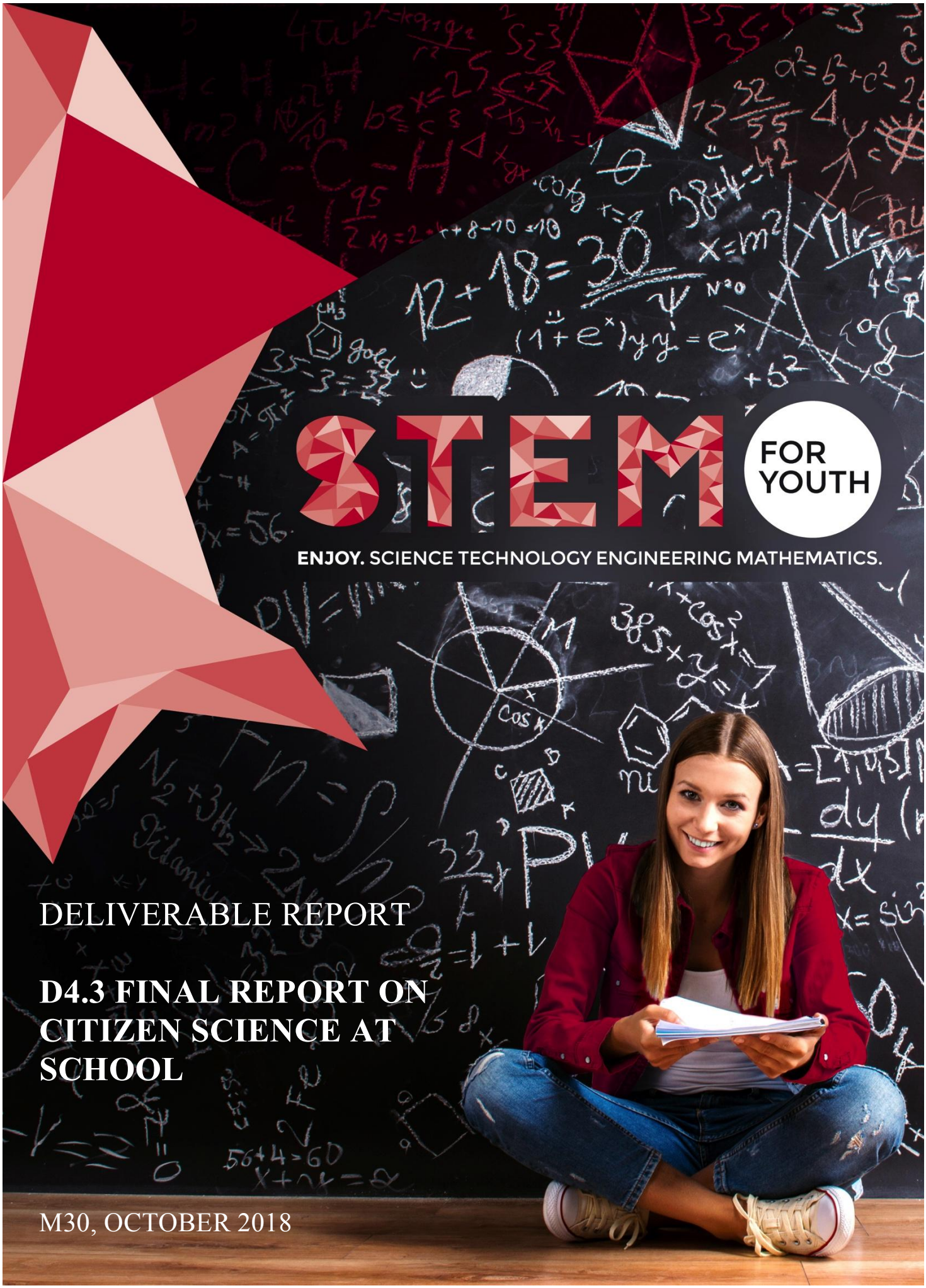

DELIVERABLE REPORT

D4.3 FINAL REPORT ON CITIZEN SCIENCE AT SCHOOL

M30, OCTOBER 2018

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO. 710577

PROJECT DETAILS

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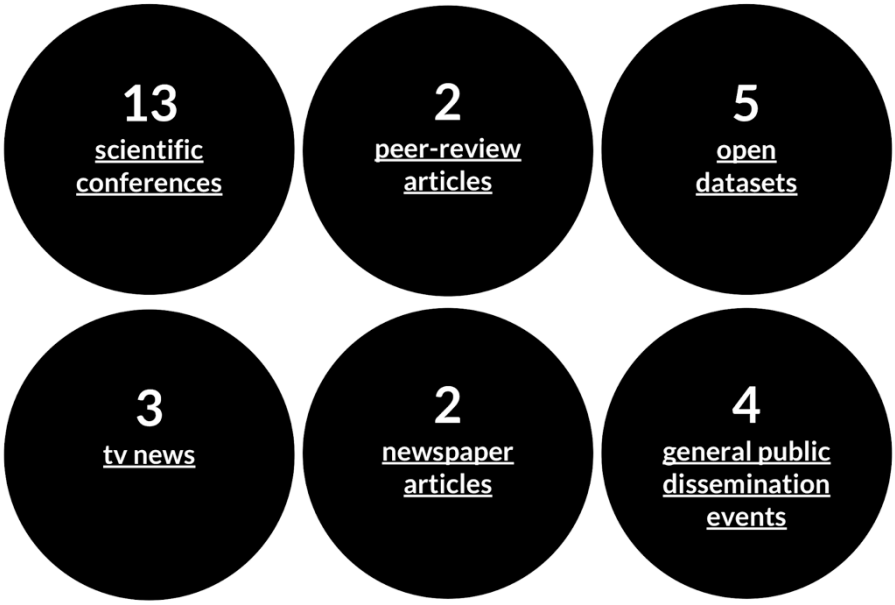

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Innovative educational methods	Data processing
Societal relevance	Result interpretation
Ownership	Teachers empowerment
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Empowerment	Evaluation assessment
Everyone can become a scientist	Ethnographic insights
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Inclusive evidence	Local synergies

Recommendations for teachers and scientists

- Use Citizen Science as a framework for practicing scientific reasoning.
- Use Citizen Science as an catalyst for inquiry-based science teaching.
- Invest time to cover all the Citizen Science research process.
- Define scientific and social objectives at the beginning of the research.
- Actively involve administrations and actors of change from early stages.
- Place the students as the central actors of the research.
- Build a Citizen Science community of teachers.
- Consider social change as an outcome of STEM projects.
- Include some transdisciplinar spaces.
- Increase students' self-confidence and self-esteem with hands-on experiences

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I. Introductory comments

In this final report on Citizen Science at School (WP4), we have summarized the main outcomes of the introduction of Citizen Science in the classroom. More detailed results on the Citizen Science Pilots (D4.1), their upscale (D7.2), the scientific outcomes (D4.2) or the methodology and the material of the toolkit (D5.2) are available in the corresponding deliverables.

