

Hands-on Science

Celebrating Science
and Science Education



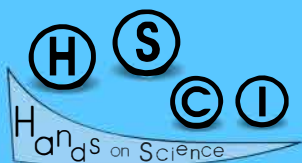
Edited by:

Manuel Filipe P. C. Martins Costa

José Benito Vázquez Dorrió

Josep Maria Fernández Novell

Carme Zaragoza Domenech



The Hand-on Science Network

Hands-on Science

Celebrating Science and Science Education

ISBN 978-84-8158-973-3

Edited by

Manuel Filipe Pereira da Cunha Martins Costa, University of Minho, Portugal

José Benito Vázquez Dorrío, University of Vigo, Spain

Josep Maria Fernández Novell, University of Barcelona, COQC, Spain

Carme Zaragoza Domenech, Department of Education, Generalitat de Catalunya, Spain



Universidade do Minho

Universidade de Vigo



UNIVERSITAT DE
BARCELONA

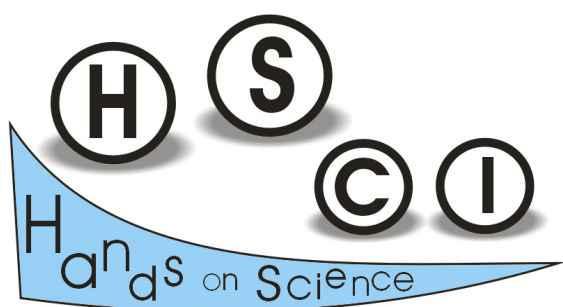


Generalitat de Catalunya
**Departament
d'Educació**



The Hands-on Science Network





Copyright © 2023 HSCI

ISBN: 978-84-8158-973-3
Legal deposit: VG 374-2023

Printed by: Copissaurio Repro – Centro Imp. Unip. Lda. Campus de Gualtar, Reprografia Complexo II,
4710-057 Braga, Portugal
Number of copies: 400
First printing: July 2023
Distributed worldwide by the *Associação Hands-on Science Network* - contact@hsci.info
Full text available online (open access) at <http://www.hsci.info>
The papers/chapters published in this book are exclusive responsibility of the authors.

Please use the following format to cite material from this book:

Author(s). Title of Chapter. Hands-on Science. Celebrating Science and Science Education. Costa MF, Dorrió BV, Fernández Novell JM, Zaragoza Domenech C (Eds.); Hands-on Science Network, 2023, Page numbers.

The authors of this book and the Hands-on Science Network, none of them, accept any responsibility for any use of the information contained in this book.

All rights reserved.

Permission to use is granted if appropriate reference to this source is made, the use is for educational purposes and no fees or other income is charged.

Science and Technology Teacher Training Project Based on Social Inclusion

PM Castro¹, M Marqués², A Dapena²

¹*Universidad da Coruña, A Coruña, Spain*

²*Universitat Jaume I, Spain*

adriana.dapena@udc.es

Abstract. This paper reports an experience carried out in the Master Degree in Compulsory Secondary Teachers, Upper Secondary Education, Professional Training and Language Teaching, specialization in Technology, of two Spanish public universities. This experience promotes a higher education based on collaboration and social inclusion. Work teams from both universities developed technological projects that respond to needs of people with autism spectrum disorders, supervising those of their respective mirror teams, considered as sister, from the other university. In this way, we work on a large number of transversal competencies, which are crucial for university students and, especially, for these future teaching professionals.

Keywords. Collaborative Learning, Social Engagement, Sustainable Development Goals, Technology, Transversal Competencies.

1. Introduction

The development of transversal competencies requires education in citizenship [1] and the inclusion in teaching of activities aimed at the mastery of basic social skills [2], such as effective communication, respect, social inclusion and assertiveness. Although the reports of the degrees of the Spanish university system usually include these competences, there are very few subjects in our degrees in which collaborative learning activities with solidarity objectives are developed, especially in those of a technological nature [3, 4].

In this paper we present an experience carried out in the first quarter of the academic year 2022-2023, involving professors and students of the technology specialization of the master's degree in teaching from two Spanish universities. This master's degree provides professional qualification for teaching in compulsory and specific subjects of Technology, Digitization and Digital Education, as demanded

by today's society, immersed in a dizzying process of digital transformation driven by the pandemic context of recent years [1, 5].

This experience, which begins in September 2022, is based on the development, by the students of these masters, of science and technology projects aimed at people with autism spectrum disorder (ASD). These projects include in university teaching activities focused on achieving the following three sustainable development goals: number 4 (quality education), number 10 (reduction of inequalities) and number 17 (partnerships for the goals). In order to foster collaborative learning, the projects developed by each work team are supervised by a sister team from the other university. In addition, three associations from the environment of these universities, which are dedicated to the care of people with ASD, also participate in the development of the projects to advise on their adaptation to the characteristics of this group. Finally, science and technology fairs were held at both sites, with the aim of providing the students of the master's degree and the users of these associations with a meeting place for mutual learning and in which direct personal interaction is essential.

