# GOMA: AN ACTIVE PROGRAM THAT AIMS TO EMPOWER STUDENTS IN RURAL AREAS THROUGH EDUCATION AND SCIENCE

**R. Branquinho[1], C. Sarabando[2], S. Ambrósio[3], C. Damião[4], J. Duarte[2]**

*[1]University of Porto - Faculty of Arts and Humanities, REMA (Research Management & Science Communication Hub) (PORTUGAL)*
*[2]Agrupamento de Escolas Gomes Teixeira, GOMA Coordination (PORTUGAL)*
*[3]CIDTFF - Department of Education and Psychology, University of Aveiro (PORTUGAL)*
*[4]Armamar´s Municipality, Culture and Science Councillor (PORTUGAL)*

## Abstract

In the heart of Northern Portugal, Armamar is an attractive rural territory with an ageing population and low population density (5680 inhabitants and a population density of 48/km², contrasting with 197/km² of its district capital, Viseu). Considering urban centers, this region has a thin institutional layer, a weak network of local actors (schools, civil society, local governments) collaborating with academia, and a peripheral economic and geographical position. Due to this dissonance, limited access to science and innovative educational offers resulted, leading to the creation of accentuated barriers, social inequalities and stereotypes, as well as low school performances and overall reduced involvement in active citizenship initiatives.

In response, GOMA (Gomes Teixeira Science Academy) was formed in 2022 by the public school (Agrupamento Escolas Gomes Teixeira), Armamar Municipality and the University of Porto. GOMA's formal and non-formal approaches are designed to develop and implement a transdisciplinary education strategy that emphasizes student empowerment and their active- and centered-learning. A key intention is to position the school as an active democratisation hub in this region, addressing locally relevant challenges. Fourteen science-based activities were carried out in 2021/2022. In total, these activities involved over five hundred children (from kindergarten to high school), fourteen teachers and four scientists, in addition to five local or national partners. One of these activities included a two-day workshop - "The science of science communication"-, aimed to bring communication into students' curriculum by improving their oral, written, and designing skills. Additionally, this workshop encouraged students to collaborate, enhance and stimulate discussion, and value each other's opinions and views in a spirit of sharing and cooperation. Participants included fifty-three high school students (from the Natural Sciences and the Social Sciences and Humanities), along with three teachers and one scientist.

According to the assessment results, the program had an exceptionally positive impact on students, boosting their capability to incorporate new and relevant communication skills into meaningful core elements; enhancing their curiosity, critical and creative thinking, teamwork and time management; improving awareness of its individual role in contemporary societies; and helping to strengthen their trust in science.

This paper aims to present GOMA, a means of fostering science, technology, innovation in rural territories, and a bridge connecting Armamar's school community to its civil society, academia and science. Moreover, it intends to present the "Science of Science Communication" workshop as a tool for active citizenship and citizen empowerment.

Keywords: Democratisation hub, rural zones, student’s empowerment, science-related activities, equity.

## 1 INTRODUCTION

Armamar is a delightful rural area in northern Portugal, south of the Douro valley. It is characterised by an ageing population and a reduced demographic density (5680 inhabitants and a population density of 48/km², contrasting with its district capital Viseu of 197/km²). This region holds a weak network of local actors (schools, local governments, civil society) in cooperation with academia, a reduced institutional thickness, and a peripheral economic and geographical position concerning urban centers. This dissonance entails considerably insufficient access to science and innovative educational offers. Therefore, this leads to the creation of accentuated barriers, social inequalities and stereotypes, as well as low school performances and reduced involvement in active citizenship initiatives [1].


*ISBN: 978-84-09-49026-4*

International studies stressed that educational offers in regional, rural, remote and isolated areas, are considerably insufficient compared to urban counterparts ([2], [3]). On the other hand, accessing a high-quality education in rural areas can be a crucial factor for rural economic development and the well-being and cohesiveness of rural communities. Moreover, schools in rural communities are often regarded as the center of community life and social cohesion, which means that those rural schools are more likely to adapt to community resources for their support [4]. This dissonance was underscored by the COVID-19 health crisis, which highlighted how important education is for students' development while showing that digitalization and other related skills are essential.

