, students who had already elaborated activities in the local challenges were happy to participate as KIKS ambassadors and carry out Roadshows in their own or different schools. These Roadshows, always supervised by teachers and Spanish KIKS members, were rather inspiring because KIKS students sought to motivate and stimulate their homologous to work on STEAM Activities. KIKS students were mainly presenting their own activities from the local challenges, helping their homologous to learn new concepts as well as inspiring them to produce amended and better version of their activities. We found that having students instructing other students was very stimulating and fruitful for both the ones were delivering knowledge and the ones were receiving the information. In the following links we provide evidence of the roadshows undertaken by students from the Lope De Vega, La Albericia and Sánchez Cantón schools. These roadshows generated very positive results. The roadshows about the Dark Camera undertaken by the Lope De Vega students stimulated other students for developing different types of Dark Cameras which varied mainly on the size. The roadshows about Recycling Art, undertaken by students from La Albericia school, inspired other students to built statues with used cans. The roadshows about Arches In Our City, carried out by students from the Sánchez Cantón Schools, encouraged other students from the same school to construct a wall of actual dimensions, with a semi-circular arch, which was used for the theatre school group in an event dedicated to the Spanish writer Carlos Casares.

Lessons learnt from the hothousing

In the Spanish context we designed different sequential hothousing according to the necessities of our schools. We had schools with little experience on STEAM, whose teachers demanded several Hothousings for them to learn about the elaboration of STEAM activities and about how to guide their students on this learning methodology.

So every roadshow was prepared according to the necessities of our audience, improving more and more each time our events. For instance, for the lowest motivated students, we designed roadshows with KIKS students who could attract them better to STEAM activities. For the teachers working on Micro:Bits activities, it was necessary to create — together with the English, Finnish, and Hungarian members— a WIKI Space where our teachers could share information and keep updated about all the new enhancements: https://kiks-micro:bit.wikispaces.com/

Importantly, during the hothousing process we have tried to improve our teacher and student understanding of STEM and helped or students to learn new concepts as well as inspiring them to careers in STEM.

5. Local Challenges

Local Challenges was the second phase of the project where students had to develop their STEAM activities. Students were asked to create teams of four or five members to participate in the project, although larger teams up to 20 members were also permitted. Although in Spain all secondary education students were invited to participate in the project, the majority of the students were age 14-16, as suggested in the project proposal.

In the Spanish context, each team was supervised for at least one teacher, normally two, from any of the STEAM areas, although students were who chose their own STEAM topics of interest and designed their own practical sessions. That is, students had control about their projects, recruited by themselves the other team members, researched the topics, designed and developed any practical work, and delivered the workshops to their peer groups or younger students in schools. They also evaluated, made changes and amended their projects.

All local challenges were introduced by the question: **How would you get your schoolmate to love STEAM?** The teams' choice of activity was obviously influenced by a previous Hothousing experience, but in the Spanish context the activities could also emerge from a students' or even a teacher's idea. All teams were asked to develop and present a similar portfolio consisting of their STEAM project solution and associated evidence of collaboration. The portfolio consists of the following elements:

(1) A Word Document or Power Point written in English language, which includes:

- The team presentation
- The description, development and results of the activity, including mainly the analytic parts.

- The Appendices with the generated files: GeoGebra, Photos, mockups, etc.

(2) A Video edited in English language, including

- The production of the activity, which includes mainly the practical or visual part of the activity: the construction or functioning of the product elaborated.

The length and the time invested in the STEAM activities varied according to the type of activity selected. Activities were elaborated inside or outside of the school schedule, depending on teachers' and students' availability. Teams had to organized themselves, planning the number of sessions and distributing the tasks among the members.

To support in the local challenges, KIKS members opened several platforms including:

(1) **A Google Drive**, which was used
- To storage information (ideas, talks, activities) for the teams
- To exchange ideas among teachers/coordinators
- As a repository of the first documents elaborated by the teams

(2) **A YouTube canal**, which was used
- As repository of videos

(3) **An International Facebook**, which was used
- To exchange ideas and initial products among students and also teachers

(4) **A WIKI Space**, which was used
- To exchange information and ideas about Micro-Bits mainly among teachers

(5) **An Arduino Blog**, which was used
- To exchange among Spanish students information and ideas about Arduino
- As a repository of the first Arduino activities elaborated by the teams

(6) **An Official Web Page**, which was used
- As repository of final products

Apart from the above, the Spanish KIKS members also supported the Spanish teams in aspects related to English language (e.g. writing, and oral expression), and providing technical support (e.g. video edition, and online connections). Video tutorials were also offered to introduce students to new software or IT tools such as Tracker, Microbits or Arduino.

In the Spanish context, students under 18 are not allowed to use Facebook. Therefore, the Spanish KIKS members and teachers were in charge of uploading the initial products of their students and exchanging ideas and information with the international community.

Then, this information (for example comments or suggestions about the initial products) was transferred to the Spanish students. Spanish students used mainly the Google Drive and YouTube platforms as well as the Arduino blog to initially upload their products and to interact with their homologous in a learning community.

Besides the online interaction, during the Local Challenges the student teams worked also in a collaborative face-to-face environment, involving or presenting their initial work to other students in their school or nearby schools. The working language of the groups in local communication was English as well as in the international communication. KIKS members were always encouraging English communication, helping students to improve the learning of this language, and preparing them for the international challenges.

During April-May 2016, local groups were formed in all participating countries. Many of the local groups' members and their teachers have entered the closed KIKS Facebook Group. The **KIKS Facebook Group** has currently more than 120 members and it was the main platform of on-line work throughout the project. Team-members, teachers and local KIKS-coordinators were encouraged time by time to post regularly in the KIKS Facebook-group about their progress in their own STEAM inspiration project (see an example here). Most of the individual posts and comments on each other's post related to STEAM were made by the teachers and international KIKS-project members.

Until the end of 2016 May, local groups have posted at least once in the KIKS Facebook Group to introduce their group and their school. Most of the Facebook-posts were short videos, in which (1) the group-members told who they are, (2) where they are studying, (3) what do they find interesting about STEAM, and (4) what kind of KIKS project they have in their mind or what are their expectations about the KIKS project. These videos can be accessed on KIKS-project YouTube-channel

Between September 2016 – 2017 February, teams have worked on their project about making their school and local environment inspired about STEAM. All teams have prepared and published on the KIKS-website their e-portfolio, which documented their work (see Developed Activities). Many of the e-portfolios contain several kind of on-line material – like a short video, a photo-album, and textual summaries –, which serves as an introduction of the local project.

