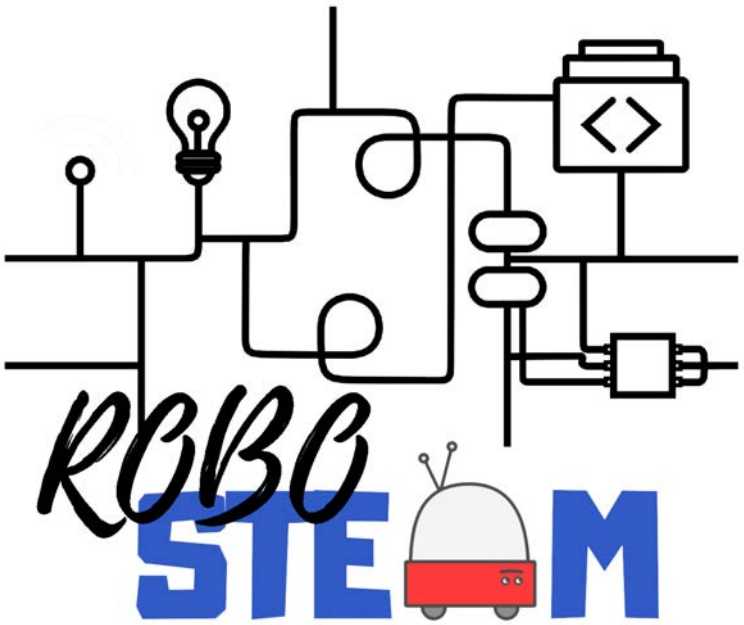
Project Management Handbook



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0.1	16/02/2019	First draft of the PMH
0.2	30/09/2019	Second draft (Format Adaption)

Table of contents

1 INTRODUCTION

This Project Management Handbook (PMH) describes the project organisation and internal procedures of the 2018-1-ES01-KA201-050939 RoboSTEAM project [1-3]. Its intention is to provide a written collection of rules that will govern the work of the consortium and a set of tools needed to facilitate the day-to-day management of the project.

The PMH is a living document. It will be regularly updated throughout the entire duration of the project to reflect the changes in -and evolution of- the project. Therefore, always check the project platform if an updated version of this document is available.

ALWAYS CHECK THE PROJECT PLATFORM FOR AN UPDATED VERSION OF THIS DOCUMENT.

The preparation of this document is based on the following project documents:

- RoboSTEAM Application form 2018-1-ES01-KA201-050939.
- RoboSTEAM Grant Agreement 20180528 and its annexes.
- RoboSTEAM Contracts between the beneficiary and the partners.

(Reference materials can be found on the project platform, section ***Documents***).

2 PROJECT OVERVIEW

Nowadays, everybody is involved in what is known as Digital Society and they need specific training to participate efficiently in their context. Students should be prepared for this landscape that includes new problems, new information sources, new devices and even new concepts. This requires learning approaches that help students to better understand and be prepared for the digital society. This society needs skilled professionals for ICT (Information and Communication Technologies) and there are high unemployment rates when this requirement is not satisfied.

Given this context, it is especially important for students to learn computer programming from an early age. This knowledge together with other technical skills make possible the development of what is known as "Computational Thinking". In this way, they need to develop skills like critical thinking, problem-solving, collaboration, communication and creativity. In the specific field of school education, students need to see how these problems are solved and to "touch" the solution. In this sense Physical Devices and Robotics (PD&R) [4, 5] application is a popular and very valued option.

This kind of learning activities are usually linked to STEM (Science, Technology, Engineering, & Mathematics) education [6]. Degrees and learning programs related to STEM have drawn particular attention from both teachers and politicians during the last years. Different research works have shown that STEM based education can lead to more efficient worker performance and is critical to increasing a country's innovation capacity [7, 8]. In fact, there is an important demand of professionals related to STEM. This suggests that it is necessary to attract young students toward these disciplines as stated Eurostats and PISA studies. In addition, and in order to ensure defining successful solutions, an interesting choice is to include the acquisition of creative thinking by including Arts in the equation, in what is known as STEAM [9].

However, competences [10] such as computational thinking [11-14], programming [15, 16] or STEAM disciplines are not be developed easily by using traditional learning approaches. This is because it is not easy to summarize all this knowledge in a set of subjects without an associated loss of quality, and it cannot be focused only on some subjects or degrees [7, 8]. This means that new educational approaches are needed and a possible option can be Challenge Based Learning (CBL). It encourages students to leverage the technology they use in their daily lives to solve real-world problems.

The present proposal aims to experiment with STEAM integration projects that help learners to develop computational thinking by using/programming PD&R in pre-university education environments. To this end, the present project proposes the exchange in the European context of experiences related to this topic. This would allow training of in-service and future teachers in such a way that they can apply this

knowledge in class. This project will define a set of challenges and tools to address them. Two pilot cycles will be carried out exchanging these challenges and tools between institutions, so it is possible to analyse the impact of the context where they are used. From the results achieved and the instruments used, good-practice guides will be defined about the development of computational thinking from STEAM integration.

2.1 Objectives

The main objective of this project is the definition of a knowledge base to facilitate integrating STEAM and computational thinking by using robots. This will be carried out by developing pilot programs, gathering good practices and tools, and defining learning actions and educational resources for teachers.

In order to achieve this objective some sub-objectives are defined:

- Analyses the different existing activities that deal with STEAM integration.
- Define some challenges and instruments to facilitate STEAM integration and computational thinking development.
- Define metrics to evaluate both the integration and the competence development.
- Establish guides for the definition of integration STEAM challenges by using PD&R.
- Define educational resources for in-service teachers and future teachers.
- Establish ways of collaboration between robotic companies and educational institutions.
- Publish the obtained results in order to involve other educational institutions of the same and different contexts.

RoboSTEAM project needs to be carried out transnationally in order to prove to which extent the proposed methodology and the ICT environment are able to identify

patterns and offer different action plans fitted to the potentially very different needs of students from different cultures, in different schools' systems, etc. The countries involved through the partner institutions represent this diversity and, at the same time, constitute a challenge since STEAM integration is essential for present socioeconomical environment.

