COVID-19 and Higher Education: Crossed Perspectives in the Construction of Knowledge and the Rise of Citizen Science. Theoretical reflections and practical approach in the 11th Encounter of CeiED researchers.

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Ensuring that learning is participatory and even further democratized seems particularly important at a time when people are kept apart because of a COVID-19 pandemic that thrives on proximity. Whilst learning is based on exchanges, it also benefits from the existence of a learning community, the access to which needs to be equal and taking account of learners' diversity. How is Higher Education equipping itself to adapt to new learning conditions? How can it ensure that it can meet new types of needs? To address these questions, a workshop was organized at the Interdisciplinary Centre for Research on Education and Development (CeiED), Lisbon, on an emerging area of research called 'Citizen Science'. Citizen Science has been gaining popularity in many disciplines. Here, we are interested in how it could help to improve education and learning, as well as how current research in education might also help approaches in Citizen Science to move forward. Reflections on theory were carried out in parallel with a one-day practical online workshop on 'operationalizing Citizen Science', involving researchers in the center's three areas – education, museology, and urbanism. This article explains the outcomes of this event.

Keywords: Citizen Science in education; distance learning; inclusive social learning; Design Thinking practices.

Introduction

In July 2021, the annual research meeting of the Interdisciplinary Research Centre for Education and Development (CeiED) involving its three areas of interest (education, urban planning, and museology) focused its 11th edition on Citizen Science (CS). Entitled '*Do cientista cidadão a ciência cidadã: olhares cruzados na construção do conhecimento*' (From Citizen Scientist to Citizen Science: Crossed Perspectives in the Construction of Knowledge), it encompassed, on top of plenary sessions, a visual art exhibition, a series of parallel sessions dedicated to doctoral research and a one-day practical workshop on design thinking and operationalizing CS. The latest were organized around various themes which triggered specific questions in relation to CS. The dialogical process between the various components of the conference was based on questions triggered by the COVID-19 crisis and the need to improve teaching and learning conditions in a world

where students are gaining more and more autonomy whilst still needing to belong to a supportive community of learners and teachers.

For a new approach inspired by CSto unfold in a satisfactory, professional, ethical, and scientifically rigorous manner, initial and open debates about its objectives, usefulness, methods, and beneficiaries are necessary. Based on this great aggregating theme, CeiED invited doctoral students, researchers and professors in Education, Urbanism and Museology, to participate. The objective was to highlight that, thanks to a wide range of Information and Communication Technologies (ICTs) and the will to build knowledge differently and to understand better each other's perspectives, 'learning experiences' and, by extension, 'education systems' could be enriched, and approaches such as CS could help to do so. Table 1 presents how the CeiED's research relates to CS.

Table 1
Links between CeiED's areas of research and Citizen Science.

Term	Useful references	Description	Relevance for research in Citizen Science
Museology	Pierroux (2020); Hetland et al. (2020); Noel-Cadet and Bonniol (2015); Atwood Mason (2014); Sancho Querol (2021)	The study of the history of the museum institution and of its changing role in the society during centuries. (Dictionary IGI Global)	The shaping of societies and mentalities occurs, partly, through culture. Citizen Science encourages the creation of inclusive museums that can reflect and express people's needs, art, and aspiration.
Urbanism	Franco &Cappa (2021); Simon et al (2022); Paulos (2009); Colston et al. (2015); Roger and Motion (2021); Saundlers et al (2018); Soanes & Lentini (2019).	The study of how inhabitants of urban areas, such as towns and cities, interact with the built environment. (Dictionary IGI Global)	Research in urbanism is seeking ways to make urbanism more 'social' and participatory i) in view of making it more democratic and ii) to benefit from people's knowledge and encourage the co-creation of urban spaces.
Education	Roche et al. (2020); Golumbic & Motion (2021); Hitchcock et al. (2021); Mitchell et al. (2017)	The process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and of preparing oneself or others intellectually (dictionary.com)	Reforms in education encourage moving away from the 'transfer of knowledge' from experts to 'non-experts', aiming to value different types of knowledge, forms of learning, and informal versus formal education.

Pedagogical approaches	Kloetzer et al. (2021); Bonney et al. (2009b); Crain et al. (2014); Herodotou et al. (2028)	Educational decisions made by the instructor to support student learning, engagement, and instructor-student, student-student, or student-content interactions (Dictionary IGI Global).	Reform in pedagogical approaches encourage inclusive processes through debates, teamwork, experiential learning – all investigated in Citizen Science – in order to expand the field of knowledge and scientific literacy.
Participatory approaches	Pateman et al. (2021); Bonney et al. (2009a); Skarlatidou & Hacklay (2021); Freire (1987); Krazny & Bourney (2005) https://www.participatorymethods.org/page/about-participatory-methods	Participatory methods (PMs) include a range of activities with a common thread: enabling ordinary people to play an active and influential part in decisions which affect their lives.	With CS, people become better heard, their voices shape outcomes. Because respect for local knowledge and experience is paramount, the result is interventions that reflect local realities with better supported long-lasting social change.