While analyzing the results of this 30 months process to introduce Citizen Science at school in a radical and completely new manner, the goal of this report is to provide short and concise bullet points. This way the report, that will also be made available through Zenodo repository, will have a practical use for teachers and scientists willing to follow the same methodology and replicate the process. For this reason, we privileged short texts and graphic visualizations of the contents in order to foster a wider dissemination.

Citizen Science Pilot experiment in public space. Badalona, April 2017.

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II. Impact of the Citizen Science Experiments

II.1. Short facts

Timeline

6 public experiments were carried out between April 2017 and May 2018.

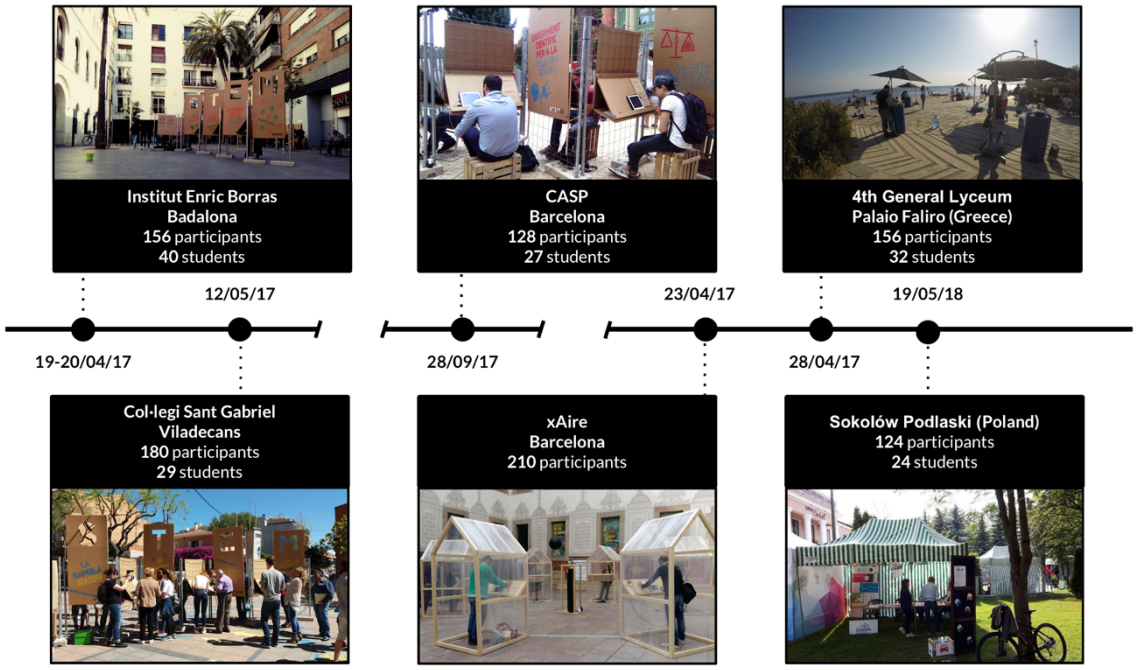

Figure 1. Timeline of public experiments under the form of ephemeral interventions in the street, number of students involved and public mobilization. A total of 152 students co-created the interventions and a total of 954 volunteers were engaged. 887 participants (93%) completed the collective experiment with valid contributions.

Participation overview

Figure 2. Total participation of students in the co-creation sessions and volunteers in the collective experiment.

Volunteers' gender, age and working status.

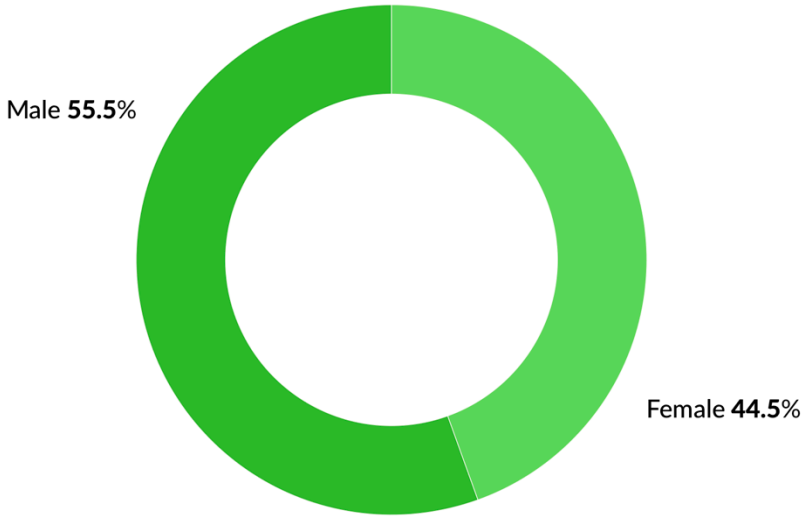

Figure 3. Gender distribution of volunteers . 918 participants to the experiments reported his/her gender, 510 (55.5%) were males and 408 (44.5%) were females.

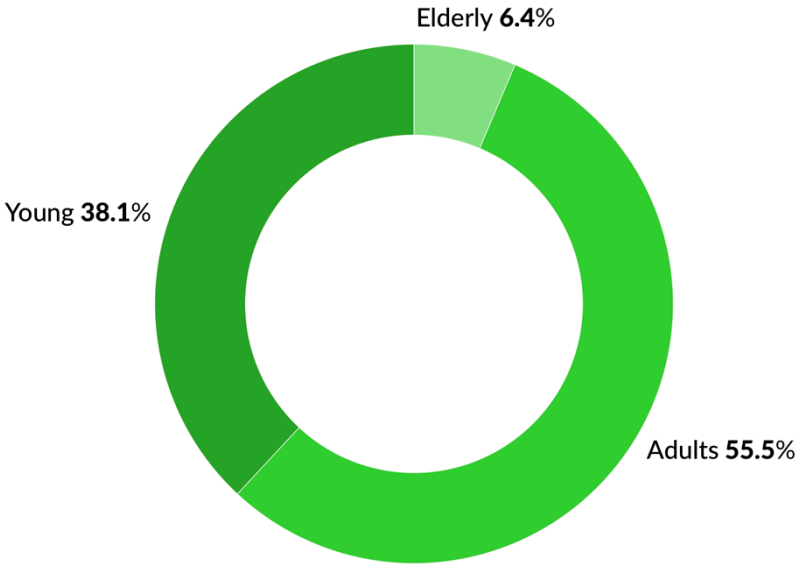

Figure 4. Age distribution of volunteers . 801 participants to the experiment reported his/her age, 305 (38.1%) between 14-24 years old, 445 (55.5%) between 25-64 years old and 51 (6.4%) are more than 64 years old.