Starting from November 2016 each local team shared their full e-portfolio, which documented their STEAM inspiration project and local teams. They have collected *likes* and comments in the KIKS Facebook group, too. Each local team was expected to invite their peers, teachers and members of their local community to see and give a 'like' to their and to other groups' e-portfolio. All e-portfolios were collected and re-presented on KIKS-project's homepage as well. During this process, five activities were at least developed by the Finnish and Hungarian KIKS teams, and more than 15 by the Spanish and English teams.

Spanish student projects were very diverse and included different STEAM areas. We had projects integrating Mathematics, Art and Astronomy (e.g. How to determinate the Geographical North), Technology, Physics and Engineering (e.g. Wireless Telegraph), and Engineering, Art and Technology (e.g. Star Wars Robot). See further examples in Annex II.

6. 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.

6.1 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.

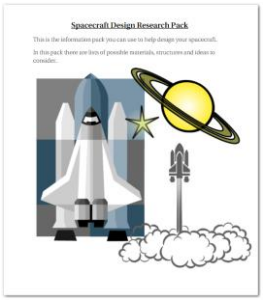
From Finland almost 50 KIKS participants took part in the international collaborations, mainly from Laukaa School and Viitaniemi Schools. From England Alton Covent Rainham and Westbridge schools participated with 25 students at least. From Spain more than 60 students participated in the international 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.

6.1.1 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?

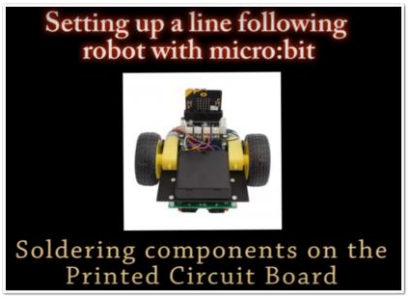
More specific questions about the mathematics and technology used in the project were also asked. After raising these questions, a collaborative interaction process started with regular on-line meetings. Apart from the above, Lauren talked about the award received as result of her participation in the 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.

6.1.2 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.

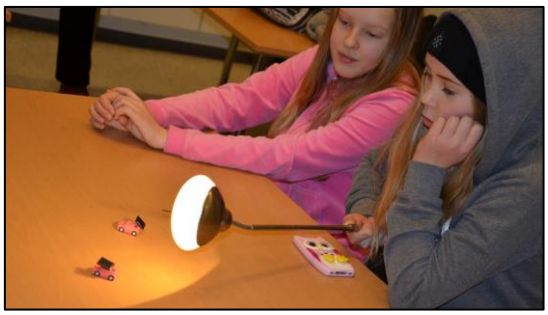
In particular, the project aimed two main steps:

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).

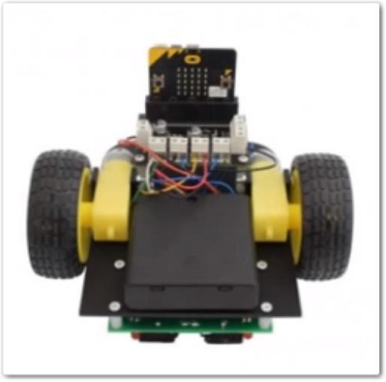
Second Step: in a videoconference, each team exposes their data, to compare the velocity is different in each country. They have got to debate what is the reason of these differences: it was the same model of car and the data were obtained at the same solar hour.



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



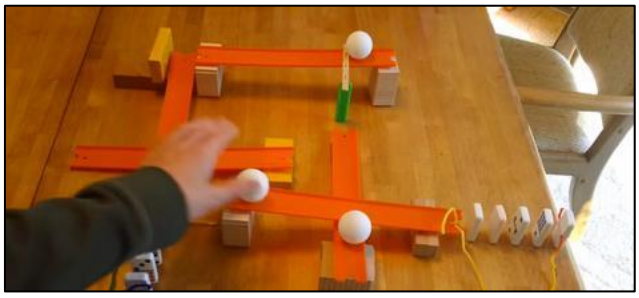
After a first videoconference where students from the Rainham School and San José school presented the Micro:bit KITRONIK and Wireless-telegraph projects respectively, the two schools started their collaboration on a further Micro:bit KITRONIK project.

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

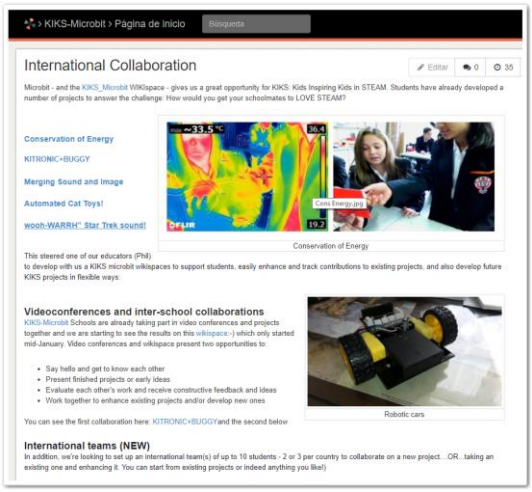
Micro:bit Chain Reaction project: collaboration between Sydan-Laukaa and Westbride Academy



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

6.2 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 π 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.

6.3 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.

7. Impact— Dissemination and Sustainability

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

7.1 Key Impact Organisations & WEB Sites

We have embedded the project in national, long-term organisations and web sites. Below we describe some of these organisations and our relation with them.

iSTEM+

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

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

UNITED KINGDOM INSTITUTE OF ENGINEERING AND TECHNOLOGY

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

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

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

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

STEMFORYOUTH H2020 PROJECT

We have closely collaborated with STEMforyouth project, sharing ideas, information and also organising STEM events for secondary education students. STEMforYouth is a project funded under European Union's Horizon 2020 research and innovation

programme, and formed by 10 institutions across seven different countries including Slovenia, Italy, Greece, Spain, Poland, and Czech Republic. The main objective of the project is to raise the interest of young people between 12 and 19 years old for STEM fields (Science, Technology, Engineering and Mathematics). To do this, seven STEM areas have been selected (Mathematics, Physics, Chemistry, Medicine, Astronomy, Engineering and Citizen Science). Further information about the project can be found at its official website and the Spanish website.