This annual meeting not only constituted an important moment of knowledge sharing among the Center's scientific community, but it was also a reminder of the relevance of our individual efforts and our collective contribution to a science centered on the common good, cognitive justice and citizenship. This paper presents our conclusions and findings. The results from the thematic debates are presented in Part 1, whilst Part 2 focuses on our attempt to operationalize CS using an online participatory 'mural' involving students based in different countries to reflect on learning and teaching conditions and requirements in a 'hybrid' world where universities are physically semi-open because of the pandemic.

Theoretical considerations

The emergence of Citizen Science

Citizen Science (CS) established itself as a field of research and practice in the 1990s and refers to the active engagement of the global public in scientific research tasks. It emerged from a variety of participatory approaches that had already been developed, illustrating a strong need to not only democratize decision-making processes and involve people who would be holding projects but also to improve the quality of data gathered when making policies that lead to societal changes (Vohland et al., 2021). Originally conceived as a way to facilitate good quality large-scale data gathering, CS has now the potential to revolutionize how we envisage education (Aristeidou & Herodotou, 2020; Hitchcock et al., 2021; Mitchell et al., 2017) and learning processes (Kloetzer et al., 2021; Herodotou et al., 2018) as well as scientific research and its impacts (Krazny & Bonney, 2005; Schaefer et al., 2021). Whoever provides data as part of scientific research should also have a say concerning the scientific approach, and the benefits research should bring. The collective creation of knowledge through exchanges between experts and practitioners is

questioning roles and giving a voice to those who, despite often being viewed as the 'passive public', often know best. For this reason, CS is considered as encouraging social inclusiveness, on top of contributing to enriching the 'sharing of knowledge' already boosted through the use of ICTs (Hacklay & Francis, 2017; Pateman, Dyke & West, 2021; Skarlatidou & Hacklay, 2021). Traditionally used in natural sciences, CS is now extending its range of activities to social sciences and gaining popularity, including in areas related to education and the construction of knowledge (Crain, Cooper & Dickinson, 2014). Research in all disciplines could benefit from it and contribute to its advancements – the question is how. More specifically: How do we (methodologically) organize inclusive and fair participation and the representation of perspectives and needs? How can we ensure that sensitive data remains confidential, that being an enthusiastic participant doesn't make you a cheap source of extensive "big data", and that your opinion is correctly interpreted? How do we integrate the principle of reciprocity at the beginning of the project so that participants really benefit from the research projects being carried out? How do we make scientists admit that they also (not just the participants) benefit from the participatory process of CS in the co-creation of knowledge? How can CS contribute to reforming learning processes and the education system?

Bonney et al. (2009), who started working on the potential of linking CS to the field of science education and learning more than ten years ago, put a special emphasis on Informal Science Education (ISE) – an insightful improvement of the PUS ('Public Understanding of Science') concept, born in the 1940s and 1950s, which was mainly focused on the "delivery of content rather than on helping the pubic experience and understand the process of research" (p.10). To address this concern, Bonney et al. involved citizens in the co-creation of knowledge through PPSR projects (Public Participation in Science Research) and through non-formal education and reviewed a wealth of scientific projects that successfully generated knowledge over the long run. The experience they relate is also inspiring for more formal education settings and could, in particular, contribute to reforming interdisciplinary education on sustainability, for instance. Higher Education institutions still do need to improve such an area which has, so far, been presented in way too conceptual manners to students who do not see a clear link or relevance with their life and needs and are not invited in the co-creation of knowledge in this field (Brundiers et al., 2021). The benefits to students that CS could bring by better being integrated into Higher education have been explored by NASEM (2018) which mentions, as part of those, an increase in students' engagement, opportunities to engage students in authentic research, bringing an applied relevance to the content of the courses, introducing students to the principles and processes of research activities, and creating pathways for inclusion of science in students' lives outside of courses. These benefits, especially the improvement of students' learning and skills acquisition through CS, have been further explored by Hitchcock et al. (2021).

Corroborating what we discussed during our research meeting, Roche et al. (2020) highlighted that important challenges still exist when integrating CS in Higher Education, further enhanced by the COVID-19 pandemic. The authors identified several dilemmas facing the field, "from competing for scientific goals and learning outcomes, differing underlying ontologies and epistemologies, diverging communication strategies, to clashing values around advocacy and activism". They also stressed that "Although such challenges can become barriers to the successful integration of CS into mainstream education systems, they also serve as signposts for possible synergies and opportunities" (p.1). They key objective is to find ways to reform educational practices and settings in constraining pandemic times to empower citizens to take ownership of their science education and learning.