2. Project description

The project takes place from September 2022 to January 2023 in two Spanish public universities, located in different and distant Autonomous Communities, which makes any face-to-face contact impossible. In both cases, the students were taking the course Technology for teachers of Compulsory Secondary Education in a master's degree program for teachers. The entire project is divided into the phases described below:

- Phase 1: Organization of the activity. The professors of both universities hold several meetings, prior to the beginning of the academic year, to learn about the organization of their respective subjects, in terms of both content and schedule. From these meetings, on the one hand, a common calendar for the joint presentation of the activity, the development of the projects and the realization of the science and technology fair is agreed upon. On the other hand, the staff of each university holds, in turn, meetings with the entities dedicated to the care of people with ASD that are in its

immediate environment, to coordinate their collaboration in the different activities. In addition, an online environment is created to support the projects and facilitate assessments through surveys and forms.

- Phase 2: Presentation of the activity. The objective of this phase is the explanation of the activity and also to know the interest of the students on the development these collaborative projects to support people with ASD. This phase involves three groups of people:
 - Students, who receive information from the other agents and can actively participate by making comments or asking questions.
 - Professors, who are in charge of presenting the project to their students in the context of the master's course and explaining the criteria and assessment procedures of the activity.
 - Professionals from associations for people with ASD, who are responsible for explaining the needs and interests of the users of their services, and clarify the doubts of students and professors on the implementation of activities.
- Phase 3: Project development. The objectives of the activity were two: 1) the development of a science and technology project adapted to the needs and interests of people with ASD; 2) the creation of a collaborative environment among students from different universities. Three groups are involved in this phase:
 - Student teams: The work teams are made up of three students at each university, supervised by a sister team at the other university. Each team has to propose a science and technology project and prepare a summary sheet. This sheet is doubly analyzed by the sister team, which initially makes comments to improve the quality of the work presented and then check the final result of that project, after addressing those initial comments. Online forms are used for these mutual reviews.
 - Professors: The proposal of each work group is reviewed by the teaching team of each university (made up of 1 or 2 teachers) to verify the adaptation to the requirements of the entities and the characteristics of their users.

- Professionals from entities: These professionals participate in a training session in the university classroom to transmit orientations on the autistic condition, in general, and its users, in particular, and also accompany them on the day of the fair.
- Phase 4: Science and technology fair. A science and technology fair is held in both universities, so that the students can present their project to the users of those entities.

3. Project results

After the meetings of staff from both universities for activity organization during the months of September, October and November, contact was made with three entities (two close to site 1 and one close to site 2) that agreed to participate in both the presentation of the project and the fairs. Since the fairs are held at the facilities of each of the universities, two of the entities decide to bring the users to those facilities, but another one chooses, on the contrary, to hold the fair at its own facilities, although in a smaller version, both in terms of number of projects and users.

The presentation of the activity (Phase 2) consists of a panel discussion, in online mode, with the participation of teachers, students and professionals from the associations. After a brief speech given by the professors, professionals of the three entities make a presentation of approximately 20 minutes each, whose central theme is to show the difficulty that people with ASD have to integrate into the education system and the many barriers they have to face every day. In order to solve it or, at least, minimize its impact, they indicate some minimum guidelines to follow when elaborating the projects and exhibiting the activities during the fairs. The panel discussion ends with a question-and-answer session and a short debate among all participants.

Table 1 summarizes the data of the participants and results. A total of six projects are carried out at each university by work teams composed of three students. The groups present their ideas and collect them on an A4 sheet. The worksheet should contain the name of the scientists, materials, an explanation of how to carry out the experiment and contain some images to support that explanation. Each

sheet is reviewed by the sister team of the other university, which answers two questions via an online form:

Table 1. Experience data

Item	University 1	University2
Number of students	18	18
Number of teachers	2	1
Number of entities	2	1
Number of users	35	6
Number of technology projects	3	4
Number of science projects	3	2

- Question 1: Comment here what positive aspects you find in the worksheet in terms of structure, content and the experiment itself.
- Question 2: Comment here on what aspects could be improved, trying to come up with ideas for improvement.

It should be noted that the teams paid special attention to the fact that the explanations were clear and made suggestions for improvement both in the wording and in the aesthetics, following indications of the entities. In addition, many teams congratulate the sister team for their work.

As an example of the projects, Figure 1 shows the sheet for the construction of a Theremin using an Arduino board. Figure 2 shows the sheet of a robot that uses a sensor for object detection, so that users can play at modifying the trajectory by placing different objects around it. Both works were carried out by students from university 1. Figure 3 shows a pulsometer that introduces electrical circuit concepts in a playful way and, finally, Figure 4 depicts a cutting and engraving system that uses software developed by a team from university 2.