TESELA GROUP OF INNOVATION IN MATHEMATICAL EDUCATION (UNIVERSITY OF SANTIAGO)

The TESELA Group is a non-profit organization based at University of Santiago de Compostela Spain. TESELA collaborates with the Galician Institute for management of the Third Sector (IGAXES3) in Mathematical Education stimulation programs that take place out of the school schedule. It is **addressed towards teenagers at risk of social exclusion** and it is meant to be expanded towards the lasts years of primary school (in the Spanish education system that is children between 10 and 12 years old). The two programs that they are implementing are: (A) "Matemáticas de verano" (Summer Mathematics) and (B) Matemociones (Mathemotions). TESELA also collaborates with several schools in Galicia, as for example the CEIP Apóstol Santiago and the CEIP Vite I, undertaken extra-curricular activities as for instance the Science week. Apart from the above, TESELA collaborates with the Galician Association of Mathematics Teachers in two contests: The Rebumbio Matemático for 6th grade of Primary School and the Mathematical Olympiad for 2nd grade of Secondary Schools.

The Spanish KIKS partners have collaborated intensively with the TESELA groups organising STEAM events and training their volunteers on the elaboration and implementation of KIKS activities.

EUROPEAN RESEARCHERS NIGHT (UNIVERSITIES & EUROPEAN UNION)

European Researchers Night organise Europe-wide public events dedicated to popular science and fun learning. It takes place each year on the last Friday in September. More than 30 countries and over 300 cities are involved.

The events showcase what researchers really do for society, in interactive and engaging ways, and promote research careers to young people and their parents.

It is funded by the European Union. Funding covers any expenses linked to the organisation of a research outreach event. It can be spent on preparations and publicity, the event itself and assessment of its impact. Activities that can be supported include:

- hands-on experiments conducted by researchers
- science shows with public participation
- debates
- "researchers' dating"(meet a researcher and ask them questions)
- competitions (science quizzes, games, puzzles, photo and art contests, etc)
- workshops for children
- guided visits of labs, research institutes, and other relevant places that are usually closed to the public

All the four KIKS partners with their respective student teams have participated this year 2017 in the European Researchers Night, see more information here.


SPANISH FEDERATION OF MATHEMATICS TEACHERS

The Spanish Federation of Mathematics Teachers (C, in Spanish) is a non-profit organization that integrates all associations of mathematics teachers in Spain. It accounts with more than 20 Spanish mathematics teacher associations and 6.000 members. The Spanish Federation of Mathematics Teachers aims to promote the teaching and learning of mathematics organizing national and international events, and providing teachers with the necessary support and tools to reach a high level of teaching. Further information on: http://www.fespm.es/.

KIKS and, in particular, KIKS Spanish partners have closely collaborated with FESPM, by means of different talks about KIKS and the teaching and learning of STEAM areas (e.g. BBC: Bit at CIEM).

UNIDAD DE CULTURA CIENTÍFICA Y DE LA INNOVACIÓN (UNIVERSITY OF CANTABRIA)

The Unidad de Cultura Científica y de la Innovación (UCC+I) is a unit created in 2015 whose main objective is to enhance the communication and dissemination of research developed at University of Cantabria. UCC + I has the support and endorsement of the Spanish Foundation for Science and Technology (FECYT). In this way, the University of Cantabria has joined as a member accredited by FECYT, the Network of Units of Scientific Culture and Innovation (Red UCC + i). See further information here. KIKS and, in particular, the KIKS Spanish members have closely collaborated with UCC + I, mainly to spread and give visibility to our project (e.g. see here).

7.2 High Visibility Physical Events

7.2.1 Student Local Events

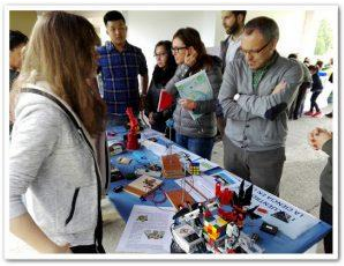
SCIENCE WEEK AT UNIVERSITY OF CANTABRIA

KIKS participated in the Science Week organised by the University of Cantabria. This is a scientific event with different talks and workshops about sciences and mathematics. Some KIKS teams from Cantabria (e.g. Lope de Vega School and San José School) presented the following activities: Dark Camera, Golden Ratio, The Memory and LED Focus Light. The even took place at Faculty of Science on 17th of November 2016 and it was the kick off of the collaborations between different teams. See all the information here.

CASTRO URDIALES INTERNATIONAL MEETING

The Spanish KIKS partner invited the Spanish schools to present their projects to the participants of 3rd KIKS International Meeting, held in Castro Urdiales, Cantabria, Spain. Several schools included the IES Vega de Toranzo participated in the event. The students presented their activities to the international KIKS committee of experts and shared ideas for new projects. Further information about the presentations can be found at here.

THE SCIENCE IN THE SCHOOL



The San José KIKS school participated at The First Educational Meeting: Science in the School organized by the Cantabrian Government department of Education between the 3rd and 4th of May, 2017 in Torrelavega (Cantabria). KIKS students presented their activities to other teachers and students of the region. More information about the event can be found at here.

VIII CIBEM

Students of Lope de Vega School participated at the VIII Ibero-American Congress of Mathematics Educatio (CIBEM). They presented the KIKS activities elaborated during the academic year 2016-2017. The CIBEM is a multitudinary congress to which attended about 2000 secondary education teachers from different parts of Spain, from different South American countries, and from Portugal. Apart from presenting their projects, the KIKS students interacted and shared information with all this range of teachers. See the video of the trip here.

MULTIPLIER EVENT

The Spanish Multiplier event was held on the 15th of June at the University of Cantabria. The Spanish team wrote invitation letters and designed a large number of flyers that were send out to the Cantabria Education Community to promote and advertise the event. In this event participated more than 10 KIKS schools, and about 140 students (see the attendance sheet). A large number of Teachers, from different schools of the region, and parents attend the meeting. Students, arranged in stands, presented their KIKS projects to the assistants. At the end of the event a committee— organized by teachers and members of the KIKS project— assessed the students' activities and

presentations, and awarded to the best STEAM projects. A gift (a bag with a book and pen) was given to all the participants for the hard work done during the project life. Everyone in event interact to each other, exchange experiences with teachers and enjoyed. See further information of the event in the following video here.

7.2.2 Conferences and Talks

In addition to the KIKS-related events, the Spanish KIKS group has mostly promoted the KIKS project in conference talks and workshops all over the globe. A list of the most relevant talks is provided below.

5th March 2016: 'Kids Inspiring Kids (KIKs): Chicos Motivan a Chicos en Ciencia Presentation by Maitane Pérez. Seminario Federal: "El papel del profesorado de matemáticas para la promoción de los estudios científicos e ingenierías y para la ciudadanía", Organización de Estados Iberoamericanos (OEI), Madrid, Spain. Further information here.

