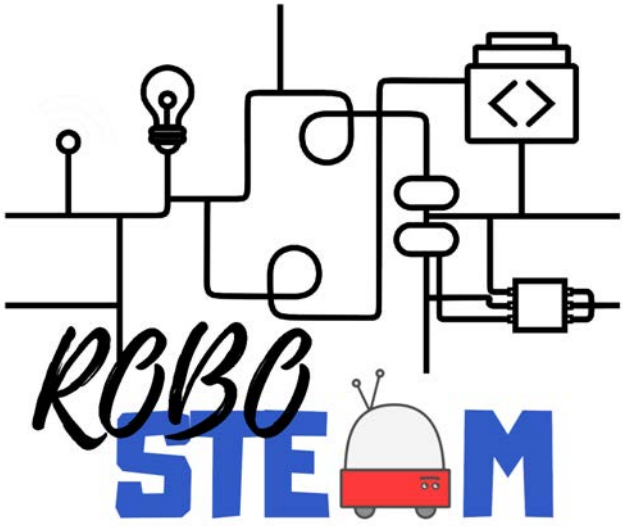
Competencies Definition – O2.A2



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Version History

Version	Date	Comments
0.1	01/03/2019	Designing a questionnaire
0.2	01/05/2019	Gathering information
1.0	01/06/2019	Including results

Table of Contents

1. O2.A2

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 competencies and computational thinking by using PD&R. In order to do so it is necessary to know the existing educational contexts, the competencies that there could be achieved, and the issues related to cultural contexts and. Given this fact it is necessary to explore the current landscape regarding this topic and for this A2 was defined. It is described as:

> "Definition of competencies related requirements depending on age and cultural contexts. Based on the previous analysis it is possible to extract the competences that facilitate PD&R application in school contexts but attending to age and cultural contexts.".

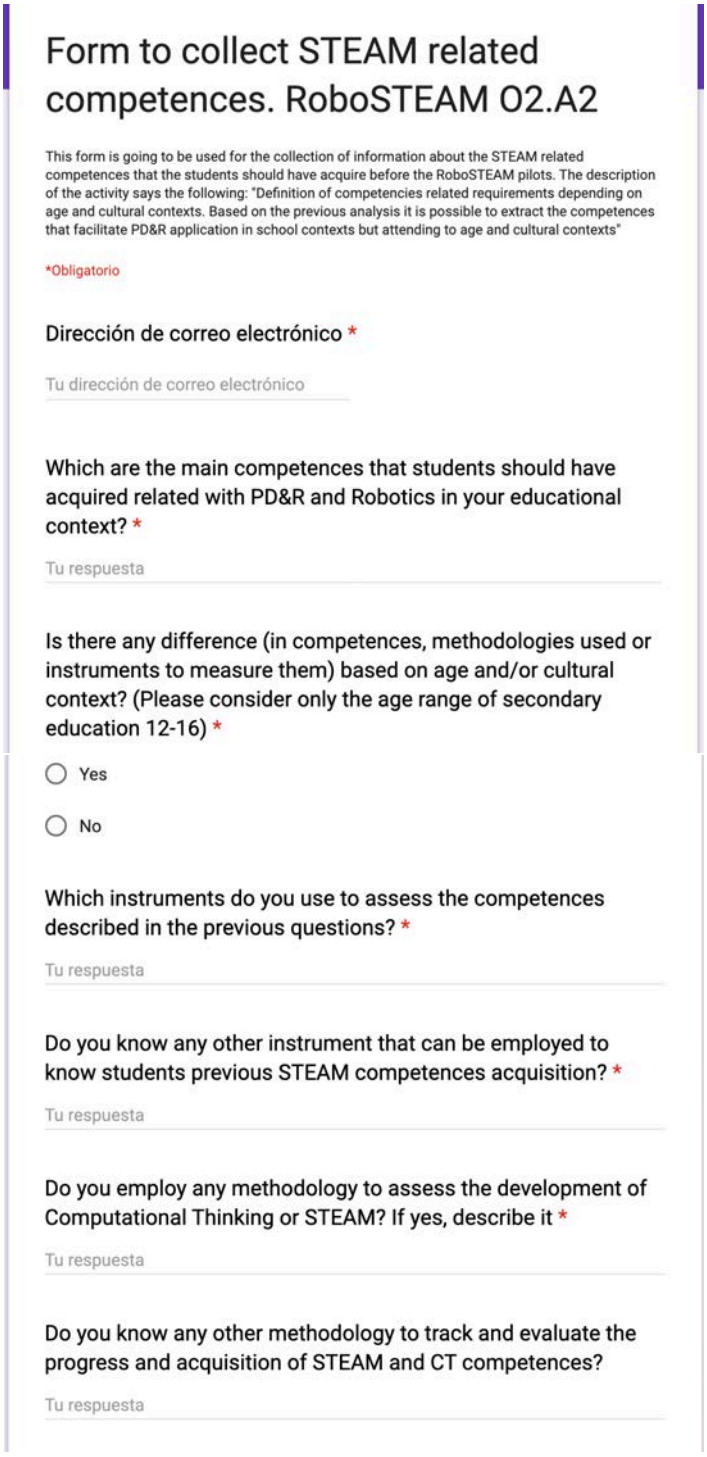
This task was related to O1 that was removed from the proposal, so the information was gathered based on the team partners experience and attending to their educational context.