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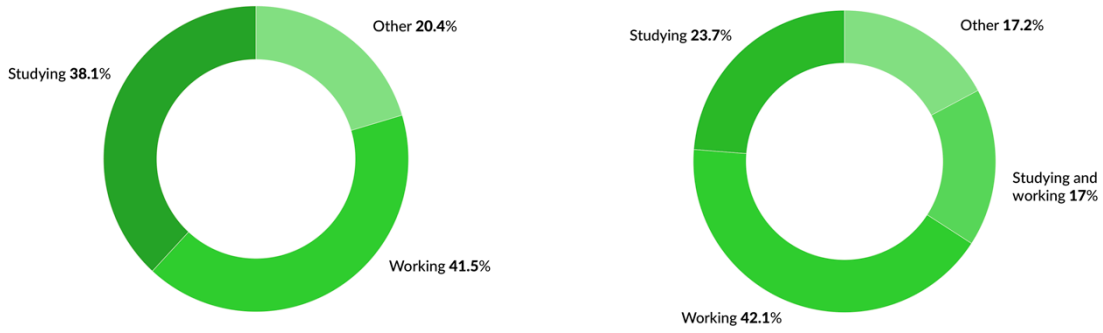

Figure 5. Working status. Working status of the participants in the experiments of Badalona, Viladecans and Barcelona (Left) and Palaio Faliro and Barcelona (Right).

II.2. Impact on motivation and engagement of students

The co-created design phase of the citizen science pilot experiments has been evaluated through anonymous surveys (addressed to students, teachers and researchers) and interviews (involving researchers only), all of them summarized in an open access research paper[1]. This has been done with the collaboration of external researchers that have also contributed in the co-design phase as facilitators (Dimmons, Universitat Oberta de Catalunya). We did this way for the sake of more neutrality and objectivity, and because we wanted to include not only the scientists who run the experiment when analysing the process as a whole. Concerning the participation of students, following the co-design sessions for each of the three citizen science pilots, an anonymous online questionnaire was sent to all the students who took part. A total of 79 students (81.4 % of all students involved), aged 13 to 17, and with an equal gender mix, answered this survey made of 12 questions (11 closed questions and 1 open question).

The Citizen Science toolkit: an effective engagement tool

The methodology and materials used in the classroom are based on a “design thinking” dynamic used to achieve a co-created research design, in which interaction sequences between the different groups of participants were developed. This methodology was extensively described in a research paper[1], in D4.1 (Report on Citizen Science Pilots Experiments) and in D5.2 (Citizen Science Toolkit for Teachers).

The students perceived that this process was coherent as 92% of them stated that the different phases and co-design sessions were quite or very connected, as seen in Figure 6. On the same page, regarding the co-design canvas, 84.8% of the students valued the material as useful or very useful.

[1] Senabre, E., Ferran-Ferrer, N. & Perelló, J. (2018). Participatory design of citizen science experiments. *Comunicar* 26, 29–38 https://doi.org/10.3916/C54-2018-03

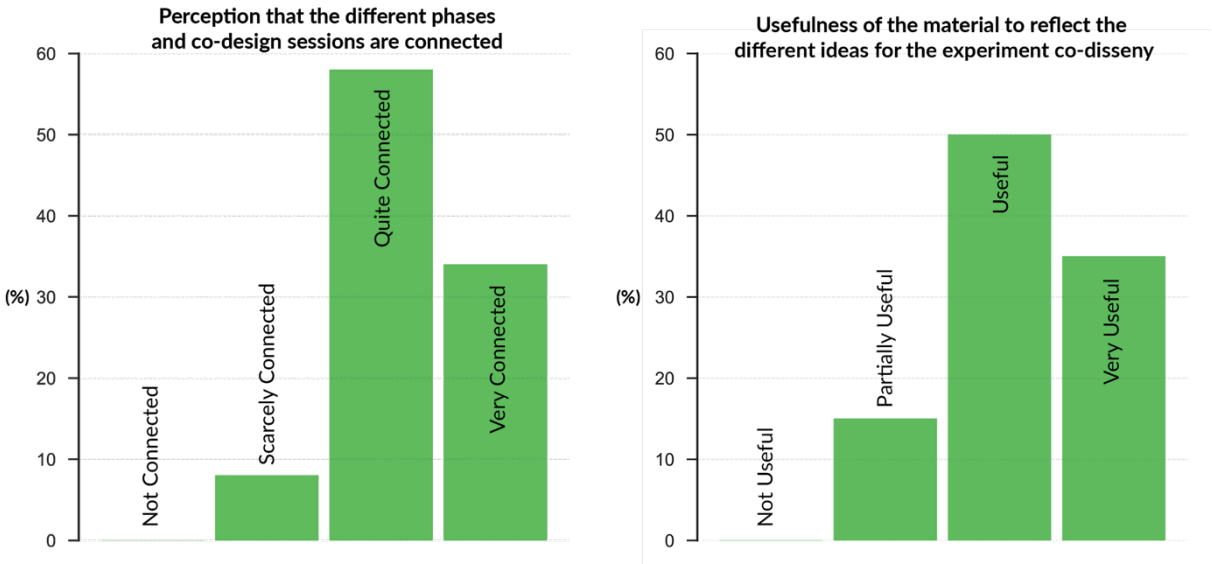

Figure 6. Evaluation of the Citizen Science toolkit material and methodology.

The experiment: a common goal boosting ownership and motivation.

The high level of motivation and commitment of the students achieved through this co-creation process is reflected in the answers to questions: "Motivation to carry out the experiment" and "Satisfaction with the definition degree of the experimental design", displayed in Figure 7. A total of 79% of the students were highly or very highly motivated to perform the experiment, whereas 77% of the students were highly satisfied with the experimental design. As observed previously[2], the involvement of the students in an early stage of research co-creation boost their motivation. Also, the concrete and common goal of performing an experiment in a public space of their neighbourhood, explicitly pointed out sincethe very beginning, allowed them to acquire ownership and to visualize a concrete and timely defined objective.

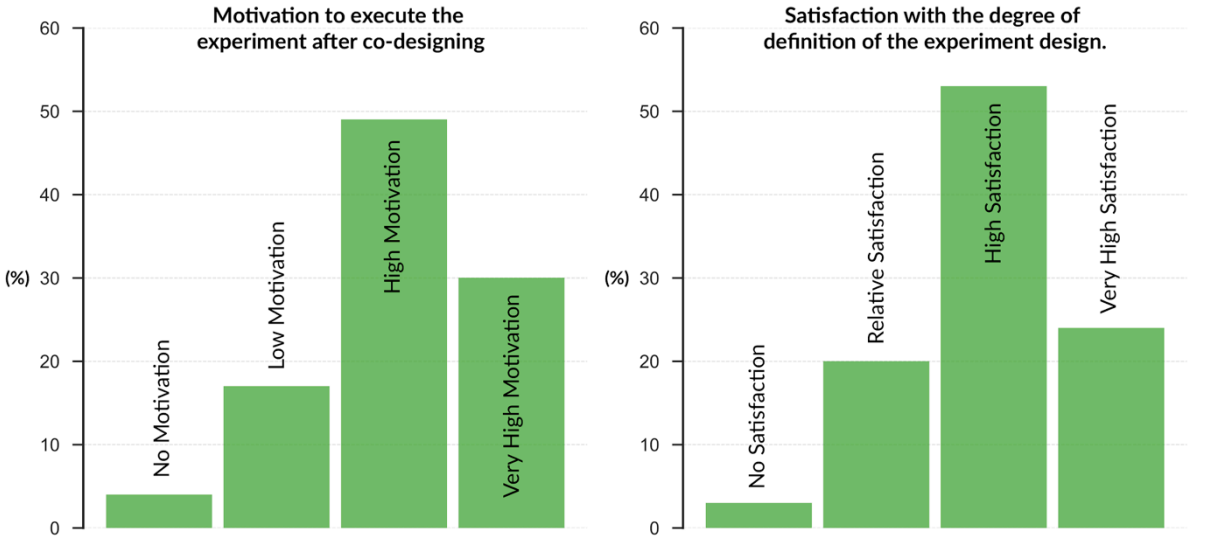

Figure 7. Students' motivation to execute the experiment and satisfaction with the experiment co-design.

