Application of the kits – O2.A5

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0.1	01/05/2019	Pre-Piloting
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1.0	01/07/2019	Pilots Application

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1. O2.A5

This document describes part of the work of the RoboSTEAM project [1, 2] Output 2 - Guides for designing Open Hardware PD&R. The output aims to define guides that allow designing learning challenges for the development of STEAM [3] competencies and computational thinking [4-8] by using PD&R [9-11]. An important part of this output is the application of the challenges and kits defined in the previous activity. This is described in the project proposal as follows:

> "This will be done during the pilot activities that is developed in A3 and A4. For the first pilot kits defined specifically for each specific testing contexts are used. The second will use again the same kits and other achieved from other socioeconomic environments".

2. THE PROCESS

The process followed was the selection of the challenges to apply, the adaption to the target contexts and the selection of the assessment instrument to apply before, during and after the experience. In order to ensure the success of this application a pre-pilot was carried out in a summer camp at IPB [12].

2.1. The pre-challenge description

The Robotics Summer Camp at IPB has a duration of 5 days, not being only scientific, because the students have many activities that are not related with the scientific topics of the summer course, being mainly cultural and social. The summer course starts Monday morning with the welcome reception, and then students, after lunch, initiate the course with a mini challenge that is shared by all the 16 students. From Tuesday to Thursday the students will be separated in 4 groups, having each group to address a challenge. However, the development of a Challenge involves to many hours for the camp, so the idea solving something more concrete as a Mini-Challenge that can be decomposed in Nano-Challenges.

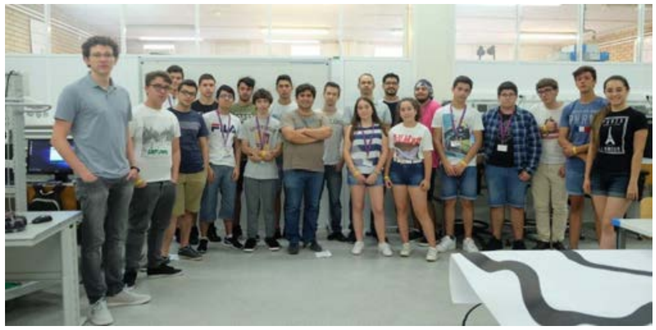

Figure 1. – Participants in the Summer Camp

Each of the groups have dealt with Nano-Challenge [2]. The summer camp ends on Thursday with a farewell dinner and on Friday it's a travelling day for them to get back to their homes. The students are from secondary schools and have an average age of nearly 15.5 years old, being present students from 14 to 17 years old, from all over the country (Portugal). The physical space that was used in the summer camp was the Laboratory of Control, Automation and Robotics of the school of technology and management of the IPB, that can be seen in Figure 2.

Figure 2. – Laboratory of Control, Automation and Robotics of the school of technology and management of the IPB.

To teach the students, there were three professors coordinating the course, José Gonçalves and José Lima from the IPB and also Miguel Ángel Conde, from the University of León, being the ROBOSTEAM Project Manager. There were also 4 monitors (three master students and a fellowship student), that played an important role, mainly in the Nano-Challenges, because each one supervised a different group that had a different Nano-Challenge.

Both the Mini-Challenge and Nano-Challenges were evaluated concerning the degree of success of each challenge, having in mind the context in which the challenges were done. The students will work with hardware only during the Nano-Challenges, having to solve previously a Mini-challenge that they have to answer a research question but they do not have to implement hardware or program any physical device.

The Minichallenge defined was defined as: Over the years, increasing fossil fuels as a source of energy for vehicles has generated a major impact on the environment. In this sense, a possible solution to solve this problem in controlled environments can be the use of mobile robots. However, mobile robotics requires the development of many tasks working together to solve problems that seem trivial to humans.

The four nano-challenges were:

- **Mobile Robots to digital transportation.**
- **Follow Lines with A Mobile Robot To Facilitate Autonomous Navigation.**
- **Follow Line with Mobile Robot Using Scratch-Based Programming**
- **Maintenance and Calibration of Mobile Robots Based on a Low Cost Stroboscope Prototype**

More information about these nano-challenges can be found at [12].

2.2. The selected challenges and kits

During Karlsruhe Transnational Meeting the different kits and challenges were evaluate. Taking into account the project proposal each partner should address a challenge with a kit in the first piloting stage, but in the second challenges and kits should be exchanged. Given this situation the partners decide:

1. The granularity of the challenge to be addressed. During the academic course, given the restrictions of each institution learning plan, the better length for this experiment was that of a mini-challenge.
2. Each partner of the piloting institution will address the mini-challenge they proposed in the first staged. That is:
    - AEEG – Wildfire and mobile robotics navigation.
    - IES Eras - Illuminated sign.
    - KIT (Karlz Benz School) – Make it Shine.
    - CIC - Logistic management of a warehouse.
    - UEF – Entertainment of Senior Citizens and also Well-being of Senior Citiziens.

For more information about the challenges check the O2A4 deliverable.