2. THE PROCESS

The process followed was the definition first of a questionnaire, which after a review was published for the partners. Each of them should answer some questions that were gathered in Google Forms. After that the results were analyzed.

2.1. The form

A form was design attending to the questions to be considered: the competences to be acquired, the differences between age ranges, the methodologies used and the application of PD&R in class, the assessment instruments and the applied tools. Fig 1 shows the questionnaire.



Form to collect STEAM related competences. RoboSTEAM O2.A2

This form is going to be used for the collection of information about the STEAM related competences that the students should have acquire before the RoboSTEAM pilots. The description of the activity says the following: "Definition of competencies related requirements depending on age and cultural contexts. Based on the previous analysis it is possible to extract the competences that facilitate PD&R application in school contexts but attending to age and cultural contexts"

*Obligatorio

Dirección de correo electrónico *

Tu dirección de correo electrónico

Which are the main competences that students should have acquired related with PD&R and Robotics in your educational context? *

Tu respuesta

Is there any difference (in competences, methodologies used or instruments to measure them) based on age and/or cultural context? (Please consider only the age range of secondary education 12-16) *

- Yes
- No

Which instruments do you use to assess the competences described in the previous questions? *

Tu respuesta

Do you know any other instrument that can be employed to know students previous STEAM competences acquisition? *

Tu respuesta

Do you employ any methodology to assess the development of Computational Thinking or STEAM? If yes, describe it *

Tu respuesta

Do you know any other methodology to track and evaluate the progress and acquisition of STEAM and CT competences?

Tu respuesta

Figure 1. – Form for O2.A2

3. RESULTS

The results obtained can be distributed in information about the competencies, about the methodology and about the tools

3.1. Competencies

Regarding the competencies most of the answers consider the same competencies and the most popular were Computational Thinking, Programming, Problem Solving, Critical Thinking, Teamwork, Project, Communication or Electronics. Competences quite common in STEAM contexts. Figure 1 shows a tag cloud with the competencies described by the partners.

Figure 2. – Competencies desirable to be developed in STEAM activities

It should be noted that the 75% (Figure 3) of the surveyed teachers and researchers consider that there are differences in competencies, methodologies or instruments depending on students ages.

