

“Really Small Science” in Colombia

Ruben Rosario, Paul Grassia

Department of Chemical and Process Engineering, University of Strathclyde,
75 Montrose Street, G1 1XJ, Glasgow, United Kingdom

Abstract

A project focused on raising awareness in science and engineering in general and chemical and process engineering in particular was delivered to students from the nationwide training service, SENA Atlantico, in Colombia. The students participating in the project study in colleges from the poorest areas in the city of Barranquilla. An objective of this pilot project was to promote their enthusiasm to follow a science focused career to support the developing oil and gas industry in the Barranquilla area. This project also had the objective to tackle local gender inequality in STEM courses, by promoting positive role models of women and debunking the common myth that an industrial setting is not a suitable workplace for women. Making use of the “Really Small Science” group’s vast experience in science outreach, the workshops delivered were focused on explaining what engineering is and how it can contribute to our day-to-day lives, as well as providing the participants with hands-on activities to further develop their knowledge about polymers, gels and foams while providing them with a first-hand engineering experience, covering ideas such as process development, production in large scales and applications. Overall the project was received with enthusiasm by the participants and showed itself to be very effective in building their knowledge about engineering and changing positively the participants’ idea of women working in an engineering context.

The Oil and Gas sector in Colombia is currently expanding significantly with plans to launch an offshore industry based in the city of Barranquilla. Due to this, there is an increasing need for technical personnel to staff this industry. In a UK trade mission to Barranquilla, in which the supervisor of this project - Dr Paul Grassia - participated, one of the objectives was to link Colombian educational institutions with UK education providers with expertise in teaching STEM subjects in the area of oil & gas, in which the Chemical and Process Engineering Department at the University of Strathclyde is very experienced. During this trade mission, SENA Atlantico - Barranquilla’s branch of the nationwide training service - was found to be very enthusiastic about establishing a partnership to deliver a project focused on science outreach to encourage students into STEM subjects to cover future labour needs.

Research has shown that during secondary school, students’ interest in science declines [1]. Science outreach activities are amongst the tools that can be used to develop/manage interest and curiosity in science, especially if the activities are brought to the students (rather than students being obliged to go out and seek them) [1, 2]. These are the types of activities developed by “Really Small Science” - a group created to develop science outreach activities to increase the recruitment numbers for STEM courses in general, and for Chemical and Process Engineering in particular. The “Really Small Science” group has vast experience in performing hands-on workshops with students from primary school to college and was awarded with a Highly Commended Institute of Chemical Engineers (IChemE) Global Award 2015 in the Education and Training category.

The aims for the present project were centred around performing science outreach activities with college students (16 to 17 years old) in order to increase their level of engagement with science. The activities planned were delivered by a PhD student, Ruben Rosario - an experienced volunteer from “Really Small Science” - in the college Centro Nacional Colombo Aleman which is part of SENA Atlantico, from the 16th to the 27th of April, 2018. SENA Atlantico provided support with all the logistics involved and supplied 6 volunteers (4 of them being females) to help run the workshops. The participants were students from colleges in the most deprived areas (south and south-west) of the city of Barranquilla [3].

The workshops were structured in such a way so that a session would last a whole day and it was divided in 2 periods. The morning period started with a brief presentation by Mr Ruben Rosario about his career in science and research in the engineering area, in order to provide a positive role model for the participants. Before the session continued, a small self-reflection exercise was proposed to the participants, so they could assess what their knowledge was of chemical engineering. The exercise required each participant to write 3 words on a post-it that he or she associates with chemical engineering. This would then be repeated at the end of the session, so they could reflect how their image about the subject changed during the workshop. Moreover, an introduction to chemical and process engineering was given, to provide the participants with some background information on its importance, applications and how chemical engineering is present in our day-to-day life. Another exercise consisted in asking the students to describe a chemical engineer, focusing on what they wear, where they work and gender. This period then progressed to teach the students about polymers and their role in gels, ending with an experiment called Nanojelly with the aims of demonstrating the principles of water/solution entrapment in a

polymer net. Applications in our day-to-day life such as nappies and beauty/cleaning products were mentioned. To further build on the participants' knowledge, another short practical demonstration was performed to depict the absorption capacity of a nappy, by putting its filling in a bowl with 2 litres of water. The results were checked later on during the workshop, with all the water being absorbed to form the gel. This corresponded to the end of the morning period.