In most Organisation for Economic Co-operation and Development (OECD) countries (80%), education is recognised as a right within their constitutions and 58% provide a constitutional guarantee of universal access to education [5]. Nonetheless, and in practice, the structure of education levels differs significantly across countries. Table 1 stresses the 2011 International Standard Classification of Education (ISCED) overview from early childhood to upper secondary education, accordingly ([5], [6]). In Portugal, education structure occurs at primary, secondary and higher levels. Pre-school education is optional and starts at age 3 to the age of entry into primary education. Primary education is universal, compulsory and free, starting at the age of 6, and is divided into the first cycle: grades 1, 2, 3 and 4; the second cycle: grades 5 and 6; the third cycle: grades 7, 8 and 9. Secondary education is compulsory, starts at age 15, and comprises a three-year cycle including 10th, 11th and 12th grades. Higher education is optional and comprises three different degrees [7].

*Table 1. Distinction of education levels across OECD countries.*

| ISCED level | International name | Typical age range | Examples |
|---|---|---|---|
| 1 | Early childhood educational development | 0-2 years | Creche, day care centre, nursery, early childhood development, child-minding services |
| 2 | Pre-primary education | 3-5 years | Pre-primary education, early childhood education, kindergarten, pre-school education |
| 3 | Primary education | 6-11 years | Primary school/ education, elementary school, special primary education, basic school, comprehensive school, special primary education |
| 4 | Lower secondary education | 12-14 years | (Lower) secondary school, (technical and) vocational education, special secondary education |
| 5 | Upper secondary education | 15-17 years | General secondary education/school, upper secondary schools, vocational (upper) secondary education, higher technical and vocational college |

The United Nations' 2030 Agenda for Sustainable Development established 17 Sustainable Development Goals (SDGs) to tackle global issues such as poverty, climate change, food shortage, the protection of the planet and to ensure that all individuals enjoy peace, prosperity and quality of life. Education, and particularly STEAM education (science, technology, engineering, arts and mathematics), plays a crucial role in the achievement of these SDGs, intending to assist in the development of competency-based curricula that prepare young people with required competencies to live a sustainable, fulfilled and healthy lives, in the rapidly changing world of the 21stcentury ([8] [9] [10]). In addition, it is widely agreed that solutions to the challenges that the world faces today will require a new multidisciplinary scientific workforce equipped with a skill set of new technology and interdisciplinary thinking that may "require the integration of multiple STEM concepts to solve them" [11]. The aim of taking an integrated or interdisciplinary approach to STEAM is to advance and synergize the efforts to equip students with a sturdy theoretical foundation that will enable them to propose innovative solutions to the problems of the society and the world ([8] [9] [10]).

Thus, in response to these challenges, in 2022, the public school of Armamar (Agrupamento Escolas Gomes Teixeira, AEGT) along with their partners created GOMA (Gomes Teixeira Science Academy).

This paper is intended to present GOMA – as a vehicle for the promotion of science and technology and for deconstruct stereotypes, as well as a bridge connecting Armamar's school community to its civil society, to academia and to science. Work will be also focuses on GOMA´s "Science of Science Communication" workshop as a tool for stimulating an active citizenship and citizen empowerment.

# 2 METHODOLOGY

## 2.1 Introducing the GOMA aims and activities planned for 2021/2022

The GOMA - Gomes Teixeira Science Academy was established in 2022 by the public school (AEGT), the Municipality of Armamar, and the University of Porto (through its Faculty of Arts and Humanities). It was funded by the Portuguese Agency - Ciência Viva.

This hub aims to promote science literacy in Armamar's rural area, tackling educational disadvantages and inequities in accessing science. Moreover, it is intended to position the school as an innovative ecosystem and active democratization hub, allowing to address locally relevant challenges in collaboration with (local) key stakeholders. While designing the process, four main aspects were considered:

1. Rural areas have experienced a precipitous decrease in interest in science.
2. Many students still perceive science as a difficult and/or complex subject, resulting in a lack of motivation to pursue a scientific career.
3. Deconstruct the stereotype that still exists about scientists.
4. The need to strengthen the relationship between scientists and society, allowing interaction with the so-called "role models."

