Final Report for Colombia-US workshop on Nanotechnology for Energy and Medical Applications – Poster Presentation

Background

On February 11th of 2013 I informed GEP my interest of applying for a travel grant to cover my expenses on presenting some of INSPIRE work in Colombia, with the main objective of strengthening the links between Purdue and Colombia under the Educational Frontiers area on the CPIASR Agreement. On February 15th I submitted the application, and on March 7th I was informed I got the grant, which I accepted on March 8th. I traveled to Medellín-Colombia on March 10th and on March 11th-13th I presented the poster that is attached in the following page of this report and performed networking sessions with professors of Los Andes University (Bogotá), Antioquia University (Medellín), Costa Rica Institute of Technology (Cartago-Costa Rica), and Purdue University among other institutions. I traveled back on March 16th-17th.

The event

During the first day of the workshop keynote speakers presented four of the seven topics included in the workshop (Nanomedicine, Energy storage, Industrial applications, and Nanotechnology Education). On the second day of the event the other topics were presented (Energy Efficiency, Energy Conversion, and Advanced characterization) along with Nanomedicine. These two days posters were also presented.

For these keynote sessions, my main goal was to identify what has been done for education under the agreement Purdue-Colombia and potential connections for further work. During Nanotechnology Education session professor Magana (Purdue University) presented an example of how to use nanohub for academic purposes; professor Giraldo (National University, Colombia) presented an experience of teaching nanotechnology through Buinaima institute; professor Awadelkarim (Penn State University) presented the NACK approach for teaching nanotechnology at college levels; Professor Lalinde (EAFIT, Colombia) presented Apolo, the nanohub mirror at Colombia; and Darwin Dubay (SENA, Colombia) presented an experience of teaching nanotechnology at school level through extracurricular programs.

The third and last day of the workshop they performed breakup sessions for the main topics, including nanotechnology education. During that discussion session the group identified the

importance of creating a network for nanotechnology education in order to consolidate the area within Colombia. As outcome a document will be created by one of the participants. In addition, I was designated for creating a space in HUBzero with all participants in order to start building the network for further collaboration. Professor Magana was designated as advisor for interacting with nanohub.

After the breakup sessions a panel discussion was performed with stakeholders from Colombian universities, Purdue University, Colciencias (Science, Technology, and Innovation Administrative Department, Colombia), industry, investors, and US government.

As a closure for the workshop, international participants were invited to a tour showing the social transformation of Medellín.

Poster Presented

During the workshop posters were exposed to participants during breaks and lunches. They were also presented during the first to evenings. This was a great opportunity for connecting the advancements in INSPIRE's work related to the changes that science standards are currently experiencing, with engineering inclusion as a milestone for K-12 STEM education. With this presentation an opportunity was created for student interchange with Antioquia University, and research collaboration with Los Andes University and Costa Rica Institute of Technology.

Engineering in Science: Relationship redefined in K-12 US Education

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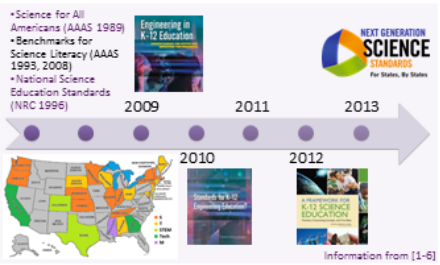
Introduction

The landscape of K-12 science education is dramatically changing. for the first time, engineering and technology are integral elements in K-12 science. This poster presents precursor developments of engineering in K-12, the role and portrayal of engineering in the US Next Generation Science Standards, and how nanotechnology has been used as an example of K-12 engineering education.

Linking Engineering and Science

Development of Science Standards and Engineering inclusion



Information from [1-6]

Next Generation Science Standards (NGSS)

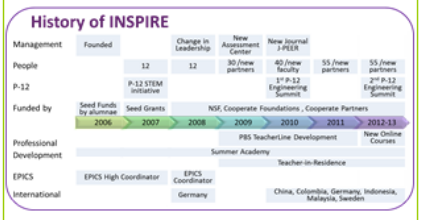
- Raises engineering design to the same level as scientific inquiry
- Gives core ideas of engineering and technology the same status as those in other major science disciplines

- **Aspirational Standpoint:** Science and engineering are needed to address major world **challenges**... [which] will **motivate** many students...
- **Practical Standpoint:** Engineering and technology provide opportunities for students to deepen their understanding of science by **applying** their developing scientific knowledge ... [and using] what they learn in their **everyday lives**.
- **Critique:**
  - Science definition matched using 'too'
  - Application-of-science focused
  - Engineering unique thinking processes underrepresented
  - Highlighting the scientific model; presuming mathematical model; ignoring the physical model

INSPIRE!

INSPIRE is a Research Institute in the School of Engineering Education at Purdue University on a mission to study engineering thought and practice at the P-12 level.