[2] Perelló, J., Ferran-Ferrer, N., Ferré, S., Pou, Toni & Bonhoure, I. (2017). High motivation and relevant scientific competencies through the introduction of citizen science at Secondary schools: An assessment using a rubric model. In Citizen Inquiry Synthesising Science and Inquiry Learning, Routledge, Oxon, United Kingdom, pp. 150-175. https://doi.org/10.5281/zenodo.1156535

Research co-design and horizontal processes: catalyzers of students' motivation.

This high motivation has also to be related to some particularities of the research co-design process, which is fully described in Deliverable D4.1. Namely, the students were asked to individually think of the local social concern to be worked on, the research questions to be addressed, the experimental design and the logistics of the experiment. Collectively, they had to select a common concern and a few research questions, the best experimental design and to agree on logistics details. Accordingly, as seen in Figure 8, 82% of the students felt that they could contribute regularly or constantly to the design of the experiment by expressing a personal viewpoint. Another important aspect that was especially taken care of was to establish an horizontal process where all the participants shared the decisional power, in order to promote an informal atmosphere where trust and respect in between participants are fundamental values that cannot be overruled. In that sense, 83% of the students stated that the sessions' environment generated trust among the participants (see Fig 8).

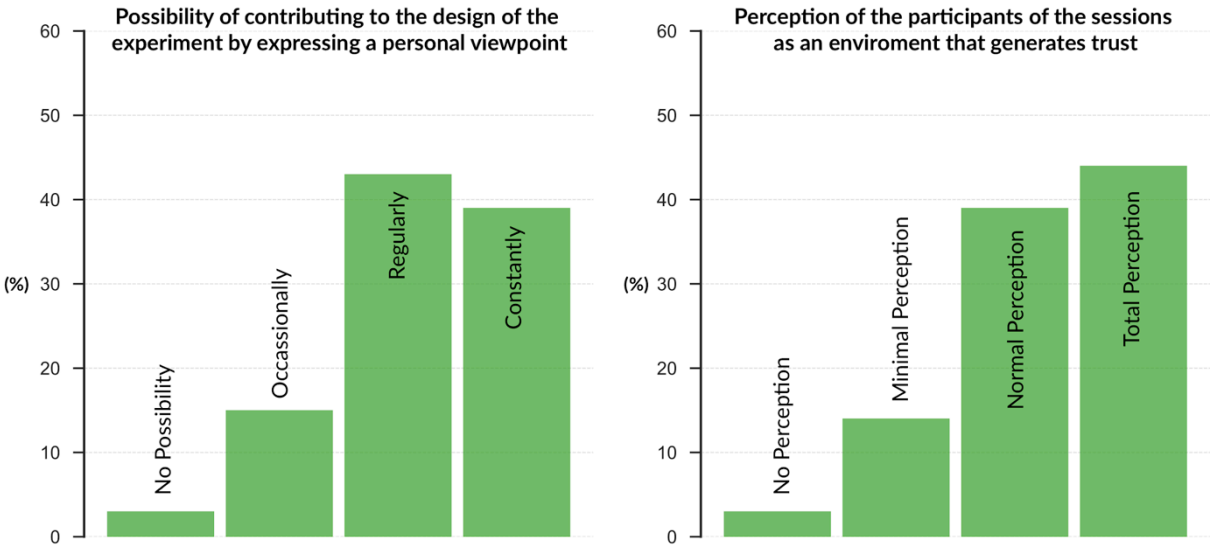

Figure 8. Students' perception of their integration in the co-design process.

Collaborative work on social local concerns: a different perspective to engage students

At the end of the questionnaire, the students had the possibility to write any comment they wanted to add. Though not quantitative, these results highlight some others aspects of students engagement. For example, several students emphasized that they enjoyed to realize a collaborative work with their classmates: "*What I liked most was to do different activities in order to find together the issue we wanted to address and to design the experiment we would do through small cooperative works*"; "*Sessions were interesting and funny. What I liked most was to collaborate as a group in order to reach a series of agreements*"

Some other students highly valued that the social concern was based on their experience and daily life. For example, a student commented: "*I liked it because this really happens*". Another stated: "..*we are willing to do it (the experiment), because we want to know the answers of the people that will participate to the experiment regarding the theme (we) proposed*." Thus, considering a trans-disciplinary process that includes collaborative work and the social concerns of the students turned out to be an effective way to engage the students.

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Citizen Science co-creation session using ad-hoc specific canvas. Viladecans, February 2017.

II.3. Teachers' view on Citizen Science introduction at school

7 teachers participated to the citizen science pilots experiments. In all cases, 2 or more teachers were involved (2 in Jesuïtes de Casp, 3 en Institut Enric Borràs and 2 in Col·legi Sant Gabriel), which was highly valuable in order to successfully organize the logistics of the sessions and the final experiment.

The teachers answered the same survey than the students and the results underlines the same trends observed in the students' surveys, with even more positive considerations. The comments they shared though were more detailed and shedded more light on how they perceived the co-creation process. Motivation increase is perceived as very important value that citizen science projects can bring in a class-group, jointly with the perception that everybody can become a scientist, which also contributes to make this career especially attractive for girls.

Researchers entering the classroom: an incentive for students and teachers

The teachers highly valued and acknowledged the presence of the researchers inside the classroom during the co-creation process (10 hours approximately in each school). They commented for example: "*I liked very much the fact that there was a direct relationship between the participants and the UB scientists*" or "...it's very important for the students do *projects that are connected with the*

outside world, in this case with UB. Be able to relate to others entities. That the scientists entered the classroom. This is really valuable". Also Institut Borràs' teachers, situated in a low income and high cultural diversity neighborhood, commented during informal conversations that the students visualized for the first time "being a scientist" as a tangible opportunity for them in the future.

Co-creation: a new positive dynamics for education

The co-creation work that was performed in the classroom also exemplified a new way of generating positive dynamics in the classroom, that the teachers could later on implement. For example, their expressed their enthusiasm for the co-creation process as: "*The work dynamics was excellent. Even the most abstract aspects were easy to understand*." "*Very good all the co-creation process. Very good all the tasks' gears. Very motivating to perform it for the outside world. We missed time to fully exploit the positive outcomes*." "*The assessment and facilitation of the co-creation sessions was the more relevant of this process*". Accordingly, they wish that this methodology could be extended to more schools: "*We wish that this way of working could be each time more extended in all schools*".

Citizen Social Science: transdisciplinarity and new skills for students

They also valued the approach that was both pushing the students out of their comfort zone but at the same time was also forcing them to acquire new transversal skills: "*A great opportunity for students to face non-usual working situations in the classroom, especially all things related with autoregulation and creativity*" "*I liked it very much because it was a transversal work and each student found its place and where he/she was more comfortable*."