During 2021/2022, fourteen different science-based activities were carried out, involving more than five hundred students (from kindergarten to high-school students), fourteen schoolteachers and four scientists, as well as five local and national partnerships. Among these activities, designed to strengthen students' 21st-century skills, was the development of a two-day workshop entitled "The science of science communication." This workshop focused on improving students' oral, writing and informatics design skills to enhance some communication skills in their curriculum. This activity will be the focus of this paper.

## 2.2 The workshop participants

A total of 53 high school students (from the Natural Sciences and Social Sciences and Humanities), three teachers and one scientist, participated in the workshop. Secondary education in Portugal lasts three years and includes grades 10, 11, and 12.

## 2.3 Constructing the workshop program and format

The workshop was constructed using a mixture of thought-provoking/discussion methodologies, games and practical exercise(s), and not a series of lecture(s). Students were also encouraged to ask questions and bring up issues during the workshop, valuing each other's opinions and views in a spirit of sharing and cooperation.

On the first day the workshop started by inviting students to explore non-verbal forms of communication through an ice-breaking game. Afterwards, a list of 20 words related to science communication practices was distributed, and students were asked to complete it according to their different experiences and visions of science communication practices (for more details, see subsection 2.4.).

The workshop proceeded with the discussion of communication definition and communication processes. To facilitate this discussion, a note-taking template where students could include their definition of communication in only one word was applied.

Through encouraged discussion, some content was explained and clarified to guide students in developing their ideas into meaningful messages and to communicate them to broader audiences (through poster art, blogging and/or oral presentations).

A check list organizing all the information was distributed at the end of the first day.

Previously, and in agreement with the teacher, a subject theme was selected to be explored in the form of a project (e.g., poster presentation, oral presentation using slides) according to the recommendations provided during the first day of the workshop. The students were divided into groups and had about a week to conceive their projects.

On the second day of the workshop, students were encouraged to:

- Share their projects and ideas;
- Ask questions;

- Stimulate their spirit of cooperation and improve their project according to the directions given by their colleagues, teachers or the workshop facilitator;
- Share relevant tools derived from their research work that they have found with their colleagues.

All groups presented a 4-minute pitch with the key message to retain from their projects.

Finally, the same page including 20 words related to science communication practices was distributed.

Moreover, as part of the celebration of the school day, different "Creative Labs" sessions were held to present the projects of the workshop to the whole school community.

## 2.4 Workshop assessment and evaluation

A list including 20 words related to science communication practices was distributed and students were asked to grade each word according to their different experiences and viewpoints on a scale of 1 ("strongly disagree") to 7 ("strongly agree"). This same list was distributed in the end of the second day. Differences were then analyzed.

At the end of each workshop, we also asked participants to complete an evaluation form (Table 2) on a 1 ("strongly disagree") to 5 ("strongly agree") scale. In the first nine questions, participants were asked to rate aspects of the workshop, followed by five questions about the scientist/facilitator. The last three are open-ended questions.

*Table 2. "The science of science communication" workshop evaluation form.*

| ***Question Number*** | ***Topic covered*** |
|---|---|
| ***About the workshop*** | |
| 1 | The workshop met my expectations |
| 2 | I learned new skills and/or information |
| 3 | The workshop awakened or increased my interest in science |
| 4 | The workshop made me feel more comfortable to discuss science issues |
| 5 | The topic was helpful and will be useful to me in the future |
| 6 | I had the opportunity to learn methodologies or concepts I didn't know |
| 7 | I had the opportunity to carry out practical activities |
| 8 | It was the first time that this type of activity was carried out in my classroom |
| 9 | The duration of the workshop was adequate |
| ***About the scientist/facilitator*** | |
| 1 | The language used by the scientist was appropriate for my level of knowledge |
| 2 | The scientific content was appropriate and was presented with enthusiasm |
| ***3*** | ***I had the opportunity to talk/interact with the scientist*** |
| 4 | It was the first time I had contact with a scientist |
| 5 | The scientists' explanations were enlightening and/or enriching |
| ***Open-ended questions*** | |
| 1 | The strongest point of the workshop |
| 2 | The weakest point of the workshop |
| 3 | What new words did you discover and/ or which one reminded you of "Science Communication" |
| 4 | Any (other) suggestion(s) |

In compliance with the General Data Protection Regulation (GDPR), participants were invited to fill out the evaluation form voluntarily and anonymously.