3. For the second piloting phase it is decide to exchange nano-challenges instead of mini challenges. Because they are easily addressable by the teams, taking into account the number of hours employed and the equipment and teachers' availability in each institution. ERAS nano challenges can be exchanged with KIT and AEEG, CIC nano-challenges can be exchanged with Finland and vice versa. AEEG nano-challeges can be exchanged with ERAS.
4. During the students exchange it is interesting that the travelling students work with the hosting ones in solving the challenges of these last ones with the kits they have.

2.3. The evaluation instruments

Regarding the evaluation instruments they were also discussed during the Karlsruhe meeting, taking into account those described in O2.A2 and also those found when carrying out the Systematic Mapping.

Regarding the indicators it is necessary to take into account the time employed to complete the challenge, the number of persons involved in each team and the grade (that could later be compared with previous editions of the same subject). Regarding the evaluation instruments, the STEM Semantic Survey will be used in the diagnosis phase. Most of the partners need to ask for permissions and some of them to translate it and upload it to another platform different from Google. Besides, this test will be employed in a pre- and post-test with the students implied in the challenges. In the post-test, also some questions regarding motivation. In addition a computational thinking instrument to be used after the piloting that includes several CT dimensions. It is decided to use the if/else dimensions (from the conditionals section) and do/until dimension (from the loop section) because they are most related with robotics. Finally, teachers will also use a rubric to assess other competencies development. All these instruments will be available in the platform.

3. PILOT PHASE 1

Working on it.

4. PILOT PHASE 2.

To be done.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

[1] RoboSTEAM Consortium, "RoboSTEAM Project," presented in RoboSTEAM Erasmus+ project Kick-Off, Bragança, Portugal, February 15-16, 2019, 2019. Available from: https://goo.gl/Ni43mK. doi: 10.5281/zenodo.2575066.

[2] M. Á. Conde *et al.*, "RoboSTEAM - A Challenge Based Learning Approach for integrating STEAM and develop Computational Thinking," in *TEEM'19 Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality (Leon, Spain, October 16th-18th, 2019)*, M. Á. Conde-González, F. J. Rodríguez-Sedano, C. Fernández-Llamas and F. J. García-Peñalvo, Eds. pp. 24-30, New York, NY, USA: ACM, 2019. doi: 10.1145/3362789.3362893.

[3] E. Hamner and J. Cross, "Arts & Bots: Techniques for distributing a STEAM robotics program through K-12 classrooms," in *Proceedings of 2013 IEEE Integrated STEM Education Conference (ISEC) (March 9th, 2013, Princeton, NJ, USA)* pp. 1-5, USA: IEEE, 2013. doi: 10.1109/ISECon.2013.6525207.

[4] F. J. García-Peñalvo, "What computational thinking is," *Journal of Information Technology Research,* vol. 9, no. 3, pp. v-viii, 2016.

[5] F. J. García-Peñalvo, "Computational thinking," *IEEE Revista Iberoamericana de Tecnologías del Aprendizaje (IEEE RITA),* vol. 13, no. 1, pp. 17-19, 2018. doi: 10.1109/RITA.2018.2809939.

[6] F. J. García-Peñalvo and J. Cruz-Benito, "Computational thinking in pre-university education," in *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'16) (Salamanca, Spain, November 2-4, 2016)*, F. J. García-Peñalvo, Ed. ICPS: ACM International Conference Proceeding Series, pp. 13-17, New York, NY, USA: ACM, 2016. doi: 10.1145/3012430.3012490.

[7] F. J. García-Peñalvo and J. A. Mendes, "Exploring the computational thinking effects in pre-university education," *Computers in Human Behavior,* vol. 80, pp. 407-411, 2018. doi: 10.1016/j.chb.2017.12.005.

[8] J. M. Wing, "Computational Thinking," *Communications of the ACM,* vol. 49, no. 3, pp. 33-35, 2006. doi: 10.1145/1118178.1118215.

[9] F. J. García-Peñalvo, D. Reimann and C. Maday, "Introducing Coding and Computational Thinking in the Schools: The TACCLE 3 – Coding Project Experience," in *Computational Thinking in the STEM Disciplines. Foundations and Research Highlights*, M. S. Khine, Ed. pp. 213-226, Cham, Switzerland: Springer, 2018. doi: 10.1007/978-3-319-93566-9_11.

[10] D. Reimann and C. Maday, "Smart Textile objects and conductible ink as a context for arts based teaching and learning of computational thinking at primary school," in *Proceedings of the Fourth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'16) (Salamanca, Spain, November 2-4, 2016)*, F. J. García-Peñalvo, Ed. ICPS: ACM International Conference Proceeding Series, pp. 31-35, New York, NY, USA: ACM, 2016. doi: 10.1145/3012430.3012493.

[11] D. Reimann and C. Maday, "Enseñanza y aprendizaje del modelado computacional en procesos creativos y contextos estéticos," *Education in the Knowledge Society,* vol. 18, no. 3, pp. 87-97, 2017. doi: 10.14201/eks20171838797.

[12] J. Gonçalves *et al.*, "Educational Robotics Summer Camp at IPB: A Challenge based learning case study," in *TEEM'19 Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality (Leon, Spain, October 16th-18th, 2019)*, M. Á. Conde-González, F. J. Rodríguez-Sedano, C. Fernández-Llamas and F. J. García-Peñalvo, Eds. pp. 36-43, New York, NY, USA: ACM, 2019. doi: 10.1145/3362789.3362910.