2.2 Results

The present project aims to facilitate integrating STEAM and the development of computational thinking in schools by using PD&R. In order to do this, it is necessary to know how to define challenges for integrating STEAM, how is possible to assess STEAM and computational thinking related competences, the set of competences that could be promoted by applying challenges based on PD&R, the available tools and how to use them. With this information it would be possible to generate a set of results during the project that could be used in other application contexts. Taking this into account the results expected during the project and on its completion would be:

1. Analysis of current STEAM integration background in European schools. It is necessary to know what has been done in this sense, attending specially to the use of PD&R. This analysis should take into account issues such as the competences developed by applying initiatives for integrating STEAM; the tools used to do this; the profile of students involved in integrating STEAM experiments; how the experiment was assessed, and the costs related to such actions. The analysis should be carried out taking into account existing works in the literature, previous research projects and the experiments of the schools involved in the project and other included in partner's school network.

2. Set of methodological and diagnose tools that facilitate integrating STEAM through PD&R. These are: questionnaires to assess how to integrate STEAM; diagnose tools to measure how STEAM can be integrated in a specific context; pedagogical patterns for the application of STEAM initiatives; guides to carry out STEAM challenges depending on age and context; guides to adapt different PD&R stakeholders involved, samples of how to carry out STEAM integration through PD&R.

3. Bank of instruments to assess STEAM related competences acquisition. Compilation of instruments that allow assessing in different ways the integration of STEAM in subjects and the development of such competences by students. This compilation will include the most popular tools and also those related to the use of PD&R.

4. Analysis of the application of PD&R in educational contexts and sample PD&R toolkits for integrating STEAM. In order to develop this result, it is necessary to compare existing educational PD&R and how to apply them in educational contexts. It is also necessary: The definition of the competencies acquired by the application of PD&R; the definition of indicators to assess the level of success of such tools; and the description of the contexts where this PD&R were and can be applied. With this information it would be possible to define PD&R tools to be applied in schools that will be used to test the methodological framework.

5. Design and implementation of training actions. Different courses (initially in person, then online and self-learning) will train educational practitioners in the definition of challenges that integrates STEAM through PD&R.

6. Guides for defining integrating STEAM challenges that use PD&R in different contexts. Guides that describe the steps to replicate the experience in different countries and with different technologies. Common ways to integrating STEAM. These guides should be published in an open online environment.

7. ICT tools (questionnaires, rubrics, learning analytics tools) to track how STEAM integrating is carried out and gather evidences that later facilitates making decisions and assessing the acquisition of specific competences. These tools can vary depending on the application context and the learners age and background.

8. Contact networks among the companies that develop PD&R for educational contexts, higher education institutions and schools in order to carry out learning initiatives that can benefit scholars and attract them to STEAM disciplines.

3 MANAGEMENT STRUCTURE AND PROCEDURES

In this section the management structure of the project and the roles and responsibilities of the several entities in the project are described. Furthermore, the operational aspects of the project are detailed.

3.1 Project Management Organization

The project management structure is organized as seen in Figure 1.