In addition, students were asked to describe how they had developed their communication skills and to express their preferences for (other) training topics.

# 3 RESULTS

## 3.1 Participants' characterization

Related to the workshop - "The science of science communication" participants characterization, all the students (total n=53) were from the secondary education level. The majority of students were female (58,8%, n = 31) and 41,5% (n = 22) were male. Most of them were 17 years old (37,7%, n=20), 30,2% (n = 16) were 16 years old, 18,9% (n = 10) were 15 years old, and 13,2% (n = 7) were 18 years old.

The majority frequented Natural Sciences courses (n=42, 79,2%) and n=11 (20,8%) were from Social Sciences and Humanities courses. The total number of students were n=13 from 10th grade (24,5%), n=25 from 11th grade (47,2%), and n=15 from 12th grade (28,3%). The representation of frequency of distribution of students' grades by the gender assigned is shown in Fig. 1.

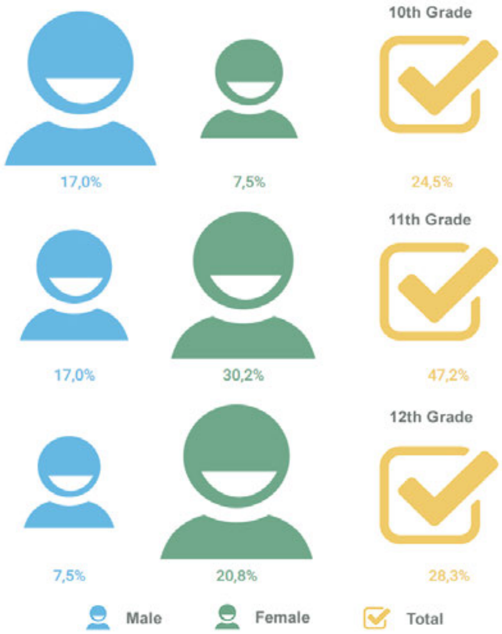


*Figure 1. Representation of frequency of distribution of students' grades (10th, 11th and 12th) by gender assigned (male and female) and total of students.*

## 3.2 Communication definitions as perceived by participants

According to the results revealed by the note-taking template where students were challenged to include their communication definition in one word, the term "express" was the most repeated (n=9), across all grades and classes, followed by "transmit" (n=8), "inform" and "speak" (n=5), "understand" (n=4), as illustrated in word cloud represented in Fig. 2.

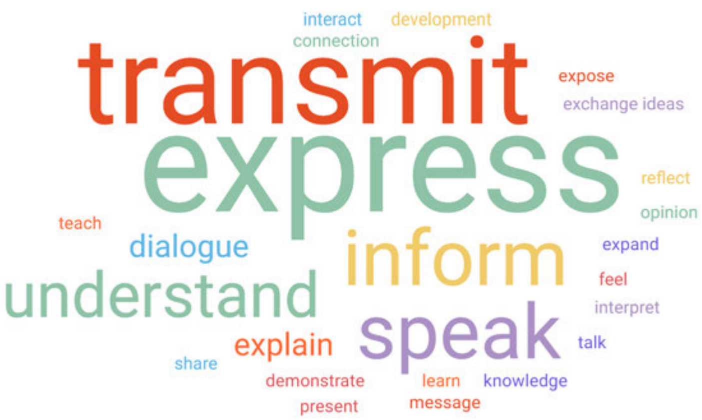


*Figure 2. Word cloud representation of the students' definition of communication at an early stage of the workshop, given the frequency with which they were listed.*

## 3.3 Workshop outcomes

Specifically, the workshops provided students with knowledge regarding the following:

- Language as a type of communication;
- How to effectively transmit an idea or message;
- Reading an audience (even if it's merely two participants in a group conversation), assessing if students should continue to expound on a topic or conclude their argument;
- How to structure a communication, in particular an oral communication or a poster communication;
- How to build visual support for oral communication;
- Know the techniques of an oral presentation;
- Know how to construct a poster using best practices and contemporary approaches;
- How to create visual support for a poster;
- Encourage collaboration, cooperation and teamwork by teaching students how to handle an issue, offer solutions, and choose the most appropriate answer.