24th March 2016: 'Kids Inspiring Kids (KIKs): Chicos Motivan a Chicos en Ciencia' Presentation by Jose Diego. Seminario para el profesorado. Universidad Santiago de Compostela, Spain. More information here.

15th August 2016: 'KIKS- Kids Inspire Kids for STEAM'. Presentation by Jose Diego, Tony Houghton and Zsolt Lavicza. Hungarian STEAM Symposium. Hungarian Cultural and Scientific Centre, Helsinki. More information here.

18th November 2016: Proxecto KIKS: interdisciplinaridade de dimensión europea. Presentation By Jose B. Búa. XXIX Congreso de Ensinantes de Ciencias de Galicia (ENCIGA). Galicia, Spain. More information here.

4th February 2017: Kids Inspiring Kids for STEAM (KIKS): Presentation by Maitane Pérez. 10th Congress of European Research in Mathematics Education (CERME). Institute of Education, Dublin City University. Dublin, Ireland. More information here.

11st July 2017: Proyecto KIKS (Kids Inspire Kids for STEAM). Presentation by Alejandro Gorgal. VIII Congreso Iberoamericano de Educación Matemática (CIBEM). University Complutense of Madrid. More information here.

14th July 2017: Desarrollo de cinco actividades STEAM con formato KIKS. Presentation by Arturo Bravo, Pablo Cañizal. VIII Congreso Iberoamericano de Educación Matemática (CIBEM). University Complutense of Madrid. More information here.

14th July 2017: Interacción y difusión de los productos KIKS. Presentation by Ignacio González. VIII Congreso Iberoamericano de Educación Matemática (CIBEM). University Complutense of Madrid. More information here.

7.3 News: newspapers and Radio

KIKS has been on the news at different levels, with significant impact at local and national levels in each participant country. Information about the progress of project, and the different organised events, has appeared on different media: national newspapers, local newspapers, Radio, and well recognised Educational websites and online platforms.

- National newspapers:

EFE Agency (20th May 2016): writes about the KIKS Kick-off session in Spain and about the Spanish schools opportunity for participating in the project.

Noticias Press (27th February 2017): writes about KIKS its objectives and the opportunity of the Spanish schools for participating in the project.

- Local newspapers:

Diario Montañés (28th March 2017): writes about the participation of the KIKS Spanish schools at the Science Cambridge Festival and their visit and interaction with the English from Cambridgeshire.

Diario Montañés (14th March 2017): writes about the KIKS Roadshows undertaken at university of Cantabria and in particular about the two STEAM activities proposed to the participant teachers: (1) Using Tracker to study physical phenomena; and (2) Measuring the concentration of gas in carbonated beverages.

Cantabria 24 horas (27th February 2017): writes about the KIKS Roadshows undertaken at university of Cantabria and in particular about the STEAM activities proposed to the participant teachers for implementation in their classrooms.


Diario de Pontevedra

«Si volvemos a Siria nos matarán»

VALIÑO
LIQUIDACIÓN
de CONFECCIÓN
hasta 50% de Descuento

Pontevedra Viva (13th November 2016): writes about the participation of the Galician schools in the KIKS project as well as their connection with KIKS English schools. The news talks in particular about the coloration between IES Sanchez Cantón and Altón Covent Schools, from Spain and England respectively.

Diario de Pontevedra (17th November 2016): writes about the participation of the KIKS school Sánchez Cantón in the Teen Tech competition, organised in the UK.


EL DIARIO MONTAÑÉS

CANTABRIA CONOCIMIENTO

«Vivimos una crisis emocional que se ha comido la pasión por las cosas»

SEGURO DE COCHE
línea directa
CALCULA TU PRECIO

Diario Montañés (10th May 2016): writes about the KIKS activities/content developed by the members of the KIKS project at university of Cantabria and the importance of implementing STEAM activities in the Spanish classrooms.

Diario Montañés (24th May 2016): Members of KIKS at university of Cantabria talk about the Project and the importance of the Science areas in education.

- Radio:

Radio Post Cadena SER (10th June 2017): KIKS's members speak on the radio about the multiplier event in Cantabria.

Radio Post Santander Viva (7th June 2017): KIKS's members speak on the radio about the multiplier event in Cantabria.

- Educational website News:

Unican (15th June 2017): writes about the KIKS multiplier event which took place days before; number of presented projects, students and schools participating, parents, and other guest invited.

Unican (9th June 2017): Announces the KIKS Multiplier event, which took part at university of Cantabria. This was a call to invite teachers, parents, policymakers and others to come alone to the KIKS event and to participate in it in many different ways.

Facebook de la UC (15th June 2017): different news about the Spanish multiplier event are published at the UC Facebook. Information about the Spanish KIKS teams and the prize given to the participants is provided.

Unican Web Site (28th March 2017): announces the trip to Cambridge of the Spanish Schools. Information is given about the schools participating in the event and also about the Spanish projects presented in the UK.

Educantabria (31st March 2017), a governmental educative website writes about how KIKS project promotes the teaching and learning of STEAM areas in Spanish secondary education schools.

Unican (27th February 2017): writes about how KIKS project promotes the teaching and learning of STEAM areas with Spanish pre-service teachers at University of Cantabria. The news also highlights KIKS the hothousing roadshows at the Spanish secondary education schools.

Unican (26th October 2016): writes about KIKS project and its participation in the Science Day, organised by the University of Cantabria. Several KIKS schools presented at the Science Day their STEAM projects, developed during academic year.

Unican (15th September 2016): writes about the progress of KIKS project in Cantabria, and makes a second call to invite further schools and secondary education students to participate in the project.

Unican (13rd May 2016): announces KIKS and their Kick-off session at University of Cantabria. Members of KIKS presented the project to several dozens of teachers from different schools in the region of Cantabria.

Facebook de la UC (16th May 2016): announces KIKS and their Kick-off session at University of Cantabria. Members of KIKS presented the project to several dozens of teachers from different schools in the region of Cantabria.

Unican (24th May 2016): disseminates KIKS project and highlights the participation of the university of Cantabria and Cantabria schools in the project.

Educantabria (12th May 2016): announces KIKS and the participation of the IES Lope De Vega School in the project. This school has fit out a KIKS schoolroom where to elaborate its STEAM activities, as part of the KIKS project.

Unican (13rd November 2015): disseminates KIKS project and highlights the participation of the Cantabria schools (as well as other Spanish schools) together with European schools.

7.4 Publications

As part of KIKS project, a number of papers have been written and published in books, and conference proceedings.