The second period, in the afternoon, continued developing the participants' knowledge of polymers, but now with an engineering approach. The students were faced with a problem where a fictitious company was asking them to produce test models of a new recipe for one of its products - bouncy balls - to check how good the recipe was (see Figure 1). At the end of the activity they were challenged to suggest steps for the production of this product in high quantities from an engineering point of view. Moreover, the workshop moved on to talk about foam and its applications, ranging from cleaning products, to solid foams in mattresses, also including separation processes used in wastewater treatment and in the food industry as well as improved oil recovery. This then progressed to the final experiment which featured a small flotation system to separate ground coffee from water. Lastly students were asked to repeat the post-it exercise and to fill in an anonymous form which covered questions regarding how their knowledge/image of chemical engineering had changed owing to the workshop and if it was now more likely for them to follow a science/engineering career. An official participation diploma produced by SENA Atlantico was delivered to the students to include in their CVs.

The outcome of this pilot project was very positive, with the feedback forms indicating that participants were very enthusiastic about the activities through having been given space to be curious. The feedback forms showed a general improvement in the participants' knowledge about chemical engineering, with them being able to provide several examples of chemical engineering applications. This type of career-focused activity is not very common especially within poorer communities in Colombia: having a workshop demonstrator from a different country but also raised in a similar background made it easier for participants to relate with him and be more open, showing that there are opportunities to study and succeed in a science-focused career, even coming from a deprived background. This clearly helped challenge the common idea among them that being raised in a deprived area is synonymous with not being able to have a successful career.

Other activities developed during the Colombia trip included visits to schools to perform one of the experiments covered in the workshops but with a group of younger students (14 to 15 years old). A workshop session focused on science and research was also developed with a older female audience (20 to 40 years old) who had been victims of social problems but were now given opportunities to study. This workshop included a forum session at the end to discuss subjects such as their possible contribution to science and development of the region, as well as how beneficial it is to interchange expertise internationally with other teaching institutions as well as companies.

This activity fed into another objective for this project which was to tackle gender inequality in science and/or engineering. In Colombia, especially in less developed areas, there is the common idea that an industrial plant/factory is not a workplace for women. The prevalence of this idea became more obvious during the workshop sessions when the participants - with the great majority of them being women - were asked to describe how they imagine a chemical engineer. Most of them said, that they do not imagine a woman working in a industrial environment as an engineer. This was tackled by having female role models as volunteers to help with the workshops and also by populating the workshop materials with positive images of women engineers in different contexts, including laboratories and plants.

Overall, the project partners from SENA Atlantico were very pleased with the immediate outcomes. SENA Atlantico will be monitoring recruitment trends from the institutions participating to gauge whether the project had a positive impact on recruitment to STEM courses. There is potential to extend this project to other branches of SENA in other cities of Colombia, such as Cartagena and Santa Marta, since they showed interest in the project.

References

- [1] Heike Itzek-Greulich and Christian Vollmer. Emotional and motivational outcomes of lab work in the secondary intermediate track: The contribution of a science center outreach lab. *Journal of Research in Science Teaching*, 54(1):3-28, Jan 2017.
- [2] David Fortus and Dana Vedder-Weiss. Measuring students' continuing motivation for science learning. *Journal of Research in Science Teaching*, 51(4):497-522, Apr 2014.
- [3] Laura Cepeda Emiliani. Los sures de Barranquilla: La distribucion espacial de la pobreza. Technical report, Banco de la Republica, Colombia, 2011.

Head of Department Report Sign-Off

Name: Prof Jan Sefcik

Signature:



Date:

9/1/19



Figure 1: Colombian students undertaking “Really Small Science” activities (Barranquilla, April 2018)