Furthermore, the programme encourages students to be creative by solving challenges, developing their inner strengths (ranging from big-picture thinking to rigorous organising), or thinking in a unique way. Furthermore, the workshop encourages critical thinking, which includes researching facts and figures for oneself, asking questions and assisting others in doing so.

In a similar vein, the results of the 20-word list grading (data not addressed in the present study) revealed that students accomplished the specified pursuits proficiently.

## 3.4 Workshop assessment

The outcomes of the feedback were invariable favourable, with average numerical scores of global satisfaction ranging from 80% to 100%.

When participants were asked about the workshop:

- 98,1% said they agreed or totally agreed that it met their expectations.
- 71,7% totally agreed that they have learned new information and/or have acquired new skills.
- 37,7% neither agree nor disagree that the workshop awakened or increased their interest in science, whereas 47,2% agreed and 11,3% totally agreed.
- 94,3% agreed or agreed totally with the statement that the workshop made them more comfortable discussing science issues.
- 84,9% said they agreed or totally agreed that the topic was of interest and would be useful in the future.
- 81,1% agreed with the statement that the workshop gave them the chance to learn about methodologies or concepts they were unfamiliar with. In addition, they had the opportunity to participate in practical exercises.
- 56,6% totally agreed It was the first time that this type of activity was carried out in their classroom, whereas 34,0% neither agreed nor disagreed.
- 67,9% totally agreed or agreed that the duration of the workshop was adequate, whereas 24,5% neither agreed nor disagreed.

When students are asked about the scientist/facilitator:

- 100% agree or totally agree that the language used by the scientist/facilitator was appropriate to their level of knowledge.
- 94,3% agreed or totally agreed that the scientific content was appropriate and was presented with enthusiasm.
- 90,6% agreed or totally agreed that they had the opportunity to talk/interact with the scientist/ facilitator.

- 100% agreed or totally agreed the scientist's/ facilitator´s explanations were enlightening and/or enriching.
- 39,6% affirm that it was the first time that they had contacted a scientist, 18,9% agreed with this affirmation, 15,1% neither agreed nor disagreed and 20,8% absolutely disagreed.

As a result of the responses given by students to the open-ended survey questions, the following is relevant:

1 The workshop's strongest points were:
   - Scientists' language;
   - The chance to learn something new ;
   - The chance to interact directly with scientists and colleagues;
   - Feeling more comfortable communicating;
   - The chance to present and receive constructive feedback on the final projects;
   - Tips for poster and slide presentations as well as communication design techniques;

2 The weakest points assigned to the workshop were:
   - The workshop's duration was too short
   - More time was needed to prepare the project.

3 New terms students learned that made them think of "Science Communication":
   - Storytelling and eye-catching.

4 Other suggestions: carry out more activities of a similar nature in the future.

When students were asked informally to describe how they had developed their communication skills, many said they had learned by doing and from others (informal training). These results suggest that this approach may be an efficient way to develop and/or build communication skills.

Additionally, we gave students the chance to express their choices for (other) training topics that were not included or specified in the survey. Training in video communication and social media communication were mentioned as answers to this query.

## 3.5 Workshop impact

The impact of the workshop results revealed a clear and very positive impact of this action on students, namely through:

- Adoption of new communication tools and/or working methods;
- Stimulation and improvement of communication tools and postures;
- Being able to work independently, in teams and to convey information to other team members in clear and effective ways;
- Development of effective collaboration and teamwork postures;
- Establishment of common goals and sharing responsibility to achieve these goals;
- Opportunity that each team member has an equal chance to participate and communicate ideas within the space of shared responsibility;
- Development of organisation, responsibility, time management and decision-making skills;
- Awareness of the relevance of their individual role as communicators in a contemporary society;
- Stimulus of curiosity for different scientific themes and/or areas;
- Possibility to participate in the process of collect and evaluate information and consider alternatives;
- Volunteering actions to perform hands-on lab activities during the "creative labs", as part of the celebration school day, under the supervision of the school teachers and the workshop facilitator.