Indeed, the different sessions covered all type of tasks including contents writing, group reporting, team working, graphic design, conceptual thinking, planification or oral communication. The approach also promotes a more flexible profile of future scientists, focused on societal issues to be addressed rather than the disciplinary and specialized profile. Real world problems need a multidisciplinary perspective.

Transversal approach: students' social and civic competences and team working

Similarly, a preliminary work was done on students competences. No common trend could be detected regarding STEM competences but all the teachers agreed on the fact that the students acquired high level of social and civic competences and team working skills. These aspects are related to Responsible Research and Innovation values asking for more inclusion in research activity and for better responding to societal issues with research practices. They are also related to a transversal approach in formal education that seeks to give students skills useful for any discipline and for his/her future professional life.

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Students working on the experiment preparation with the graphic designers. Badalona, March 2017.

II.4. Social Impact

The need to link the knowledge produced with scientific evidence-based policies or actions has been carefully considered. For this reason, the design process started with two simple and direct questions: what is your concern and which experiment can produce a social change in your local context (at the neighborhood level). Such an approach aimed at generating some form of social impact, in the sense that it scientifically (and rigorously) addressed societal issues of concern to the students.

Collective experiments: moving the research from the classroom to the public space

The students experiments thus implicitly addressed the following (ambitious) challenge: can the design and performance of collective experiments in the public space successfully tackle community concerns and promote social change?

The objective of the experiments designed and run by the students aimed at addressing those emblematic issues of their proximate environment, and to translate such common concerns into an intervention in the public space able to stimulate a process of change based on scientific evidences. We tested in this way the potential of the street to transform itself into an ephemeral laboratory to

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observe social phenomena and gather relevant data. This way, research becomes public in its broad sense and it is run where participants live.

We understand for social impact an impact that moves beyond purely scientific and educational purposes, and rather relates strictly with the performance of a collective experiment in the public space: the level of neighborhood mobilization it generated, the counter-reactions it stimulated, the consequences it had on the participants themselves, and the discussion it prompted with local governments and with the community as a whole.

II.4.1.Viladecans case study

The concerns of the students of Col·legi Sant Gabriel (Viladecans, Spain) which emerged from the co-design process addressed issues related to the public space. The students designed and run a collective experiment in the city's main street, the Rambla Modolell. They invited their neighbours to play games and answer some questions in order to collect evidences about the quality of the city's public spaces and the robustness of public life.

Public space Citizen Science Experiment at "La Rambla Modolell". Viladecans, May 2017.

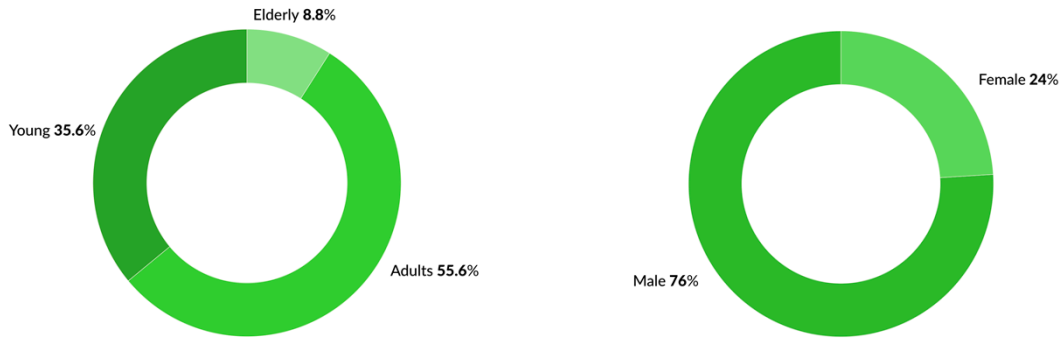

Figure 9. Gender and age experiment Viladecans (n=180).

Mobilization Overall, 180 neighbours participated in the collective experiments ranging in age, educational level, working and civil status. Although the city's public spaces turned out to be widely accessed and used, the majority of participants to the experiments (64%) claimed for some sort of improvement, confirming the concerns of the students of Col·legi Sant Gabriel.

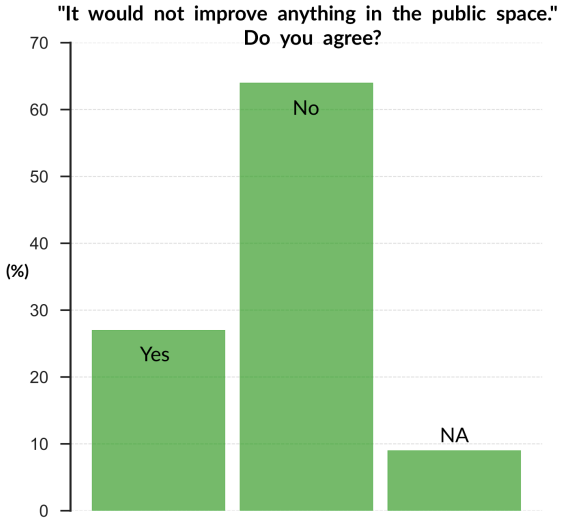

Figure 10. Degree of satisfaction with the public space.

Belonging Most neighbours (47%) showed a strong sense of belonging to the public space of the city. When deciding how to use the virtual money gained in the experimental game, the majority (30%) would invest it for the reform of the Rambla Modolell, the city's main peatonal street.

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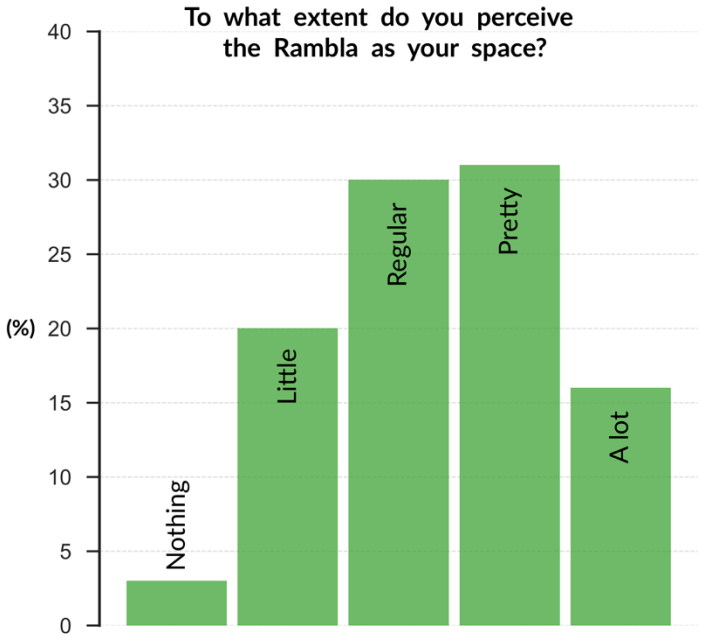

Figure 11. Sense of belonging.

Concrete proposals By the end of the experiment the volunteers suggested and recorded concrete proposals (154) for the improvements of the city's public space, among them: *"More places to sit and too much traffic noise. It should be completely pedestrian ", "More commercial activities: there are too much bars", "Fix the sidewalk. Green spaces are missing".*

Synergies Representatives of the local government actively followed up the students research process and included the final results in a participatory open call for citizens suggestions and proposals to reform the Rambla Modolell.