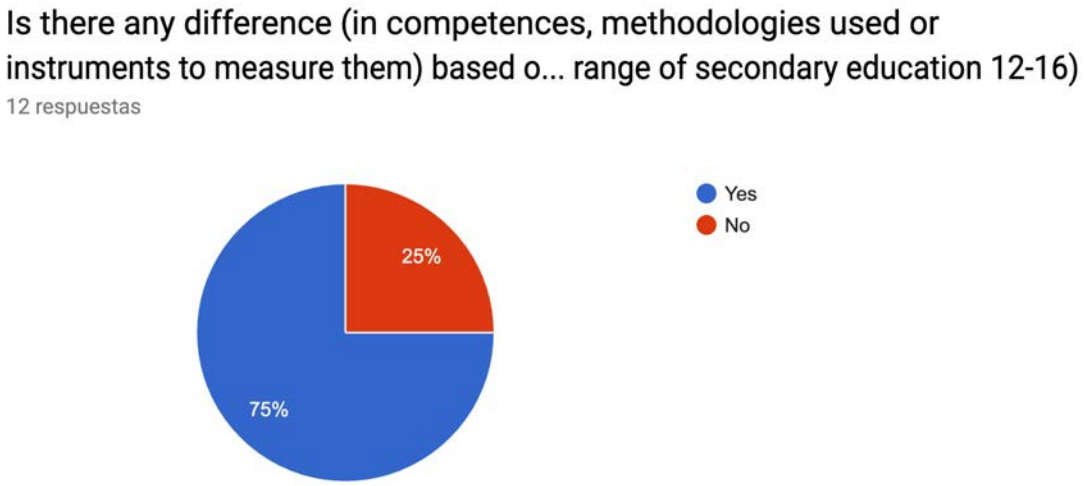


Figure 3. – Answers referred to need of adaptation based on age

From the answers obtained it was possible to see that depending not only in age but also on the context adaptations of methodologies, tools and level of competence acquisition could be necessary.

Students from 12-14 require the acquisition of competences such as Spatial Vision, Digital Identity, Basi procedural programming principles, understanding of interplay between the hardware and the software; while those from 14-16 aim to achieved more complex competences such as Math, Computational Thinking and Critical Thinking and wider applications PD&R in students' everyday life. And the acquisition of this competences should be gradual from 12-16, for instance, when talking about programming depending on age graphical programming can be substituted by text programming.

Regarding the instruments employed in the STEAM activities, first of all it is necessary to adapt the instruments used to track the students' activities, mainly because of their maturity. Younger students require items or question simple and

more graphical than the older ones. If we study the projects in PrBL initiatives or shorter projects will fit better with the younger students. Moreover, the assessment and performance cannot be the same and the requirements should be adapted depending on age.

3.2. Methodologies

Regarding the methodologies employed to assess the development of computational thinking the authors have described their initiatives and also the way in which they asses the results, the specific instruments are described in the next subsection.

Several authors described that they use of Project and Problem based Learning approaches for their STEM activities. For the assessment most of them employed their own rubrics and observation sheets to measure the acquisition of the desired competences, written tests, groups interviews, self and peer assessment, summative and formative evaluation of the projet and problems results, presentations and mixed methodologies that includes both qualitative information (gathered from questionnaires) and quantitative (gathered from validated instruments) to assess CT. More innovative are other possibilities pointed out by the experts such as the evaluation by participating in competitions, exhibitions, experiments, debates or making videos with their results.

Regarding the question about if they know other methodologies some of them mention the above posed approaches but there are interesting reflections that fits with the opinion of most of them, such as: "*Methodology depends very much on the contextual definition of CT, and what we want to assess. I feel that there is no one particular solution that would fit to all cases*".

3.3. Instruments

Some of the instruments have been described in the previous section related to methodologies. They can be summarized in:

- Written tests.

- Surveys.
- Interviews.
- Rubrics.
- Solution evaluation.
- Writing exams.
- Observation.

More concrete instruments are:

- Intrinsic Motivation Inventory, good instrument to assess the motivational aspects (https://circlcenter.org/assessing-computational-thinking/).
- Computational Thinking Test: design & general psychometry by Marcos Román-González (http://e-spacio.uned.es/fez/view/tesisuned:Educacion-Mroman)
- Computer Olympiad: Problem-solving tasks to assess Computational thinking (http://olympiad.org.za/talent-search/past-papers/pen-and-paper/)
- International Bebras Contest: Problem-solving tasks to assess Computational thinking (https://www.bebras.org/)
- Instrument to evaluate Scrath Projects (http://drscratch.org/)
- STEM Semantic survey (https://iittl.unt.edu/sites/default/files/Instruments/stemsemantics20.pdf)

4. Acknowledgements

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be held responsible for any use which may be made of the information contained therein.

5. References

[1] 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.

[2] 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.