There has been a very positive impact of the project not only on the AEGT School, but also on academia partners involved and in the community as a whole. The involvement of external experts (scientists) from academia in coaching students and co-teaching with schoolteachers contributes to the adoption of an interdisciplinary approach, which is a first step towards building the much-desired closer links between science and the citizens.

## 4 CONCLUSIONS

This paper presented GOMA as a vehicle for promoting science and technology in rural areas such as Armamar. It also stressed the program's benefit in tackling educational disadvantages and inequities in accessing science. The program also had (and still has) a key role to connect Armamar's school community with its civil society, academia and science.

Rural and remote schools have a unique responsibility for the educational opportunities of children and youth in those areas. Taking advantage of such opportunities will allow us to develop new and more integrated strategies for the interdisciplinary approach that is necessary for accomplishing this, as well as bringing science closer to the general public.

Additionally, the manuscript demonstrated the benefit of GOMA's "Science of Science Communication" workshop as a way to promote active citizenship and citizen empowerment.

## ACKNOWLEDGEMENTS

Raquel Branquinho was funded by the FCT (Fundação para a Ciência e a Tecnologia) through its Scientific Employment Stimulus Institutional program, reference CEECINST/00130/2018. Susana Ambrósio was funded by UIDB/00194/2020 and UIDP/00194/2020.

National Agency Ciência Viva funded GOMA project through the program “Impulso Jovens STEAM” (reference C06-i04.02).

The authors also wish to thank all the students for their collaboration, time and openness in sharing their experiences and observations. The authors are grateful to Micael Gomes for the feedback on manuscript drafts, and Diogo Lopes and Pedro Santos for GOMA´s communication efforts and support. The authors also wish to thank all the GOMA stakeholders for their valuable contribution, particularly to the AEGT schoolteachers involved Isabel Lopes, José Rodrigues, Paula Cardoso and Rafael Carvalho.

## REFERENCES

[1] OECD, “Rural Well-being: Geography of Opportunities”, OECD Rural Studies. Paris: OECD Publishing, 2020. Retrieved from https://doi.org/10.1787/d25cef80-en.

[2] J. Halsey, “Independent review into regional, rural and remote education – Final Report”. Canberra: ACT – Department of Education and Training, 2018.

[3] OECD, “Delivering Quality Education and Health Care to All - Preparing Regions for Demographic Change”. Paris: OECD Publishing, 2021. Retrieved from https://eer.qc.ca/publication/1631193604427/rapport-final-ocde-services-en-region.pdf.

[4] OECD, “Responsive School Systems: Connecting Facilities, Sectors and Programmes for Student Success”, OECD Reviews of School Resources. Paris: OECD Publishing, 2018. Retrieved from https://dx.doi.org/10.1787/9789264306707-en.

[5] OECD, “Education at a Glance 2019: OECD Indicators”. Paris: OECD Publishing, 2019. Retrieved from https://dx.doi.org/10.1787/f8d7880d-en.

[6] ISCED, “Operational Manual: Guidelines for Classifying National Education Programmes and Related Qualifications”. Paris: OECD Publishing, 2011. Retrieved from https://dx.doi.org/10.1787/9789264228368-en.

[7] LBSE, “Lei de Bases do Sistema Educativo”, Law nº 46/86, 14 October, 2009. Retrieved from https://dre.pt/dre/legislacao-consolidada/lei/1986-34444975.

[8] K. Pugalee, “STEAM: Considering Possibilities and Barriers for STEM Education” in *Mathematics and Its Connections to the Arts and Sciences (MACAS)* (C. Michelsen, A. Beckmann, V. Freiman, U. T. Jankvist, A. Savard, eds), vol 19, Mathematics Education in the Digital Era, Springer, 2022.

[9] C. Adams, “The 7 most important STEM skills we should be teaching our kids”, 2017. Retrieved from https://www.weareteachers.com/important-stem-skills-teaching-kids/.

[10] T.R. Kelley, J.G. Knowles, “A conceptual framework for integrated STEM education”, International Journal of STEM Education, 3, 11, 2016. Retrieved from https://doi.org/10.1186/s40594-016-0046-z.

[11] H. H. Wang, T. J. Moore, G. H. Roehrig, M. S. Park, “STEM Integration: Teacher Perceptions and Practice”. Journal of Pre-College Engineering Education Research, 1(2), 2011.