Counteraction A group of local activists on the occasion of the experiment filled the paving of the Rambla Modolell, namely the rifts on the asphalt damaged or in bad conditions, with yellow graffiti. They made evident the demand for improvements of the urban public space and claimed for reforms to the city's boulevard, in an apparent state of decay, complementing the students' call to action.

II.4.2. Palaio Faliro case study

The concerns of the students of the 4th General Lyceum (Palaio Faliro, Greece) which emerged from the co-design process related to coastal pollution, mirroring an ongoing debate about the consequences of a recent oil spill that affected Palaio Faliro as well as the neighbouring cities' coastal landscape.

The students thus designed and run a collective experiment in the local pedestrian sidewalk by the sea. They invited their neighbours to play games and answer some questions in order to promote environmental awareness and activism in a participatory way.

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Students performing the coastal clean-up action related to the public space experiment. Palaio Faliro, May 2018.

Mobilization Overall, 156 neighbours participated in the collective experiments ranging in age, educational level, working and civil status.

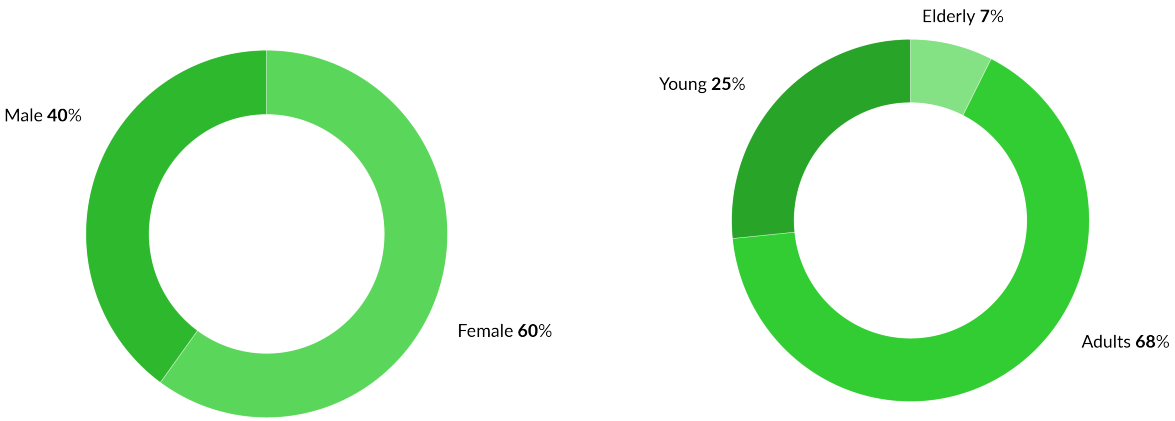

Figure 12. Gender and age experiment Palaio Faliro (n=156).

Awareness Most neighbours (46%) perceived the coast of Palaio Faliro as somewhat polluted, sharing the students' concerns.

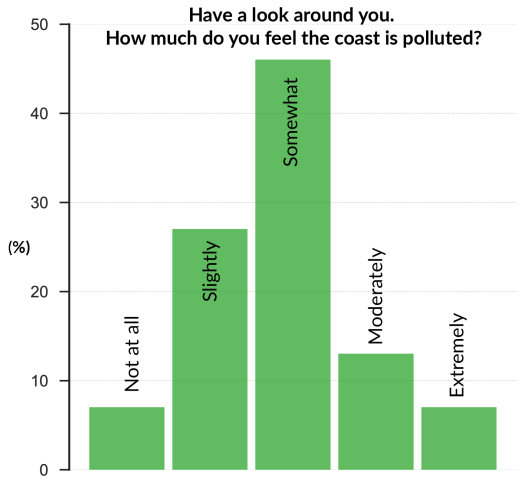

Figure 13. Coastal pollution. Perception of coastal pollution among the participants (n=149) of the experiment in Palaio Faliro.

Stewardship The majority of volunteers (77%) were somewhat to extremely convinced that the experiment could provide useful evidence to promote societal changes, and were somehow to strongly motivated by the game to reconsider their environmental habits (67%).

Synergies The mayor of Palaio Faliro participated in the experiment and started a dialogue with the students. An official report about the scientific results of the experiment was also drafted and circulated among the students[3].

Counteraction Many participants to the experiment (39%) expressed their willingness to volunteer in coastal clean-up activities and to help the students whom, the week following the experiment, engaged in an environmental action and cleaned the beach of Palaio Faliro.

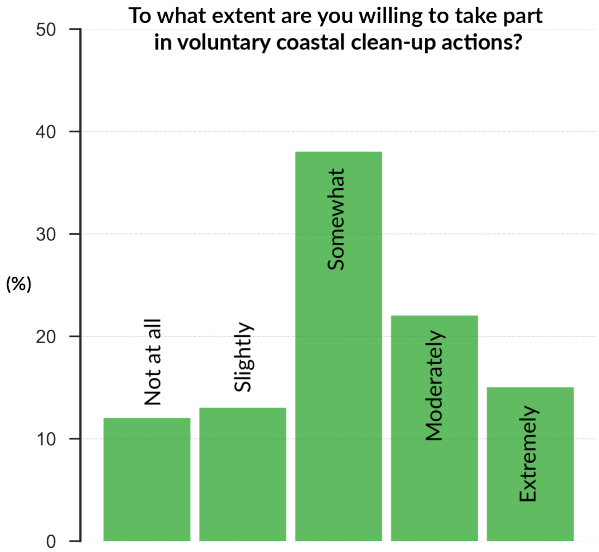

Figure 14. Coastal clean-up action. Intention to participate in the voluntary environmental action (n=149).

[3] Vicens, Julian, Cigarini, Anna, Bonhoure, Isabelle, & Perelló, Josep. (2018). Report Games xPalaioFaliro. Zenodo. http://doi.org/10.5281/zenodo.1475279

II.5. Dissemination

The results of the Citizen Science introduction were widely disseminated, in the scientific community and among the general public. Videos[4] in 3 languages (Spanish, Catalan and English) were also prepared in order to guarantee that the experience could be shared with a large public and over a long time.

Scientific difusion
13 scientific conferences in Europe, United States and South America. 2 peer-reviewed articles[5],[6] 2 self-archived open documents in Zenodo[7],[8] 5 Open Data sets in Zenodo.