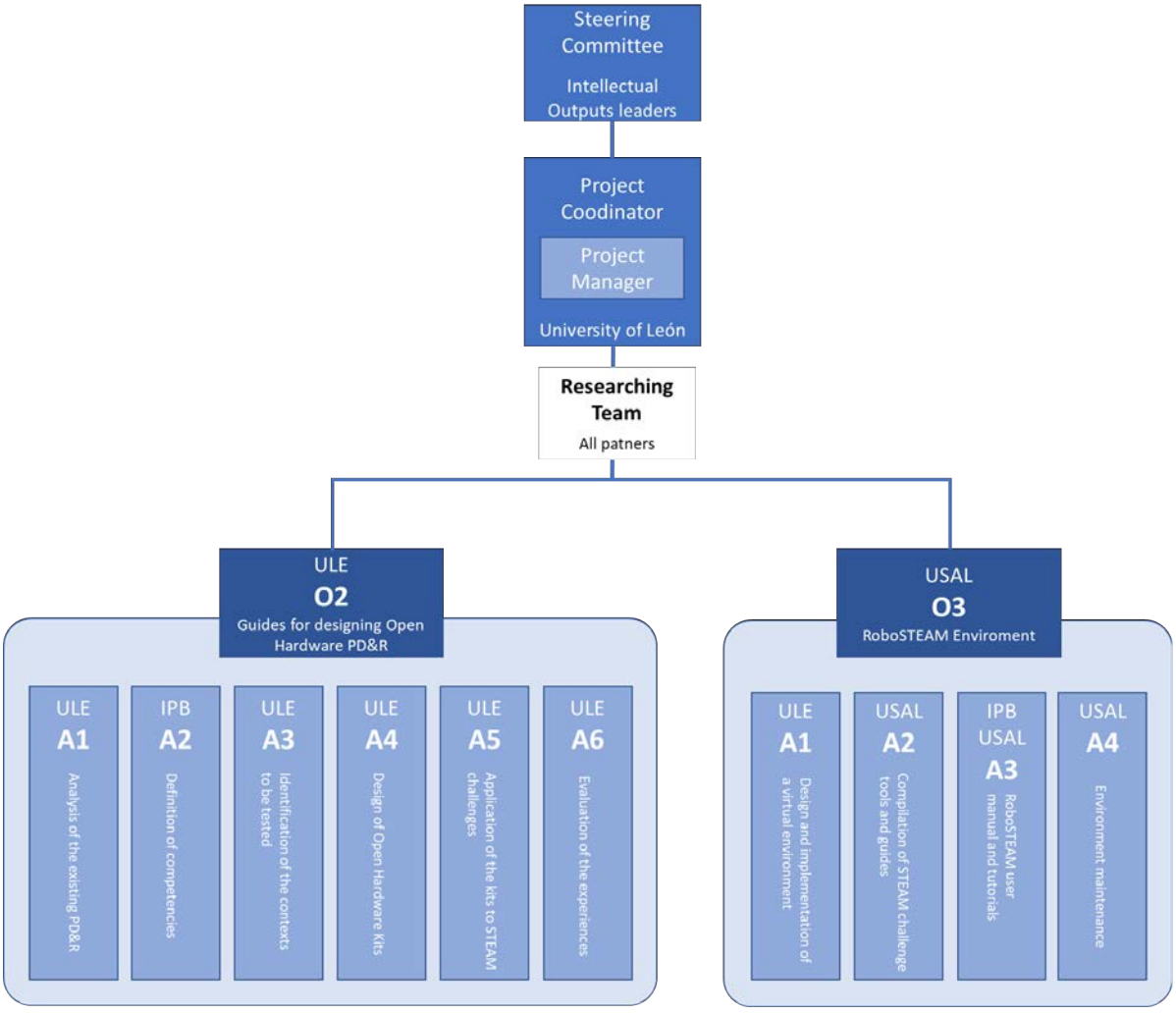


Figure 1: Project Management Structure

3.1.1 Consortium

Consortium is composed by the partners show in Table 1.

Table 1: Consortium Partners

Part. nº	Role	Organisation Name	Acronym	City	Country
P1	Applicant Org.	Universidad de León	ULE	León	ES
P2	Partner	Agrupamento de Escolas Emídio Garcia,	AEEG	Bragança	PT
P3	Partner	Colégio Internato dos Carvalhos	CIC	Pedroso	PT
P4	Partner	IES Eras de Renueva	IER	León	ES
P5	Partner	Instituto Politécnico de Bragança	IPB	Bragança	PT
P6	Partner	Karlsruher Institut Fuer Technologie	KIT	Karlsruhe	DE
P7	Partner	University of Eastern Finland	UEF	Kuopio	FI
P8	Partner	Universidad de Salamanca	USAL	Salamanca	ES

3.1.2 Project coordinator

The Project Coordinator is Camino Fernández Llamas. She is the interface between the European Commission and the Consortium as well as the supervisor of the overall progress and scientific and technical progress of the project.

The Project Coordinator shall be responsible for:

- chairing the Steering Committee and Consortium meetings, taking all actions to enable proper decision making;
- supervising the Consortium activity with respect to administrative, financial, legal and contractual aspects;
- monitoring the project planning and the delivery of project results;
- submitting all required progress reports, deliverables and financial statements to the European Commission.

3.1.3 Project manager

The Project Manager is Miguel Ángel Conde and its function is to manage the RoboSTEAM Project. The Project Manager is responsible for the following tasks:

- Managing the Consortium activity with respect to administrative, financial, legal and contractual aspects.
- Ensuring effective operation of the project, the project website and project communication mechanisms.
- Coordinating the organization of Steering Committee and Consortium meetings.
- Managing the repository of project documentation (deliverables, task reports, minutes of meetings, publications…) and uploading relevant documents and information in the project platform.

3.1.4 Steering committee

The Steering Committee is responsible for monitoring the consistency and coherence of the project throughout the project lifecycle:

- Overseeing the implementation of the project in accordance with the project proposal.
- Guiding the project's scientific progress;
- Ensuring the necessary harmonization across researchers, intellectual outputs leaders and tasks.
- Arbitrating and resolving any conflicts between participants.

It consists of representatives of all intellectual outputs leaders and is chaired by the Project Coordinator. The project manager participates as Secretary without right to vote. Each intellectual output leader has to nominate one representative that has the competence to make decisions for the respective institution.

The steering group will work by virtual communication (an online meeting every two months is expected) and assigning consortium meetings.

Steering Committee decisions will not be considered valid unless a quorum of two-thirds (2/3) of its members are present or represented.

In voting each party shall have one (1) vote. Decisions shall be taken by majority of 75% of the votes of the members present or represented. In case of tied votes, the Project Coordinator will have a casting vote.

3.1.5 Quality management team

The Quality Management team supervises the quality of all the tasks performed during the project according to the Quality Plan.

It is composed of representative of all partners. His composition will be discussed in the kick-off meeting.

3.1.6 Intellectual Outputs Leaders

Each intellectual output Leader will have the following responsibilities:

- Planning and management of the work involved in the intellectual output.
- Allocation of tasks to all partners that participate in this intellectual output.
- Coordination of the relationship between this O and the rest of the project intellectual outputs.
- Organization of technical discussions about this specific intellectual output.
- Organization of the contracted documents and deliverables of the intellectual output.
- Communication with the Consortium, Steering Committee and Project Coordinator and reporting.

3.1.7 Researching team (main staff)

The researching team is composed of staff members of all institutions involved in the project and it is chaired by the Project Coordinator.

Its main tasks include to:

- Develop the work towards the milestones and deliverables of each intellectual output.
- Address and document the implementation of the workplan and project tasks which accompany the progress towards the objectives of the intellectual outputs.

- Suggest strategies to anticipate and minimize problems and deviation from the workplan.
- Prepare all significant modifications of the work plan and inform the Steering Committee.
- Implement dissemination initiatives.

Researching team decisions will not be considered valid unless a quorum of two-thirds (2/3) of its members are present or represented.

Decisions shall be taken by majority of 75% of the votes of the members present or represented. In case of tied votes, the Project Coordinator will have a casting vote.

3.1.8 Decision making

The problem handling philosophy of the consortium is in the first place based on prevention. In case a problem arises, it will be tackled as soon as possible and at the lowest possible level, meanwhile bringing it to the immediate attention of the Project Coordinator.

Decisions are made at work package level (technical) in full consensus, else by WPLs or reporting to the Researching team for voting, if requested by one or more of his team members. The Researching team may ask for decisions by the Steering Committee.

Decisions of the Steering Committee are binding for the project.

3.2 Project Communication Mechanisms

In a (geographically) decentralized teamwork with only a few face-to-face occasions most of the process planning and – when relevant – problem solving happens via online communications tools. And when changes occur, communication is the key. Standard procedures can help foster that communication. It also helps define responsibilities, so that when changes are made, they can be implemented more easily.