Búa, J. B., Blanco, T. F., Diego-Mantecón, J. M., Istúriz, M. P., González-Ruiz, I., Recio, T., Búa, J. B., González, M. J. and Polo, I. (2016). Proxecto KIKS: interdisciplinaridade de dimensión europea. En Lires et al. (eds.) Boletín Das Ciencias XXIX Congreso ENCIGA. Santiago de Compostela. ENCIGA. ISSN:0214-7807

Istúriz, M. P., González-Ruiz, I., Diego-Mantecón, J. M., Recio, T., Búa, J. B., Blanco, T. F., González, M. J. and Polo, I. (accepted). Kids Inspiring Kids for STEAM (KIKS), in Dooley, T. & Gueudet, G.. (Eds.) (2017, in preparation). Proceedings of the Tenth Congress of the European Society for Research in Mathematics Education (CERME10, February 1 – 5, 2017). Dublin, Ireland: DCU Institute of Education and ERME.

Diego-Mantecón, J. M., Blanco, T. F., González, M. J., Istúriz, M. P., Gorgal, A., González-Ruiz, I., Búa, J. B. and Recio, T. (accepted). Proyecto KIKS (Kids Inspiring Kids for STEAM). Proceedings of VIII CIBEM. Madrid, Spain.

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INTERACCIÓN Y DIFUSIÓN DE LOS PRODUCTOS KIKS

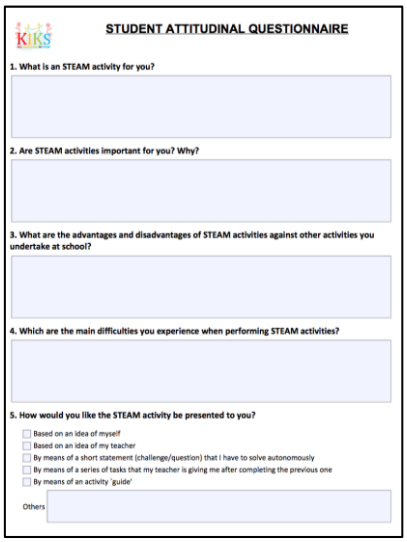
Diego-Mantecón, J. M., González-Ruiz, I., Blanco, T. F., Istúriz, M. P., Gorgal, A., Búa, J. B. and Recio, T. (accepted). Interacción y difusión de los productos KIKS. Proceedings of VIII CIBEM. Madrid, Spain.

8. Evaluation

The positive impact of the project in each of the four participant countries can be inferred by the active school participation. As shown in earlier sections, a considerable number of schools and a large number of students and teachers have enthusiastically taken part in this project. Students have developed many outstanding STEAM activities, which have been presented in different national and international events. The Spanish teams have for example presented their activities in more than 20 online and face-to-face national and international meetings. This has had a strong repercussion on the social Spanish media with more than 200 impacts in Newspapers, Educational Websites, Facebook, Blogs and Radio.

The project development and outcomes were also evaluated by (1) assessing student and teacher attitudes towards STEAM, and by (2) assessing student and teacher project satisfaction.

(1) To assess student and teacher attitudes towards STEAM, two methodological instruments were designed by the Spanish team. They were pre- post-questionnaires administered before and after teachers' and student's participation in the project. Both questionnaires included open questions like:



STUDENT ATTITUDINAL QUESTIONNAIRE

1. What is an STEAM activity for you?

2. Are STEAM activities important for you? Why?

3. What are the advantages and disadvantages of STEAM activities against other activities you undertake at school?

4. Which are the main difficulties you experience when performing STEAM activities?

5. How would you like the STEAM activity be presented to you?

- Based on an idea of myself
- Based on an idea of my teacher
- By means of a short statement (challenge/question) that I have to solve autonomously
- By means of a series of tasks that my teacher is giving me after completing the previous one
- By means of an activity 'guide'

Others

- What is an STEAM activity for you?
- Are STEAM activities important for you? Why
- What are the advantages and disadvantages of STEAM activities against other traditional activities?
- Which are the main difficulties you experience when performing STEAM activities?
- ……

And close questions in a six point Likert scale like:

a) STEAM activities should be enjoyable

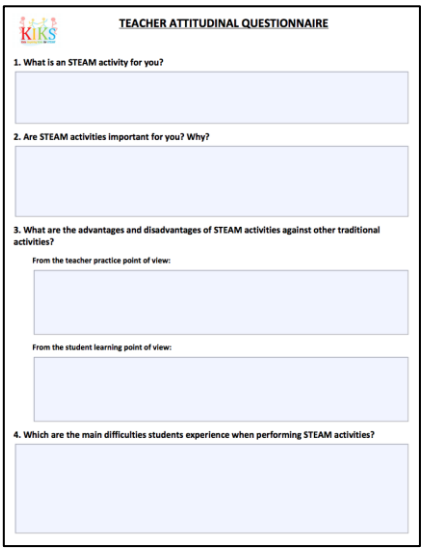
b) STEAM activities should pique my curiosity

c) STEAM activities should imply new knowledge

d) STEAM activities should imply previous knowledge

e) STEAM activities should involve the use of new technology

f) ……



TEACHER ATTITUDINAL QUESTIONNAIRE

1. What is an STEAM activity for you?

2. Are STEAM activities important for you? Why?

3. What are the advantages and disadvantages of STEAM activities against other traditional activities?

From the teacher practice point of view:

From the student learning point of view:

4. Which are the main difficulties students experience when performing STEAM activities?

The two questionnaires (Students' and teachers' questionnaires) shared several common questions. For specific information about it, please go to the Student Attitudinal Questionnaire and Teacher Attitudinal Questionnaire.

The data analyses from these two instruments revealed significant results. After students' and teachers' participation in the project— which last for one year and a half— students and teachers exhibited a better knowledge about STEAM than the displayed at the beginning of the project.

Before starting the project, the majority of the students did not know the meaning of STEAM Activities; and at the end of it, a vast majority of them were able to broadly describe the main characteristic of these activities (Interdisciplinarity, Inquiry Based Research and Collaborative Work). At the end of the project, the majority of the students also reported positive attitudes towards this learning methodology. In particular, they stressed that this way of learning, in contraposition to the traditional one, is very encouraging because allows integrating and applying the theory learned from different school subjects (studied separately at school) for accomplishing a tangible result to real problems. The majority of the students (not all of them) reported to like more working collaboratively with their peers, applying their own strategies and using the technology.