Thematic sessions

Doctoral students were invited to present their work and explain to what extent it related or could relate to Citizen Science. After receiving all proposals, it became clear that we could group the various works into various thematic sessions. We entitled the latter as it follows: Teaching profession: the educator's perspective; Inclusion; The role of education and learning for societal changes; Learning, professional training, and difficulties and constraints in becoming a learner; Pedagogical approaches; Participatory approaches; Learning with ICTS. You will recognize these groupings and titles in Table 2. They included work on education, urban studies, and museology, the three PhD programs of the CeiED.

Linking CeiED doctoral work and Citizen Science

To animate discussions that would help people relate their work to Citizen Science, a series of reflective questions were suggested to the moderators that emerged from an analysis of the references (see Table 1) on each area of research of the CeiED linked to CS by the author. These were intended to help moderators to trigger discussions. The seven axes that we focused on were identified after collecting the various presentations and grouping them in ways that would enable an interdisciplinary exploration of CS, linking doctorates in education, urbanism, and museology. These questions are presented in Table 2:

Table 2
Linking CeiED doctoral research axes with CS considerations

Questions raised on the theme of 'teaching profession: the educator's perspective':	**How is this issue generally perceived and treated in theory and practice in CS?**
Are educators facilitators of learning, or do they transfer knowledge? Are urban planners participating on an equal footing with other stakeholders in a social urban approach? New advances in museology invite people to participate in museum life and exhibitions: are 'spectators' really part of the exhibition itself? How do actors who facilitate a participatory process position themselves in the process? Can CS help key actors in education, urbanism, and museology to better understand what their role will be if their research involves more citizens' participation?	In CS, the role of the facilitator is difficult. Whoever initiates an action-research project occupies a difficult position, remaining on the sidelines, but nevertheless having to be active in the participatory process in which everyone needs to be involved. While "participatory processes" can encourage people's participation from start to finish - to impact public policy -, there remain some important boundaries to appreciate and respect. A decision-maker has been trained to make decisions. A participant, while enjoying being involved, may not want to be placed in the position of a decision-maker.
Questions raised on the theme of 'inclusion':	**How is this issue generally perceived and treated in theory and practice in CS?**
Can CS approaches help research towards a more inclusive perspective? Reciprocally, research in education, museology and urbanism can offer some illustrative examples of inclusion that can enlighten CS research from the perspective of: Methods (How to be more inclusive and how to encourage inclusion? How can you be sure that everyone can express themselves equally?); Motivation; Ethics and reciprocity:	CS is concerned with ensuring that groups of citizens –generally silenced in one way or another - can be realistically integrated and express what they think, know and need. The question is how to invite and motivate them to participate; do some people need training, or better access to technology; do they speak the same 'language'? How can they feel welcome? Genuine inclusion in CS is difficult to perfect and requires honesty, trust, conflict negotiation

How can we ensure that all participants get the same benefits out of working together?	skills and a very clear sense of the importance of inclusive processes in society.
Questions raised on the theme of 'participatory approaches':	**How is this issue generally perceived and treated in theory and practice in CS?**
In education, urbanism and museology, the value of participatory processes is increasing, albeit in different forms and degrees for all three domains. Can these three areas learn from each other in terms of participatory approaches? Can they be used as examples of application of participatory processes to demonstrate the usefulness of CS in different areas of research? Or, to illustrate the various ways CSs carry out different domains, applications and with different stakeholders? Can different types of citizen participation be identified to contribute to "different types of scientific results"?	CS includes several participatory approaches. In some of them (in particular contributory CC), participants provide specific information without being in contact with other participants, nor necessarily knowing how the data provided will be used. In other approaches, it is agreed from the outset that the participants will be part of the discussion about the process of analyzing the results, their dissemination, and the final objective. The participatory approaches used undoubtedly affect the participants' motivation, the quality of participation, whether they remain in the process until the end or not, etc. The success of CS depends on the quality of participatory processes.
Questions raised concerning 'the role of learning in societal changes':	**How is this issue generally perceived and treated in theory and practice in CS?**
Will greater participation in research help with social change? Many recent research initiatives have proven that social projects do not go very far if people do not have the autonomy to appropriate projects, from their conception to their completion and long-term maintenance. This is often the reason for encouraging more participation. Has this been demonstrated in the areas of education, urbanism and museology? For example, does participatory urbanism help to create more sustainable cities? Will social change be more successful if initiated as bottom-up, top-down, or participatory processes?	In some CS projects, the value of citizen participation is considered as important not only because policy makers have realized that many people in the general public have a certain practical knowledge and know-how that they themselves do not have and that that specific knowledge is necessary in making certain decisions to transform society, but also because these people can bring really useful insights into how social change can be encouraged. Enabling and inviting CS Project participants to give their opinion on general changes in society, rather than merely being asked to provide data is important – though not generalized for all CS projects.
Questions raised on 'lifelong learning, professional training, and difficulties and constraints in becoming a learner':	**How is this issue generally perceived and treated in theory and practice in CS?**
Being a student in an educational institution can present some 'barriers to entry' and it can be difficult to overcome them. Do more participatory forms of education present the same barriers?	Deciding to participate in a CS Project can be difficult and uncomfortable, but it can also be just the opposite. Once involved in it, staying involved in it all the way through can also be challenging.
Questions raised on the themes of 'pedagogical approaches':	**How is this issue generally perceived and treated in theory and practice in CS?**
To what extent is "participation" taken into account in learning approaches? How is it reflected in new pedagogical approaches? Participation and pedagogical approaches are designed to encourage it by questioning	The process undertaken from the beginning of a CS project to the end can vary considerably. Some CS projects encourage citizen participation throughout the project, while others view "participation" as the discreet