3.2.1 Website (internal and external)

The internal website for RoboSTEAM project management is based on a Moodle platform (http://robosteamproject.eu/moodle). Every RoboSTEAM member will be able to read and write forum posts. The internal website has restricted access and every RoboSTEAM member has its own user name and password. Partners can obtain access and password via the project manager.

The external website (http://robosteamproject.eu/) contains all public information about the project. The most important section is *Latest News* because all public events on the RoboSTEAM project will be published there. All partners can contribute to this section, for this they have to publish their news in the internal website. All partners can contribute to this section, for this they have to publish their news in *Events* section in the internal website.

In addition to external website, there are a Facebook page (https://www.facebook.com/groups/ROBOSTEAMproject) and a Twitter account (https://twitter.com/RobosteamP) for the dissemination of the project.

3.2.2 Project calendar

There is a calendar with important dates of the RoboSTEAM project in the project platform. Deadlines, face-to-face meetings and audio/video conferences dates will be published in the calendar.

Partners can subscribe to the calendar. There is a video tutorial explained how to do that.

ALWAYS CHECK THE CALENDAR IN THE PROJECT PLATFORM

3.2.3 Audio/video conferences

The audio of electronic meetings will be recorded and published in the project platform so that all partners can listen it.

The audio/video conferences will take place using Skype 5.0 and higher.

3.2.4 Emails

All communications between partners will be throughout the project platform. They should use forums and internal messages to talk with other partners about the RoboSTEAM project.

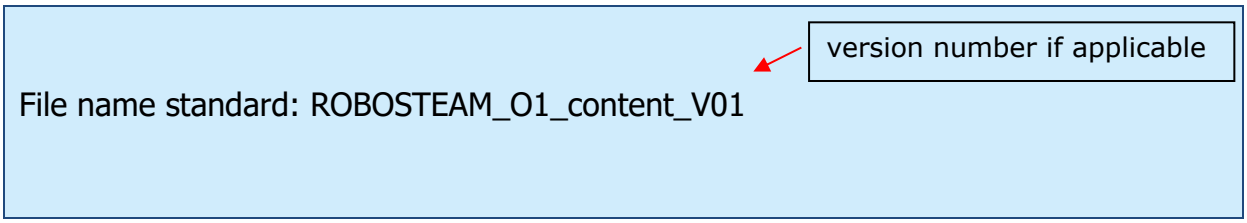
Although the Moodle platform sends emails per each forum posts, this messages should be replied in the corresponding forum.

The communication by email is restricted to special cases.

3.2.5 Documents and publications

All RoboSTEAM project documents will be available in the project platform. Public documents will be also available in the Dissemination section of the external website.

File creation standard: Templates for Microsoft Office Word and Microsoft Office Power Point are available in the project platform for downloading.



Intellectual Outputs activity - Delivery procedure of documents:

1. Intellectual output leader outlines the deliverables and deadlines for the relevant intellectual Output, informs partners about and finally gathers partners contributions.
2. Partners forwarding documents to respective intellectual Output leader → monitoring by leading partner, decides about further adaptions the partner will have to do or approval by leading partner.
3. Forwarding outcome to coordinator → monitoring by coordinator → coordinator sets further adaptions by leading partner & partner or approves result.
4. Upload of interim and final results on the project platform to grant access by all partners.

3.3 Meetings

3.3.1 Face-to-face meetings

The management of the project will require five face-to-face meetings between the representatives of each partner. There will be 4 face to face meetings during the project. They will be 2-day meetings and they will be planned at specific moments during the project lifetime in coincidence with the implementation of specific tasks. One member from each partner institution (two from the coordinator) will be expected to participate. The partner schools will only participate in the first three projects meetings because for them 2 days meetings are hard to include in their regular scheduling.

- The kick-off meeting (M1, February 2019) will be held in Bragança (Portugal) in the applicant institution and all partners will be involved in the project set-up.
- 2nd meeting (M9, June 2019) will be held in Karlsruhe (Germany) coinciding with the development of O2 and O3.
- 3rd meeting (M18, March 2020) will be held in Joensuu (Finland) when O2 is finishing.
- 4th meeting (M24, September 2020) will be held in León coinciding with the multiplier event organized for the project closure.

In an early stage of the project (after the kick-off meeting), each partner will hold a meeting with their network of schools in order to promote the project and engage other schools that can employ project outcomes when it finishes.

In addition, each partner should open month 16 (January of 2020) of the project a selection process to choose which teachers will participate in training C1 that will be carried out in month 22 (July of 2020) and that later will participate in the local dissemination events (M24, September 2020) that will take place before the closure meeting.

3.3.2 Electronic meetings

In addition to face-to-face meetings, there will be monthly skype meetings between the project leader and each partner, regular email contact, deadline reminders and warnings, monthly reminders of targets and needs and any other information or communication necessary to maintain and monitor the quality in the project.

3.4 Technical and financial reporting

The Consortium has to provide the Commission, through the Coordinator, with full information on the implementation of the project.

According to the Grant Agreement the project the leading institution of the project will prepare the Interim and Final Report about technical and financial progress following EC guidelines (see 2018 EAC/A05/2017 Erasmus+ Program (2016/C 386/09)).

The reporting period for the Interim Report runs from the start date of the project until one month prior to the submission date of the report, i.d. from 1/10/2018 to 31/10/2019.

Each Partner shall provide the Project Manager with any information and document required for the preparation of the Interim Report and with copies of all the necessary supporting documents completed and signed by the legal representative by 30/09/2019 at the latest.

The reporting period for the Final Report runs from 31/10/2019 to 30/09/2020.

Each Partner shall provide the Project Manager with any information and document required for the preparation of the Final Report and with copies of all the necessary supporting documents completed and signed by the legal representative by 30/09/2020 at the latest.

In the annexes each partner will find templates for pay sheet forms, timesheet forms and declaration of expenditures.