Press coverage
2 Newspaper articles (1 in Spain, 1 in Greece) 3 TV News (Spain)

Dissemination to the general public
1 short talk in Barcelona Science Festival (Barcelona, May 2017) 1 conference in “III Encuentro de Ciencia Ciudadana. Los ciudadanos protagonistas de la Ciencia” (Madrid, March 2018) 1 workshop with students and teachers in Barcelona Science Festival (Barcelona, June 2018) 1 conference in Pint of Science 2018 (Barcelona, May 2018)

[4] Games For Social Change. Video released on Vimeo: https://vimeo.com/293960428
[5] Senabre, E., Ferran-Ferrer, N. & Perelló, J. (2018). Participatory design of citizen science experiments. *Comunicar* 26, 29–38 https://doi.org/10.3916/C54-2018-03
[6] Perelló, J., Ferran-Ferrer, N., Ferré, S., Pou, Toni & Bonhoure, I. (2017). High motivation and relevant scientific competencies through the introduction of citizen science at Secondary schools: An assessment using a rubric model. In Citizen Inquiry Synthesising Science and Inquiry Learning, Routledge, Oxon, United Kingdom, pp. 150-175. https://doi.org/10.5281/zenodo.1156535
[7] Couso, D., Simarro, C., Perelló, J. & Bonhoure, I. (2018) 10 ideas to include the RRI perspective in STEM education. https://doi.org/10.5281/zenodo.1303805
[8] Vicens, Julian, Cigarini, Anna, Bonhoure, Isabelle, & Perelló, Josep. (2018). Report Games xPalaioFaliro. Zenodo. http://doi.org/10.5281/zenodo.1475279

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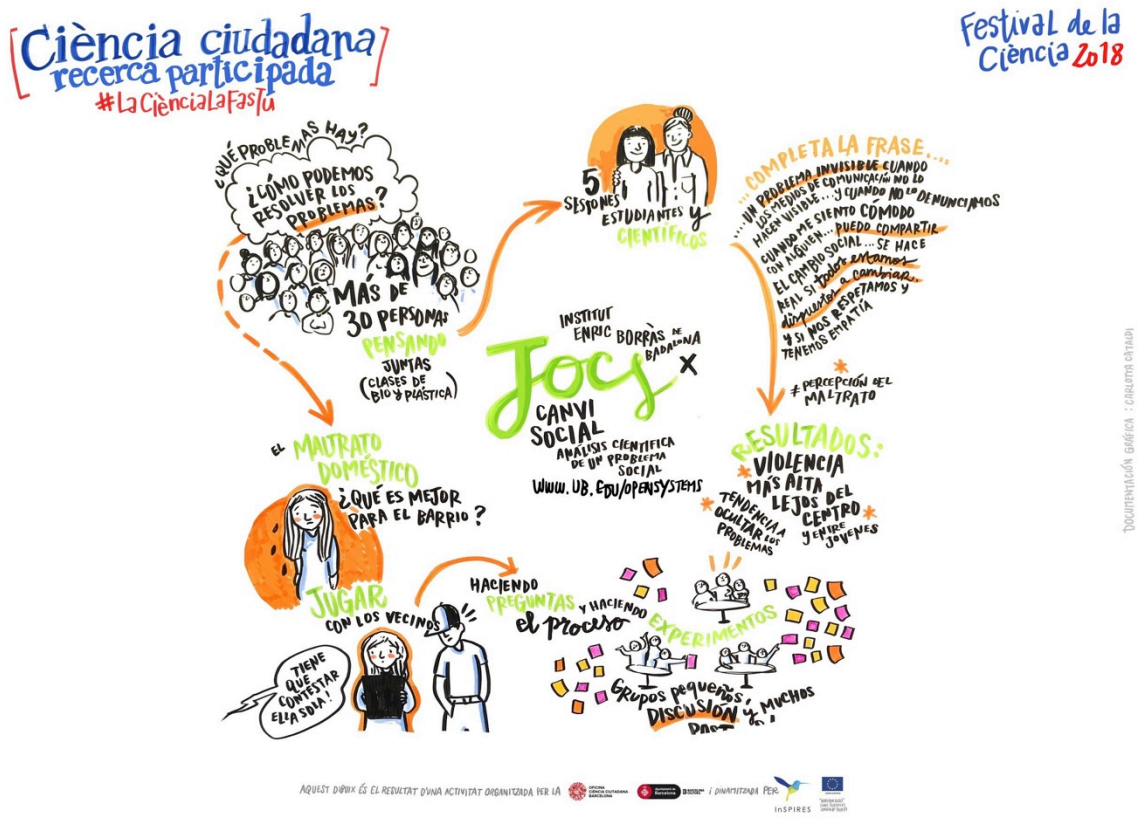
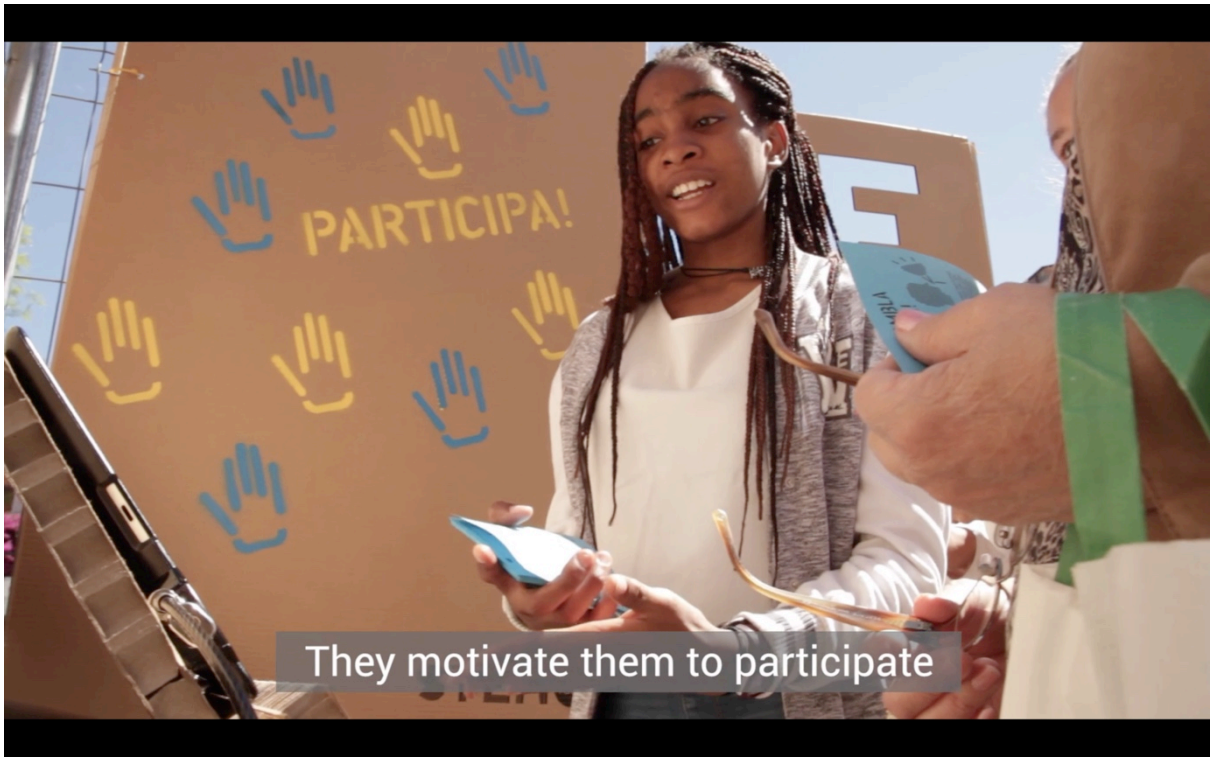


Graphic reporting of Badalona students and teachers explaining their experience of StemForYouth during the Barcelona Science Festival (Barcelona, June 2018).