History of INSPIRE



INSPIRE Ongoing Research

- Learning progression of students and teachers
- Nature of Engineering vs. Nature of Science
- What is the practice of engineers? (not conceptual model; practice-infused model)
- How to talk about engineering?
- What makes certain tasks & projects engendered?
- How to best integrate? If at all?
- How informal pathways may promote engineering education?
- How existing instrument are assessing engineering education and integration?
- How new instruments may be developed in order to measure STEM education under these new frameworks?

An Example in US: Nano K-12

K-12 Engineering Education using Nanotechnology in US

- Nanotechnology has been addressed in K-12 science education framework as an example of the supportive relationship between Science and Engineering [3]
- Since 2003 nanotechnology has been increasingly identified as a crucial area for society [7, 8]
- K-12 students are needed to get involved in order to increase the nanotechnology-career pipeline [3-5]
- Some institutions (e.g. Purdue University, Cornell University, or Penn State University) has started to develop resources for teaching nanotechnology in K-12 [9-14]

•http://wwwnisenet.org/catalog/tools_guides/nise_net_publicity_photos

Conclusions

- 2013 is an important year for engineering education. The Next Generation of Science Standards (NGSS) are being developed and will be released in July [6].
- Engineering Education is included in NGSS, however there is so much work that needs to be done.
- K-12 teachers need to understand how to teach engineering in their classrooms in order to engage students in future STEM careers.
- According to NSTC [8] one of the critical subjects to be taught must be Nanotechnology.

Acknowledgements

Global Engineering Program, School of Engineering Education, and INSPIRE at Purdue University

References

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Networking

The main goal for this interchange and presentation was to perform a networking for strengthens Colombia-Purdue connection in the area of Frontiers of Education.
For this purpose I presented INSPIRE work to several participants, in particular to Costa Rica Institute of Technology that highlighted their interest in connecting with Engineering Education, in particular with the research that has been developed for nanotechnology education in college levels. Also Los Andes University showed a special interest, specifically in finding collaborations for designing a new version of the Bioengineering course for freshman integrating PBL as a pedagogical strategy. Professor Sánchez from Antioquia University were engaged with the poster presentation and today's engineering education challenges, and commented about his interest of having a collaboration with Engineering Education at Purdue, for master students. I suggest that these spaces can be useful for engaging international prospective students into Engineering Education research while taking high quality courses that may be incorporated as part of their plan of studies back in their Colombian Universities.
Finally, during the nanotechnology-breakup-session I develop some networking with people from K-12 STEM education (SENA , The Columbus School, Pontifical Bolivarian University, and others), which opens a new opportunity for INSPIRE to collaborate in teacher training and collect data from other cultures about how students learn STEM through engineering projects.

Further Work

I would suggest that next steps for strengthen Colombia-Purdue collaboration for Frontiers in Education should include:

- Creating the space for Frontiers in Education, and including diverse stakeholders into CPIASR webpage, promoting inclusiveness and diversity through the incorporation of several Purdue research groups such as INSPIRE, EPICS, First-Year Engineering Program, Discovery Park, and Technology Education. Also incorporating several Colombian initiatives such as engineering course design, teacher professional development, and student interchange, among others.
- Follow-up to the network started during the workshop with Los Andes University, Antioquia University, Costa Rica Institute of Technology, and Schools Programs.
- Creating a space in HUBzero for CPIASR Frontiers in Education, with nanotechnology-breakup-session participants.
- For me to become a GEP Ambassador.

Appendix: Photos







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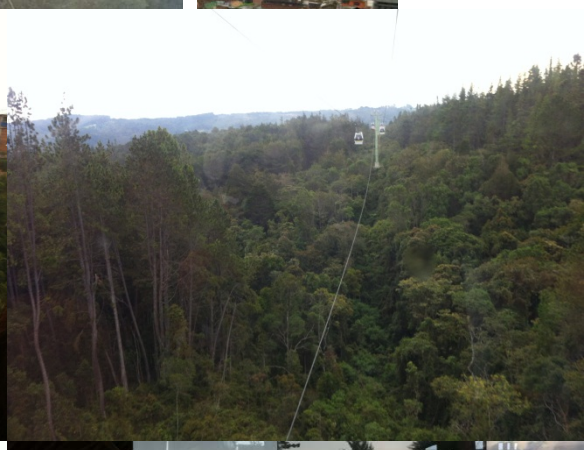

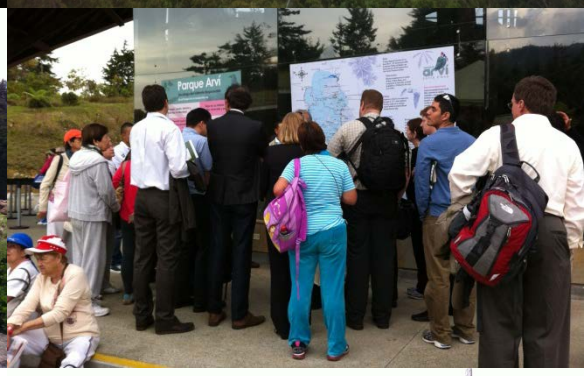
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