Teachers also stated positive attitudes towards the application of a STEAM learning methodology. They however highlighted several important handicaps about it implementation in the Spanish classroom. They indicated that although the Spanish curriculum promotes the STEAM methodology (through key dimensions like Interdisciplinarity, Inquiry Based Research and Collaborative Work), the educational system is based on independent assessments of each of the STEAM subjects. This characteristic of the evaluation system hampers the implementation of the STEAM methodology in the Spanish classroom, and can only be performed with the students in

exceptional moments during the academic year or outside the classroom. Importantly, teachers underlined that this methodology stimulates student communication skills, enhances student learning autonomy, promotes collaborative work and develops creative thinking.

(1) To assess student and teacher project satisfaction, structured interviews were carried. Many of the interviews undertaken to the Spanish students and teachers were video-recorded, and included questions such as:

How would you describe you experience with the KIKS project?

(1) Were you satisfied with the process of being part of the KIKS project?

(2) How did you and your school benefit from this project?

(3) Would you like to keep working this way in the future?

(4) What recommendations would you make for this project and STEM education?

The vast majority of the teachers and students described KIKS as an enriching and inspiring experience for them. They pointed out a large number of benefits related to their participation in the project. Students and teachers also indicated that KIKS brought positive rewards to their schools, inspiring and stimulating the way of learning of their homologous. Some of the Spanish schools have now set up a KIKS classroom in their schools to continuing working this way forward in the future and motivating younger students in the development of STEAM projects. Students and teachers specially like this way of working because allow them to collaborate in the resolution of real life projects, where they have to achieve a tangible solution. Below we provide a concise list of statements given by the students and teachers when they were interviewed about their participation in KIKS project.

Students' project satisfaction

- Interacting and working with students from another country was very rewarding and motivating for me (Ismael 15 years old).

- Connecting and exchanging ideas with professors from the university and other schools was very motivating for me (Fernando 14 years old).

- I think the idea of working as a group and feeling part of something made us feel useful, and was very rewarding for us (Ana 16 and Maria 15).

- Seeing yourself in the news participating in the project and seeing people interested in our activities made us feel important (Teresa 16 years old).

- The part that we like the most is to go to other schools and to talk about our activities for motivating others to participate in the project (Amalia15 years old).

- Etc.

Teachers' project satisfaction

- It was very stimulating for my students to work on real projects, in which something tangible was attained at the end of the process (Arturo 53 years old).

- For my students it was very motivating to work knowing that their projects would be used to inspire others who were far away (Luis 40 years).

- It was a challenge for my students to do all the work in English. That was really motivating, especially for those students with a low English level (Pillar 45).

- For my students traveling to the university city of Cambridge and presenting their projects in English was a really motivating experience (Cañizal 38 years).

- Participating in the Science Fair at the University of Cantabria and sharing the work with others was very motivating for my students (María 60 years)

- Etc.

9. Main Conclusions

We think that this report clearly yields several evident conclusions. One, that the small group of members of the Spanish KIKS project (9 members, mostly from the Mathematics Department of the University of Cantabria, but also including two from the University of Santiago of Compostela, in the not so distant region of Galicia), have devoted a lot of time and efforts along the past years. Time and efforts dedicated to the dissemination of KIKS goals, to the training and support of teachers' involvement in the project and, most crucially, to making possible the creation and development of so many teams of students. We believe that this report clearly supports this statement.

One remarkable fact –perhaps not specific of the Spanish context—is the difficulty to implement, within our schools' heavy traditional approach and bureaucracy-- non-standard methods, such as the ones that KIKS intends to present. Thus, in some sense, our second conclusion is that KIKS ideas are powerful enough as to make possible to break such high barriers (tradition, bureaucracy, extra work required…). Our experience and the experiences of the involved teacher and students, as described in previous sections of this report, confirm this impression.

A third conclusion, less optimistic, is that the difficulties we have mentioned towards implementing in practice the KIKS message, still require some external as a stimulus for the educational system. The evaluation of the KIKS project we have performed, even if quite limited, clearly shows that some institutional changes are needed (e.g. concerning the exam method for STEAM subjects) for KIKS' goals to get consolidated in our school system.

In this context, we think, as a final conclusion, that the continuation of an external action (a national or European project, driven by a group of external agents, etc.) is yet very necessary in order to consolidate and get full benefit of the very positive, although limited, results of the KIKS project.

Annex I. Proposed Activities

- The use of Tracker to study physical phenomena

The following is an example of a potential activity for generating mathematical models of physical phenomena. To obtain data for generating the mathematical model, the program Tracker is employed.
More information: https://www.kiks.unican.es/en/el-uso-de-tracker-para-estudiar-fenomenos-fisicos/

- Springs. Hooke's Law and Constant of Elasticity

The following is an example of a possible development of an activity to obtaining the spring constant of elasticity, in relation to Hooke's Law. More information: https://www.kiks.unican.es/en/muelles-ley-de-hooke-y-constante-de-elasticidad/

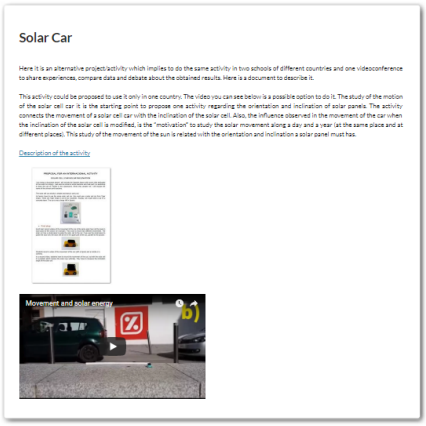
- Construction of focus in the shape of a pyramid trunk

Example of activity focused on the construction of light bulbs with LED. In particular, the construction of a pyramid-shaped bulb shape is described.
More information:
https://www.kiks.unican.es/en/construccion-de-focos-en-forma-de-tronco-de-piramide/

- The sinusoid and the sinusoidal function

Example of activities' development about the sinusoidal curve and the sinusoidal function.
More information: https://www.kiks.unican.es/en/la-sinusoide-y-la-funcion-sinusoidal/

- Solar Car

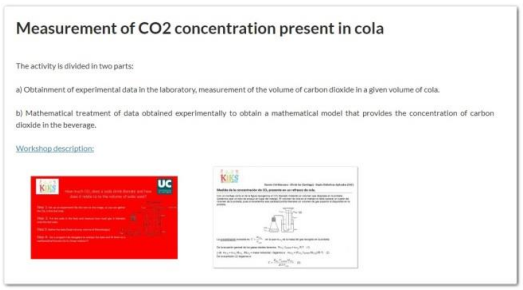


Here it is an alternative project/activity which implies to do the same activity in two schools of different countries and one videoconference to share experiences, compare data and debate about the obtained results. Here is a document to describe it.
This activity could be proposed to use it only in one country. The video you can see below is a possible option to do it. The study of the motion of the solar cell car it is the starting point to propose one activity regarding the orientation and inclination of solar panels. The activity connects the movement of a solar cell car with the inclination of the solar cell. Also, the influence observed in the movement of the car when the inclination of the solar cell is modified, is the "motivation" to study the solar movement along a day and a year (at the same place and at different places). This study of the movement of the sun is related with the orientation and inclination a solar panel must have. For more information please visit: https://www.kiks.unican.es/en/coche-solar/

- Measurement of CO2 concentration present in cola

The activity is divided in two parts:

a) Obtainment of experimental data in the laboratory, measurement of the volume of carbon dioxide in a given volume of cola.