The WP leaders will find the template for work packages status progress report.

In addition, for internal consumption by the consortium, two Internal Progress Reports will be produced along the project life: one after six months from the beginning of the project and other after a year and six months.

The objective of these reports is to ensure that all are aware of the progress made and any emerging issues that need addressing. It will include information about resources used and progress made as well as reports on the deliverables due during the period. They will include a section by the Project steering committee and a report from the subcontracted external evaluator.

4 PROJECT PLANNING AND TIMETABLE

4.1 Project description

The project will be managed using a process methodology (PRINCE2). All the partners have broad experience on collaborative projects and many of them have worked together before, so a smooth development of the project can be assured. This methodology will supervise all the activities planned in the project: meetings with stakeholders, development of materials, local and multi-site events, teachers training, students exchange, dissemination, and management of the sub-projects.

During the discussions while putting together this proposal, one of the major concerns of all applicants was making the results really applicable when the project was over. We think that the outputs of this project may achieve this goal in the long term because we have carefully designed the whole value-chain from research groups on robotics and also in education technologies, going through groups with wide experience on transferability, schools to test an evaluate the products, and associated partners to support the process.

In the same way, the dissemination activities are designed to ensure impact of the project. A multi-site hackathon will be organized to involve students, teachers and researchers. More classical events will be organized at each location with the local associated partners to ensure the dissemination of the project.

Finally, we think that this project will contribute to increase the number of STEAM vocations in the EU by promoting computational thinking as a valuable tool in different areas. We also would like this project to cause an increase in the use of ICT in different areas of secondary education, which will, in turn, help to trigger modernization and to reinforce education systems response to the main challenges of today's world (employment, economic stability, etc).

4.2 Project Schedule

For the agency the beginning of the project and the end are the same we proposed at the beginning. That is the project has started the 1st of October of 2018 and will finish the 30th of September of 2020. However, the new schedule could be seen in the Figure 2.

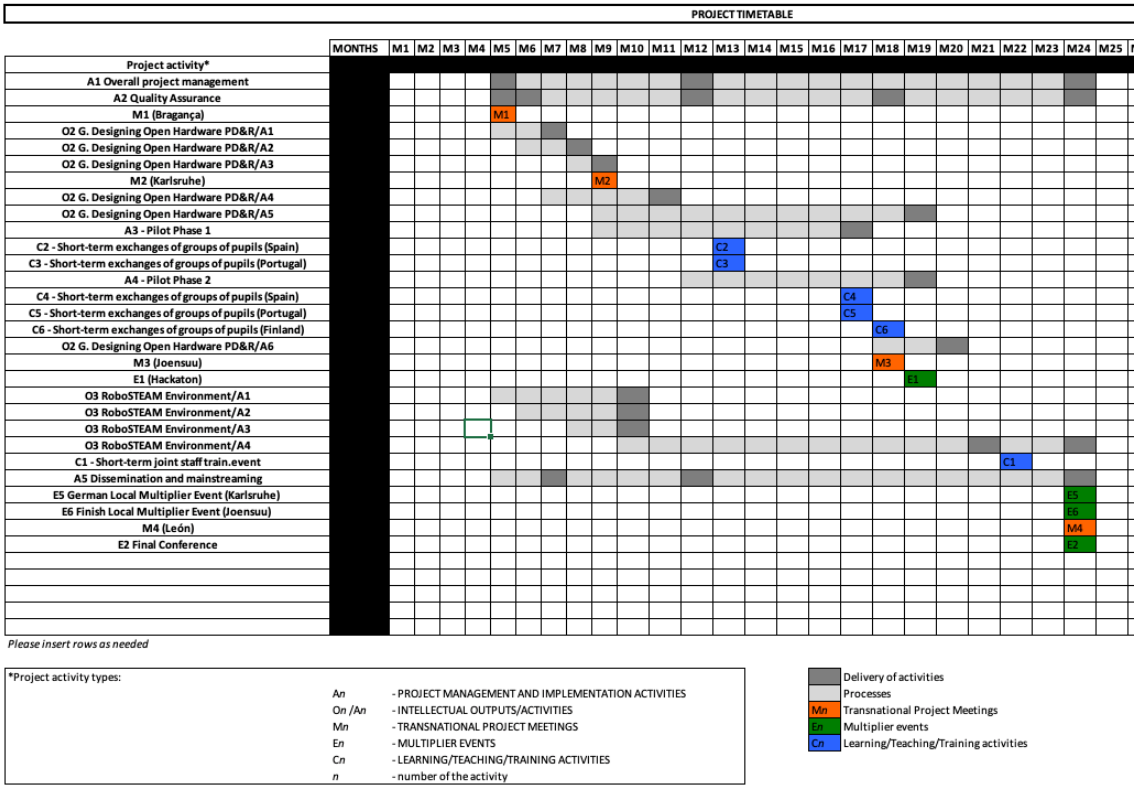


Figure 2: Project Schedule

4.3 Intellectual Outputs

O1 and O4 have been removed from the original proposal by the agency.

4.3.1 O2. Guides for designing Open Hardware PD&R

This outcome 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 technology and what to apply depending on age or context. Taking each context into account several open hardware kits can be designed, tested and assessed in the different context of the project partners.

O2 is coordinated by ULE and the tasks that lead to production of the intellectual output are:

- **O2.O1.** – *Analysis of the existing PD&R.* This task requires to carry out a systematic literature review to gather and analyze the existing works related to the application of PD&R in education, taking into account three issues: the methodology applied, the acquisition fo competences mediated by this works and the age and cultural contexts of the students involved. Moreover it is necessary to take into account PD&R toolkits that could have been applied but are not published as research works. This task is leaded by ULE and participates IPB and USAL

- **O2.A2.** – *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 is leaded by IPB and participates all partners except for USAL.

- **O2.A3.** – *Identification of the contexts to be tested (1 or 2 per partner)*. With the previous information it is possible to define possible different contexts to apply challenges based on PD&R and to take into account what context related issues could have an impact in the learning experiment. This task is leaded by ULE and participates all the partners.