The activity culminates with a fair at each of the universities, of which some photographs are shown in Figure 5. The fair at the site of university 1, referred to as site 1, is attended by approximately 20 people divided into three groups: a first group of eight children under 18 years of age, attending different secondary schools in the area; a second group of four

adults, and a final group, also of eight people, aged between 10 and 12 years. The entity that holds the fair at its headquarters has approximately 15 users between 13 and 15 years of age. Finally, the second site is attended by 6 elderly people who live in the association's residence. Although the association has an educational centre attended by children under 18 years of age, in the end none of them participate because the activity is organized outside school hours.



Figure 1. Sheet for the construction of a Theremin using an Arduino board (in Spanish)



Figure 2. Sheet for the construction of a robot for obstacle detection (in Spanish)

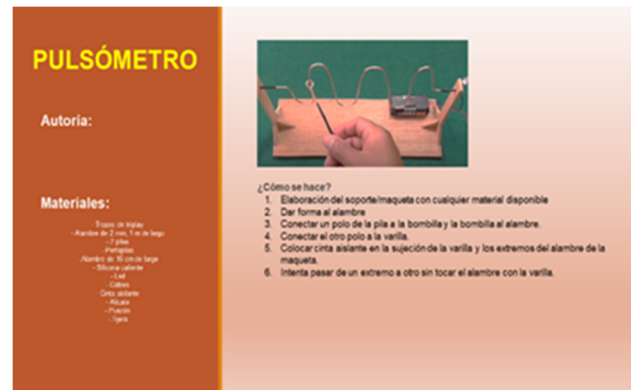


Figure 3. Sheet for the construction of a pulsometer (in Spanish)

All these groups of people attend accompanied by the professionals of the entities that usually work with them. In addition, a professional from one of the entities of university 1 comes to the fair to get to know all the projects and choose three of them to be carried out in their facilities.



Figure 4. Sheet for a cutting and engraving system (in Spanish)



Figure 5. Photographs of the projects shown in the science and technology fairs

The students had the opportunity to give their opinion about the project. In particular, these are the answers received to the question "What do you think is the main strength of the service-learning project carried out?":

- "Dealing with external agents of the university."
- "Being able to interact with people outside the centre."
- "Meet students with possible difficulties and motivate them with the use of technologies."
- "Contact with students of similar ages to those we will encounter in our future work."
- "The face of children."
- "Collaboration between the different associations."
- "To get to know other realities, understand differences and value sharing experiences."
- "The material realization of the projects and the staging."
- "The usefulness that the activity has in the social fabric."
- "That everyone who participates learns from their own perspective."
- "To be able to put into practice the knowledge acquired with a real group."
- "I find it an innovative methodology and it does social good."
- "To be able to influence the community in a direct way and to do interesting and motivating teaching."
- "Having real contact with students with difficulties allows you to learn about them: how to deal with them, their behaviour and their likes and dislikes and concerns."
- "Better understanding of the needs of the association's users."
- "Applying knowledge in real life. Dealing with people."

4. Discussion and conclusions

Collaborative learning is the educational approach that seeks to improve the acquisition of competencies through teamwork. In the experience presented in this paper, collaboration takes place between members of the same university, but also through twinning with members of another university located in a different Autonomous Community. In general, the first type of collaboration, of an internal nature, can be easily carried out and is frequently used as a work methodology in the university context. On the other hand, the second type, of an external nature, is very infrequent, and presents problems not only of synchronization of academic calendars for its realization but also of differences between obtained results, both in terms of projects carried out and assessments through surveys and forms.

The implementation of activities aimed at people with ASD is very positively valued by the students of both universities, which is important because the master's degree trains future secondary education teachers who will surely find students with ASD in the classrooms.

In addition, very good rates from assessments have been received from the three

entities that have participated in the experience, which highlight, above all, the involvement of students and professors. One of the greatest satisfactions of this experience has been, without a doubt, the great interest of those attending the fairs on the projects that the students had developed, actively participating in the proposed activities and interacting with students. Many have shown their intention to replicate the projects at home or in their entities, and have even shown interest in the possibility of repeating the events next year.

5. Acknowledgements

This work has been supported by grants ED431C 2020/15, ED431B 2022/39 funded by Xunta de Galicia and ERDF Galicia 2014-2020; by grant PID2019-104958RB-C42 (ADELE) funded by MCIN/AEI/10.13039/501100011033.

6. References

- [1] Vial, G. (2021). Understanding digital transformation: A review and a research agenda. *Managing Digital Transformation*, 13-66.
- [2] Nagel, L. (2020). The influence of the COVID-19 pandemic on the digital transformation of work. *International Journal of Sociology and Social Policy*, 40(9/10), 861-875.
- [3] Sá, M. J., & Serpa, S. (2018). Transversal competences: Their importance and learning processes by higher education students. *Education Sciences*, 8(3), 126.
- [4] Tejada, J. (2013). The development of professional competences through service-learning. *Cultura y Educación*, 25(3), 285-294.
- [5] Nagel, L. (2020). The influence of the COVID-19 pandemic on the digital transformation of work. *International Journal of Sociology and Social Policy*, 40(9/10), 861-875.