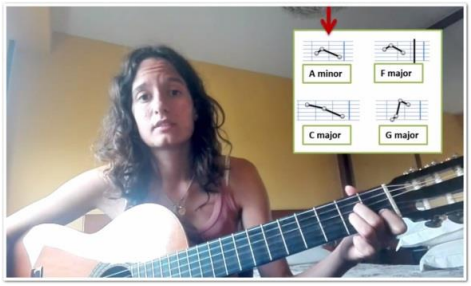
b) Mathematical treatment of data obtained experimentally to obtain a mathematical model that provides the concentration of carbon dioxide in the beverage.

More information about this proposed activity on: https://www.kiks.unican.es/en/medida-de-la-concentracion-do-co2-presente-en-un-refresco-de-cola/

- Practices with Arduino

12 different practices to introduce students to work with Arduino programming. Some examples are: activation of a LED with a push button, programming a traffic light or Generating sounds with a buzzer.
More information: https://www.kiks.unican.es/en/practicas-con-arduino/

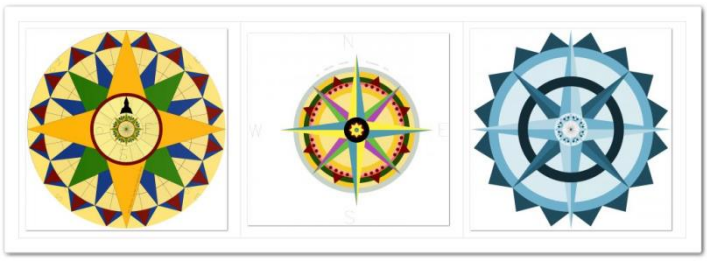
- Mathematics and Music



The next video explains a musical and mathematical activity. A list of modern songs will be chosen to analyse their chorus chords. After we study the songs, we classify them in four different groups. Based on this data we learn statistic and probability concepts. For further information please have a look at: https://www.kiks.unican.es/en/matematicas-y-musica/

Annex II. Developed activities

- How to Determinate the Geographical North



A wind rose is used to view the most important geographical directions (North-South, East-West) and the secondary geographical directions (northwest, south west, northeast, etc.). It is a drawing very common in nautical maps. Galicia (Spain) has a very close relation with the sea, so the use of wind roses to decorate the floor of a building is very usual.

This scholar year, the Mathematics and Technical Drawing Departments of the Sánchez Cantón High School proposed to students a contest. The contest has two parts: how to determinate the geographical north and to design and install a wind rose in the hall of the school. To design the wind rose students used Draftsight Program (CAD Program, similar to AutoCAD).

One Spanish team took part in the contest. They did a video and a word document (converted to pdf format) to explain the problems they had to solve to do the work:

– How to determine the geographical directions?

– How to translate the geographical directions from one place to another?

More information: https://www.kiks.unican.es/en/english-how-to-determinate-the-geopraphical-north/

- Ramps and Accessibility

The physical disabled people has a problem in our towns and cities. Some of them use a wheelchair, so they can´t go up stairs. To solve this problem, ramps are built for disabled people. These ramps have to accomplish a legislation that specifies the width and inclination angle (or slope) of the ramp.

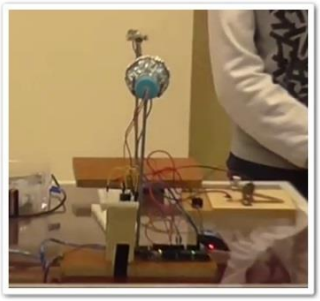
One Spanish team of Sanchez Cantón High School had studied the width and inclination angle of several ramps of a zone of their city (Pontevedra). To check if the ramp accomplish the legislation, they had to solve a problem: how to measure the inclination angle of a ramp?

More information: https://www.kiks.unican.es/en/english-ramps-and-accessibility/

- Golden Ratio

The golden ratio (also called the divine proportion) is an irrational number, represented by the Greek letter φ.
A Spanish team from San Jose School has carried out the project on this issue, explaining what it is and analysing its presence in nature and art.
More information: https://www.kiks.unican.es/en/numero-aureo/

- Wireless Telegraph



The Telegraph is a communication system, which allows transmission of information through electrical pulses and using a preset code signs.
One group of San Jose School has done a modification of the traditional telegraph, and they have 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.
More information: https://www.kiks.unican.es/en/wireless-telegraph/

- Arches in our City

In this activity some semi-circular arches from Pontevedras were analyse.
This activity was made by one team of IES Sanchez Cantón from Pontevedra, Spain. The students, besides analysing the arches of the city, constructed their own arches with different materials and exposed them in the school. This work inspired a later work of the art teacher of the school for the decoration of a play.
More information: https://www.kiks.unican.es/en/arcos-de-medio-punto/

- The Memory

Memory is the faculty of the mind by which information is encoded, stored, and retrieved. One group of Lope de Vega School has done 3 experiments were evaluated to evaluate short-term memory, in relation to three of the five senses: vision, smell and touch. The students selected a sample of subjects, six-year-old children, who were offered ten different objects that they had to play with their eyes closed and then remembered the order in which they were presented. They repeated the experiment for the sense of smell with characteristic odours. Finally cards with different amounts of elements were visually presented. The results indicated that the sense of vision facilitates short-term

memorization to a greater extent than the other senses. A fourth experiment on the memorization of numerical sequences consisted of memorizing up to 500 figures of the number 'pi', using own algorithms to give a structure to the series of decimal numbers and thus to demonstrate that the limits of the memory capacity are beyond where one might suppose.
More information: https://www.kiks.unican.es/en/la-memoria/