- **O2.A4**. – *Design of Open Hardware Kits to be applied during the learning challenges*. Definition of some PD&R kits taking into account the competencies that students should acquire and the best way to facilitate this acquisition taking into account the socioeconomical contexts where challenges take place. This task is leaded by ULE and participates those partners with expertise related to PD&R (IPB and UEF). The associated partner Arduino will provide its expertise in this field to support the activitiy.

- **O2.A5.** – *Application of the kits to STEAM challenges in the defined contexts*. This will be done during the pilot activities that is developed in A3 and A4. For the first pilots, 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. This task is leaded by ULE and participates all partners.

- **O2.A6.** – *Evaluation of the experiences.* Once the pilots are finished it is necessary to analyze the results and describe in the guides how kits can be designed to be applied in a more efficient way depending on students and contexts. Issues such as the challenge achievement, degree of achievement, time and resources employed, quality of the solution, etc. should be taken into account. This task is leaded by ULE and participates all partners.

4.3.2 O3. RoboSTEAM Environment

It is an educational environment [17-19] which will offer to schools and teachers a complete set of tools, activities, guides and support to manage the implementation of STEAM challenges.

The environment will be composed by:

- Portal, repository, community and social tools. It will consist on a web-based social networking environment developed with open source solutions, that will be used to support the project activities. In this community space interaction and communication between members about STEAM through PD&R will take place.

- IT tools for diagnostic (see diagnostic indicators at A3.O1). They will be particularly useful to provide the school with a general overview about how is STEAM integrated and computational thinking developed, and especially if PD&R is applied and how this is done.

- Authoring tools for designing the challenges to be solved at school that could depend on age and the socio-economical context where they are applied.

- IT tools for the evaluation of the results of the challenges carried out at school and the creation of reports for decision-making.

O3 is leaded by USAL and all partners are involved in the development. The main tasks necessary to address this output are:

- **O3.A1.** – Design and implementation of a virtual environment as the base of the portal (It should include functionalities such as: web site, virtual campus, software repository for STEAM challenge, software repository with evaluation and diagnosis tools, video conference, social media capabilities, intranet system regulated by roles, etc.). ULE will be in charge of the development of this infrastructure with the support of IPB and USAL.

- **O3.A2.** – Compilation of STEAM challenge tools and guides (definition and/or compilation of tools and guides that may be used to carry out STEAM challenges). This is the core functionality of RoboSTEAM environment. IPB and USAL will be in charge of the development of the user manual, guidelines and tutorials. The rest of partners will provide support for reviewing the contents and testing the usefulness of these materials.

- **O3.A3.** - RoboSTEAM user manual and tutorials. It has two main documents:

    - Collection of multimedia, video and HTML guidelines and tutorials for the use of the system. Special attention to accessibility requirements will be paid to facilitate the use of the environment to any user, regardless his/her technical expertise and/or eventual disabilities. These materials

will be accessible in their own contexts as "help tips", but also in a specific section.

- Complete User Manual for teaching staff and students.

IPB and USAL will be in charge of the development of the user manual, guidelines and tutorials. The rest of partners will provide support for reviewing the contents and testing the usefulness of these materials.

- **O3.A4.** – Environment maintenance. The environment will be maintained and improved during the project lifecycle, with special attention to the needs and requirements of the community members. New functions/manuals/tutorials will be added or improved if considered necessary. USAL will lead these tasks in which also ULE and IPB are involved.

Table 2 shows the distribution of work between the partners

Table 2: Work distribution between partners

	AEEG	CIC	FS	IER	IPB	KIT	UEF	ULE	USAL
OUTPUT 2. – Guides for designing Open Hardware PD&R								**L**	
O2.A1. – Analysis of the existing PD&R regarding age and cultural contexts					**P**			**L**	**P**
O2.A2 – Definition of competencies related requirements depending on age and cultural contexts	**P**	**P**	**P**	**P**	**L**	**P**	**P**	**P**	
O2.A3 – Identification of the contexts to be tested	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**L**	**P**
O2.A4 – Design of Open Hardware Kits to be applied during the learning challenges					**P**		**P**	**L**	
O2.A5 – Application of the kits to STEM challenges in the defined contexts	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**L**	**P**
O2.A6 – Evaluation of the experiences (challenge achievement, degree of achievement, time and resources employed, quality of the solution, etc.).	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**L**	**P**
OUTPUT 3. – RoboSTEAM environment									**L**

O3.A1 – Design and implementation of a virtual environment as the base of the portal					P			L	P
O3.A2 – Compilation of STEM challenge tools and guides	P	P	P	P	P	P	P	P	L
O3.A3 - .RoboSTEM user manual and tutorials	P	P	P	P	L	P	P	P	L
O3.A4 – Maintenance of the RoboSTEAM					P			P	L

4.4 Project activities

A1 & A2 provide services that guarantee the smooth and effective running of the project:

A1. Project Management. Overall project management tasks include monitoring the progress of all work done and the budget and resources used, and ensuring the timely completion of deliverables. For this purpose, there will be internal progress reports, as well as the required interim and final reports M12, 24). For managing communication within various tools will be used (4 project face to face meetings, regular audio/video conferences, an email list, and an online workspace which will be embedded within the portal, with forums, wikis for collaboration and a storage space). A Project Management Handbook will be created at the start of the project (M1) in order to ensure consensus and clarity within the consortium regarding reporting processes, risk management, contracts, conflicts and other issues. The project management will also liaise closely with the Quality Assurance plan in order to make the most of synergies with that work. **Organisation**: A1 will be led by the coordinating partner, ULE. All partners will be involved according to their participation in reporting and project meetings.