Games For Social Change Video (Vimeo).

II.6. Long-term impact

Experience of the several pilots has allowed to develop a tested toolkit that can go beyond school and educational contexts. The toolkit will be left open to any organisation or group that wants to start a citizen science collective research under the form of an intervention in the public space. Main aspect to be underlined is that the toolkit primarily focuses on citizen science research on social issues. The toolkit, in its pdf format, is supplemented by several materials such as videos that visually explain the citizen science experiments for social change being developed so far. Collaboration is already envisaged with different partners in order to further implement similar experiences. In the forthcoming months, we will perform analogous actions within different public libraries in Catalonia, thus considering as a leading group of the public experiment the librarian jointly with library users and other local organisations and several areas of the municipality. We also plan to use an identical strategy with youths of a particular neighborhood with low income and with social inclusion issues. This latter experience will be done during the afternoon, out of the school and with a foundation particularly interested in this kind of activities to increase learning and motivation among youngsters.

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III. Conclusions

III.1. Our vision: Games for Social Change, a proposal for Citizen Social Science

We strongly believe that citizen science practices can contribute to improve methodologies in STEM education. What makes citizen science particularly relevant in schools is that it offers a “real” scientific research with clear objectives that goes beyond the competencies and skills evaluation frames inside a given curricula. Our proposal is however not limited to contribute to a scientific research led by scientists. Our intention also has been to invite students and teachers to participate in a co-creation process in a way that the collective research conducted could respond to shared social concerns within a group class and thus promote social change. This effort takes the form of a public intervention: the students,part of the research team, invite neighbours to participate in an experiment able to measure important social traits in specific and local contexts and in the middle of the street. The experiment is thus able not only to contribute to the study of human behaviour in urban contexts but also to encourage evidence based driven collective actions and policies.

III.2. Outcomes of the introduction of Citizen Science at school

The general objective of WP4 “Citizen Science at School” was to pilot the introduction of the Citizen Science concepts and methodologies at school. The pilot was meant to test the ability of Citizen Science to increase the students’ participation and motivation for STEM learning while responding to the demands for societal participation and engagement in research and innovation processes.
The effort wanted on the one side to offer an original methodology to easily involve the students from the very early stages of the scientific inquiry, and to increase their motivation and engagement in the process of scientific knowledge production. On the other side, the project also aimed at moving out of the classroom to transform the public space into a space for action driven by the students, and to prompt a collaboration between the students, their neighbours, and city representatives for the collective discussion of concrete solutions to the city’s dilemmas based on scientific evidences.

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III.2.1. Opportunities

Innovative educational methods The Citizen Science toolkit allowed the students to actively practice scientific reasoning (the formulation of a research question, the research design, and the data collection) in an attractive and original way.

Societal relevance Participative design methodologies ensured the students' research projects (research question, research design and data collection) be fully aligned with their social concerns and local challenges.

Ownership The opportunity to design and run a real experiment in their neighborhood turned out to be particularly successful for the students to take ownership over the process of scientific inquiry.

Motivation The early involvement of the students within the research process and a collaborative work with the peers on concrete social concerns boosted high levels of motivation and commitment to the research projects.

Empowerment A horizontal approach that placed the students at the center of the research process challenged traditional power dynamics typical of formal science education, enhancing the students' empowerment.

Everyone can become a scientist Student motivation and self-identification with someone who could actually do science were the most valued strengths of introducing Citizen Science in the classroom according to the teachers.

Transdisciplinarity The co-design and implementation of a scientific experiment pushed the students out of their comfort-zone and stimulated the acquisition of new transversal skills, including social and civic competences, and experience in team working.

Local expertise The students acted as local 'experts' about the city context and practices, whose concerns mirrored the same concerns shared by their neighbours.

Public and reflective experimentation The students great commitment and motivation inspired a large public mobilization to the collective experiments, atypical in similar but most traditional laboratory experiments. The participants to the experiments were faced with the students concerns, and challenged with a call to action.

Inclusive evidence The co-creation and collective experiments situated the data collected in relation to the broader local context, drawn from a more heterogeneous 'ordinary citizen' population. This also entails embracing the uncertainties and pitfalls, including bias and measurement error, of generating socially relevant scientific knowledge.

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III.2.2. Challenges for the future

Data processing A delayed data processing of the experimental evidence slowed down the process of dissemination of the results and discussion of concrete proposals for community action.

Result interpretation Due to time constraints challenged by formal classroom curriculum activities we did not foresee the students engagement in the data interpretation process nor in the collective discussion of the results obtained.

Teachers empowerment The reinforcement of the role of teachers as 'facilitators' (what the toolkit is meant to encourage) might have inspired and enhanced teachers' commitment to unusual, transdisciplinary and creative working modes.

Curricular fitting These types of project and approaches, being highly transdisciplinar, can hardly match with the curriculum and entirely rely on the proactivity of the involved teachers. Some transdisciplinar activities should be included in the curriculum.

Evaluation assessment The lack of a predefined evaluation strategy when dealing with citizen science interventions and social impact.

Ethnographic insights An ethnographic analysis could have provided valuable insights into the context-sensitivity of the co-design and collective experiment processes.

Measurable social change Because of the complex and gradual nature of social change, quantifiable aspects of social transformation and community impact following the collective experiments were hard to assess.

Comprehensive vision Given the exploratory character of the pilot, a comprehensive strategy capable to speed up the scientific and social impact of the collective experiments was missing.

Follow-up The structural constraints of the academic year (i.e. the gap ESO-baccalaureate or baccalaureate-university, elective periods) impeded a systematic follow-up of the project implementation and outcomes with the students.

Local synergies The involvement of public administrations since the very beginning of the students research projects could have facilitated the inclusion of the evidences gathered into local governance debates.

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III.3. Recommendations for teachers and scientists

- Citizen Science in its most participatory mode of engagement provides a fresh and attractive framework for students to actively practice scientific reasoning.
- Keep in mind that teachers empowerment and appreciation of Citizen Science principles is key to successfully move classroom practices from teach & tell textbook oriented towards inquiry-based science teaching.
- Include Citizen Science within classroom curriculum and make sure to have enough time at your disposal to cover all phases of the research process, before and after the experiment!
- Be aware that scientific and social objectives, however ambitious, need to be clearly defined and stated at the beginning of the research process for coherent evaluation assessments.
- Administrations, NGOs, associations and any other kind of actors of change should be explicitly identified and be more actively involved in the research process development from its very early stages.
- The success of the process depends on the level of trust and respect achieved among participants, based on a horizontal relationship where all share the power. In this case, the students are central actors of the research activity.
- It's good to build a Citizen Science community of teachers where different projects can exchange and learn from each other!
- Consider social change as a possible outcome of students engagement and a way to motivate and engage them more as well as to increase STEM careers attractiveness for different types of students.Include some transdisciplinar spaces, not based on specific curriculum contents, where projects like this one can be an effective way to weaken students' genuine curiosity for STEM.
- Citizen Science experiments become an excellent opportunity to those students that have more difficulties to follow STEM classes. They are able to find their own way to learn STEM topics in a genuine hands-on experience with a "real" scientific research and they increase self-esteem and self-confidence.

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