- The Golden Ratio

In this activity, students from Lope de Vega School had to define the golden ratio mathematically. It help them to check the proportions of our body designing and using the three-prong compass, to use computer applications to analyse the golden proportions of the human face, to manipulate the golden ratio of a segment, and explain the relations of direct proportionality using the physical properties of elastic bands. For the construction of the artefacts, such as the three-pronged compass, the Department of Technology has collaborated, but it has not been necessary to allocate any budget because low-cost material has been used: wooden slats, elastic bands, transparent sheets, felt-tip pens, etc.
More information: https://www.kiks.unican.es/en/el-numero-de-oro/

- The Dark Camera

The objectives were five: (1) to build a dark camera, (2) to learn the history of dark cameras, (3) to know the basic characteristics of geometric optics, (4) Experiments related to binocular vision. Low-cost waste materials were used to build the darkroom. In particular, it was made with a large beach umbrella and a black plastic covering it completely. The plastic was fastened to the floor with wooden slats that prevented the entrance of light from outside. This activity was developed by one team of Lope de Vega School.
More information: https://www.kiks.unican.es/en/la-camara-oscura/

- Update your Torch

The activity consisted in changing the bulb of a traditional flashlight led bulb, which involves changing the battery, design circuit connections in protoboard plates, and the welding and wiring of all elements in the new flashlight. Recycled materials were used

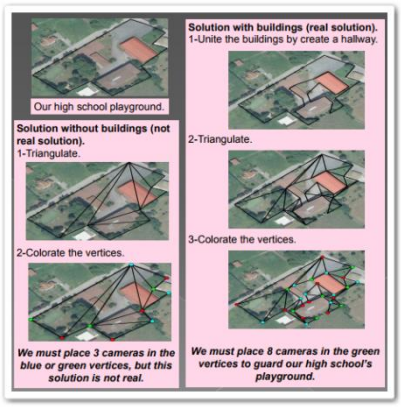
for this activity, including flashlights, external batteries, resistors, cables and switches. Low-cost leds were purchased as new material. This activity was developed by one team of San José School.
More information: https://www.kiks.unican.es/en/actualiza-tu-linterna/

- Measuring the Concentration of Gas in Carbonated Beverages

The project consists in measuring the concentration of carbon dioxide in carbonated beverages. In the following video we present the experimental part of the project carried out by the two teams of the IES de Sar (Santiago-Galicia). The colleagues of the IES Sánchez Canton (Pontevedra-Galicia) will carry out the mathematical analysis of data.
With the experimental data obtained by the teams of the Sar School lead by Ramón Cid, the students Elena Fernández Blanco and Gabriela Aboy López from the Sánchez Cantón School, have tried to obtain a mathematical model. The model tries to describe mathematically (through a function), the loss of CO2 present in the carbonated beverage, following the process followed by the students of the de Sar School.
These two students tried to make a data adjustment using different functions. Of all functions they tested, the one that provided the best results was the exponential function. As can be seen in some specific image of the document, it is striking that GeoGebra does not provide the exponential function as the best fitting the data. For this reason, the students used sliders (mathematical parameters) to get the function.
More information: https://www.kiks.unican.es/en/medicion-de-la-concentracion-de-gas-en-bebidas-carbonatadas/

- Guarding our High School

A team from Vega de Toranzo School has raised the following problem: where should the smallest number of security cameras be placed so that the entire courtyard of the school is covered?
More information:
https://www.kiks.unican.es/en/vigilando-nuestro-instituto/



- How to Make a Star Wars Robot

The STEM project carried out by three teams of La Albericia School from Santander aims at students to design and build a robot that operates autonomously or guided with a wireless device. For the construction of the structure some recycled materials such as cardboard, plastic and aluminium sheets have been used. The electric part consists of a battery of power that feeds several servomotors able to make turn the head and to move the robot. The electronic part consists of a series of LEDs, RGBs and buzzers that are housed in the head to simulate the light and sound effects of R2D2. Finally, the most important part is the Arduino microcontrollers with built-in Bluetooth, which allow you to program the movements of the robot and be governed remotely by a mobile or tablet thanks to the App Inventor program. One group decided to reproduce this media robot that appears in the saga Star Wars. Other groups created the robots "Güido" and "Machaca Hommer", characters of the series "Cars" and "the Simpsons".
More information: https://www.kiks.unican.es/en/como-hacer-el-robot-de-star-wars/

- Chocolate:

Almost everyone likes it, but few know what it is. We consume it as an elaborate product, fruit of the transformation of the seeds of Theobroma cacao. On the labels of chocolate tablets, we can read that they contain cocoa, sugar or sweeteners... However, what makes it such a prized food? A group of students from the 2nd ESO of the Juan de Lanuza School in Zaragoza have researched the chemical substances that give chocolate its unique flavour and properties.
More information: https://www.kiks.unican.es/en/la-composicion-del-chocolate/

- Simon says with Arduino

In this project, students have built the famous memory game “Simon says”. It consists of four lights that are lit with a sequence that must be memorized and reproduced by activating a few buttons. In this case it has been made with an Arduino Uno microcontroller, leds, pushbuttons, protoboard boards and a buzzer. In addition, a hexagonal structure containing all the components has been designed. The game has been made by Maykel Montalván and Mario Cantera, 16-year-old students of La Albericia School.
More information: https://www.kiks.unican.es/en/saymon-says-con-arduino/

- Recycling:

It is a work on recycling done to show that even beverage cans can be reused for other purposes. The Bayer process of obtaining aluminum is quite expensive, by students Aroa Camino and Raúl Garrido of La Albericia School have been involved in this project to raise awareness of the need to recycle materials. In this work almost 250 cans of soda have been used to build a Minion, a character well known for animated films.
More information: https://www.kiks.unican.es/en/reciclando/

- Boost:

This activity describes the shoes manufacturing process (Storage of Materials, Transport to the Process Area, Cutting Pieces, Joining Pieces, Cutting Machining,etc.), the different parts of a shoe (Sole, Midsole, upper sole), the chemistry insideshoes, as well as the textile pigments. This activity was developed by one team of Juan de Lanuza School in Zaragoza.
More information: https://www.kiks.unican.es/en/boost/

- How can we measure the beauty?

This activity is a research about the Golden Ratio and the Divine Proportion. In particular students did a research about The Vitruvian Man— "The proportions of the human body according to Vitruvius". This is drawing by Leonardo da Vinci around 1490, with notes based on the work of the architect Vitruvius, called the Canon of Proportions. Students in this activity test this proportion on different people. This activity was developed by one team of Juan de Lanuza School in Zaragoza.
More information: https://www.kiks.unican.es/en/como-se-mide-la-belleza/