A2. Quality Assurance. This WP will focus on ensuring that all the activities, resources and objectives planned in the proposal are correctly executed, used and achieved. This work will involve two perspectives, that of internal quality management, based on a Quality assurance plan developed early in the project (M1), which will use regular and systematic reporting processes (reports on M6, 12, 18, 24) to ensure timely completion of the work and early anticipation of problems. Questionnaires and individual and group interview techniques to

identify partners' perceptions and issues that may arise will be used. **Organisation**: A2 will be led by the USAL All partners will be involved according to their participation in the monitoring activities.

A3 & A4 will show the full potential of RoboSTEAM project by putting into practice both methodological approaches and ICT tools for integrating STEAM by using PD&R.

A3. Pilot Phase 1 (M9-M17) will launch the testing of both RoboSTEAM methodology and PD&R testing kits. During this pilot the 5 secondary schools are involved with their students from 12 to 16 years old. The pilots consist of a first diagnostic phase, later challenges will be posed for small students' groups, and finally the results will be analysed. During the diagnostic phase all students in the previous commented range of ages will fulfil a questionnaire about their perception about STEAM and how it is taught in their school. After this, 4 challenges will be posed to a class of secondary students. They will solve these problems and the results will be analysed and compared with the students that do not participate in the challenge. Indicators to be used could include: the time employed, the grade obtained, the external people involved, the assessment of computational thinking and STEAM related competences acquisition by using the instruments and methods defined in O1, and students self-perception about the experiment.

A4. Pilot Phase 2 (M12-M19) will launch a second testing stage. The secondary schools will be involved again. They should develop the same activities than in Pilot 1, and the same students' groups are involved in the challenges. In this case students can choose the instruments, methods and tools from other socioeconomic contexts present in RoboSTEAM environment. The idea is analysing how PD&R kits work in a different socioeconomical context. Later the results will be compared with students that do not participate in the challenges, and with the results obtained during Pilot1. The indicators to be used are the same of Pilot1.

A5 Dissemination and mainstreaming will be structured in three main stages, each one characterized by a different objective:

- First stage will focus on introducing the project to the community of practitioners and stakeholders potentially interested in their activities (schools, teachers, parents, local educational administrations).

- Second stage will focus on describing the approach and the initial outcomes of the first pilot phase and generating interest in the RoboSTEAM environment (engagement of schools out from the partner countries.

- Third stage, which will last from the second pilot phase, will showcase the results and the approach providing clear evidence to interested parties of the value of RoboSTEAM tools and practices. In the third stage dissemination (which focuses on raising awareness) starts to overlap with exploitation (which aims at engagement and adoption of the approach by third parties).

A Dissemination Plan and the Overall graphic design will be delivered in M3. RoboSTEAM environment should be available in M10. Reports will be produced in M12 and 24 covering all dissemination activities carried out during the project, be it online or not.

Dissemination will be leaded by UEF.

4.5 Multiplier Events to carry out

E3 and E4 have been removed from the original proposal by the agency.

E1. Hackaton

Coordinated multisite event for the development of STEAM challenges and for the definition of new Open Hardware PD&R kits. Hackathon is a is the combination of the words "hack" and "marathon", where "hack" is used in the sense of programming, not computer crime. Basically, the idea is to foster the development of software by

gathering a group of programmers (hackers) and specific matter-experts to collaborate intensively on specific projects. Many hackathons are intended simply for educational or social purposes and typically last between a day and a week. In this case it is possible to involve students, teachers and or researchers and it is not necessary that their expertise field was related to programming. These participants can define new challenges taking into account the PD&R kits and the methodological framework defined during the project. The hackaton will be carried out in Portugal (Brangança) and we expect to involve 30 local and 8 foreign participants. The results expected for this multiplier event will be a greater dissemination of the project, a testing of existing kits and the definition of new challenges and kits to integrate into the project.

Participants: all partners.

E2. Mainstreaming RoboSTEAM Final Conference

A closure event will be held in León (Spain) at ULE in month 24 coinciding with the project closure. It will be organized by ULE with the collaboration of all the partners and the contribution of the schools involved in the pilot phases.

In fact, the partners will select representatives of the schools involved in the pilot phases (schools coordinators and teachers) as examples of best practices and they will be invited to participate in the conference.

This event will have a focus on attracting key note speakers from Europe who represent practice and policy in education and a wide spectrum of stakeholders: school teachers, academic staff, in-service training institutions, educational NGOs, regional educational authorities, ICT companies, PD&R developers, local media. It will be attended by up to 60 delegates from the sectors concerned. At this event all products, tools and resources will be officially launched and specific workshops will be organized where teachers, PD&R developers and students (if possible) will present their experience to a broader audience. The working language will be English.

Participants: All universities and León School.

E5. German Local Multiplier Event

Dissemination event for German School teachers to describe the project and how to apply it in their context. It is necessary to disseminate the results of the project and each partner has their own school networks. However, for school and school staff teachers it is not easy to attend to events in order countries because it means rescheduling classes what it is not always possible. In order to involve an important number of schools and teachers in the project we have set up a multiplier event per country. In this event will participate at least 20 teachers or potential teachers. These teachers could later apply the project outputs in their institutions so the number of involved participants benefited by the project could be really increased. In the event will participate the local project team and the staff of the local institution involved in C1. The local events will include workshops for the methodological framework, the PD&R kits application, the use of RoboSTEAM environment and the application of the project and methodology. The working language for this local event will be German. The event is carried out after the training action and before the closure meeting.

E6. Finnish Local Multiplier Event

Dissemination event for Finnish School teachers to describe the project and how to apply it in their context. It is necessary to disseminate the results of the project and each partner has their own school networks. However, for school and school staff teachers it is not easy to attend to events in order countries because it means rescheduling classes what it is not always possible. In order to involve an important number of schools and teachers in the project we have set up a multiplier event per country. In this event will participate at least 20 teachers or potential teachers. These teachers could later apply the project outputs in their institutions so the number of involved participants benefited by the project could be really increased. In the event will participate the local project team and the staff of the local institution involved in C1. The local events will include workshops for the methodological framework, the PD&R kits application, the use of RoboSTEAM environment and the application of the project and methodology. The working language for this local event will be Finnish. The event is carried out after the training action and before the closure meeting.

4.6 Learning Teaching and Training Actions

A short-term joint staff training event is planned to give teachers coming from the partners' institutions the opportunity to benefit from 5 days of in presence training. After this training, they will support the application of the RoboSTEAM initiative in local school contexts and so consolidating the project results. The participants in this training are later going to be involved in the local dissemination events where they contact local teachers, and their experience will contribute to make the project objectives more consistent with the local school contexts and so consolidating the project. It is located in Germany.

In addition, 5 short-term exchanges of groups of pupils will be carried out during the project. The idea is to check how students from similar and different sociocultural context address their challenges:

- During the first pilot, Portuguese students will travel to Spain and vice versa (C2 and C3). With these exchanges, students can know how other pupils from a similar socioeconomic context try to solve the challenges and what type of tools they apply. It is especially interesting to compare how students from Arts (such as AEEG) solve the problems versus how students with an educational background related to technologies (CIC and IER) do the same.

- During the second challenge there will be three exchanges, between AEEG, CIC, IER and UEF secondary school (C4, C5, C6). In this case the idea is to compare the tools and methods applied to address the challenges in different socioeconomic context. In this case Finish students will travel to Spain and Portugal and vice versa. As in C2 and C3, we should again analyze differences not only in socioeconomic context but also between those students with a profile in Arts and those with a technological background.

4.7 Partners' responsibility

ULE acts for the implementation of the project as Project Coordinator, it represents the consortium in its relations with the European Commission, and it is responsible for the Project Management.

The European Commission recognise contractual links only with the Project Coordinator, that is the legal person with whom the Commission has contracted for the implementation of the RoboSTEAM Project and does not recognise contractual links with other Parties in the project, therefore any communication to the European Commission must be channelled through the Project Coordinator.

Each partner shall ensure that the activities for which it is responsible, as specified in the Project and in the Consortium Agreement, are carried out in accordance with the Intellectual outputs described in the EC Contract.

To that end the partner shall mobilise all the financial, human and material resources required for the full implementation of the project. The partner must implement the work with the requisite degree of care, efficiency, transparency and diligence, as required by best practise in the field concerned, and in compliance with the contract.

Each partner shall report to the Project Coordinator the progress in the implementation of activities, as described above, and whenever requested by the Coordinator.

5 ANNEXES

To be completed.

6 CONTACTS

Project Coordinator: Camino Fernández Llamas (camino.fernandez@unileon.es).

Project Manager: Miguel Ángel Conde González (mcong@unileon.es).

Researching team coordinator:

Webmaster and technical support:

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8 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] F. J. García-Peñalvo, "O3 RoboSTEAM Environment – First overview and discussions," presented in RoboSTEAM Erasmus+ project Kick-Off, Bragança, Portugal, February 15-16, 2019, 2019. Available from: https://goo.gl/hro7tc. doi: 10.5281/zenodo.2571497.

[3] 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.

[4] 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.

[5] 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.

[6] M. S. Ramírez-Montoya Ed. "Handbook of Research on Driving STEM Learning With Educational Technologies," Advances in Educational Technologies and Instructional Design (AETID). Hershey PA, USA: IGI Global, 2017.

[7] F. J. García-Peñalvo, "A brief introduction to TACCLE 3 – Coding European Project," in *2016 International Symposium on Computers in Education (SIIE 16)*, F. J. García-Peñalvo and J. A. Mendes, Eds., USA: IEEE, 2016. doi: 10.1109/SIIE.2016.7751876.

[8] TACCLE 3 Consortium. (2017). *TACCLE 3: Coding Erasmus + Project website*. Available from: https://goo.gl/f4QZUA.

[9] 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.

[10] E. Morales-Morgado, F. J. García-Peñalvo, R. A. Campos-Ortuño and C. Astroza Hidalgo, "**Desarrollo de competencias a través de objetos de aprendizaje**," *RED. Revista de Educación a Distancia,* no. 36, 2013.

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

[12] F. J. García-Peñalvo, "Computational thinking issues," in *Fifth International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'17) (Cádiz, Spain, October 18-20, 2017)* J. M. Dodero, M. S. Ibarra Sáiz and I. Ruiz Rube, Eds. p. Article 1, New York, NY, USA: ACM, 2017. doi: 10.1145/3144826.3145349.

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

[14] C. S. González-González, "State of the art in the teaching of computational thinking and programming in childhood education," *Education in the Knowledge Society,* vol. 20, art. 17, 2019. doi: 10.14201/eks2019_20_a17.

[15] F. J. García-Peñalvo, "Computational thinking and programming education principles," in *TEEM'18 Proceedings of the Sixth International Conference on Technological Ecosystems for Enhancing Multiculturality (Salamanca, Spain, October 24th-26th, 2018)*, F. J. García-Peñalvo, Ed. pp. 14-17, New York, NY, USA: ACM, 2018. doi: 10.1145/3284179.3284184.

[16] 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.

[17] F. J. García-Peñalvo *et al.*, "Learning services-based technological ecosystems," in *Proceedings of the Third International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM'15) (Porto, Portugal, October 7-9, 2015)*, G. R. Alves and M. C. Felgueiras, Eds. pp. 467-472, New York, USA: ACM, 2015. doi: 10.1145/2808580.2808650.

[18] F. J. García-Peñalvo *et al.*, "Enhancing Education for the Knowledge Society Era with Learning Ecosystems," in *Open Source Solutions for Knowledge Management and Technological Ecosystems*, F. J. García-Peñalvo and A. García-Holgado, Eds. Advances in Knowledge Acquisition, Transfer, and Management (AKATM), pp. 1-24, Hershey PA, USA: IGI Global, 2017. doi: 10.4018/978-1-5225-0905-9.ch001.

[19] F. J. García-Peñalvo, "Ecosistemas tecnológicos universitarios," in *UNIVERSITIC 2017. Análisis de las TIC en las Universidades Españolas*, J. Gómez, Ed. pp. 164-170, Madrid, España: Crue Universidades Españolas, 2018.