the roles of participants (are there still experts vs students or do we all have something to learn and teach? How is this reflected in the way we share and learn? Can pedagogical approaches compromise participation?	provision of data by participants (Contributory CS). The "pedagogical" approach used in computer science can strongly affect people's motivation to participate, as well as the trust built with Project facilitators. Citizens need to feel that the value of their contribution is recognized.
Questions raised on the themes of 'learning with ICTs':	**How is this issue generally perceived and treated in theory and practice in CS?**
Does technology facilitate exchange of perspectives, knowledge and know-how, discussions between different types of students who do not normally learn together? Are teachers/educators as technologically literate as their students? Learning processes are changing – because of the pandemic, but also of a whole range of new online tools. Do technology-enabled learning experiences automatically promote citizens' involvement in social change? If so, how are the online learning experiences connected?	In CS, digital technologies are widely used (Apps, online participatory platforms, participatory Geographical Information Systems, etc.) and are considered ways to make citizen involvement easy and even inviting (because 'access' to participation is in the hands of the citizens, mixing data, words, images, videos. However, issues such as digital divides or technological literacy (or illiteracy) may exclude some. In the case of complex problems involving various and different stakeholders, conflict management and negotiating online techniques might be needed.

Conclusion on the outcomes of the discussions on existing research at the CeiED
Each parallel session led to very rich debates and exchanges of ideas. Moderators orientated those towards feeding a reflection on the link between research being carried out at the CeiED and research on Citizen Science. The outcome of such reflection is presented below, for each of the parallel sessions.

In the session focused on the *teaching profession: the educator's perspective*, several participants referred to the beneficial changes brought by the COVID-19 pandemic, particularly the change in methods and the broader use of digital tools. For many, CS is a way of humanizing the teaching-learning process. The teaching profession must be part of this and become an agent of transformation and transmission of science. Within the 'construction of knowledge' process, teachers have a fundamental role to play in the training of participative and active citizens. Teachers and schools (although they often feel their role is not valued) are an essential part of creating a more reflective, critical-thinking society.

The session *inclusion* emphasized the call to better communicate the results to citizens participating in research projects, and the importance of putting knowledge at the service of all. A citizen-centered research calls for qualitative research methods or, when such methods are adopted, these intend to contribute to a better knowledge of socio-educational phenomena and, consequently, to serve as a basis for inclusive interventions. This session gave further insights into the need to improve the contexts and practices of inclusive citizenship, paying attention to ethics and data protection, and that the trans-nationality and transculturality of research focuses and instruments are useful dimensions for inclusive citizenship.

The session *the role of education and learning for societal changes* focused on learning processes (inside and outside educational institutions) and their impacts on society. Participatory approaches that could improve learning and social change were explored. For instance, the project "Museum as Social Technology" looked at CS, social technology,

and social innovation while emphasizing that the place of technology is not of digital technological resources, but of knowledge sharing processes, knowledge accumulation, collective and participatory construction, and acknowledging these methods as technology. These themes, as well as the interest of students in developing skills from «experimental learning», were also explored in another project on urban agriculture and sustainable cities, which highlights the fact that, without the contribution of CS, it will be difficult to make cities 'sustainable' in socially meaningful way. The project on eco-museology reported the importance of the *territory* and co-creation alongside the potential of CS to increase their values. The project International Movements for a New Museology, with a focus on Latin America, stressed the role and (missing) place of women, native peoples, Quilombolas, and Afro-descendants and the importance of reciprocity of knowledge between academia, museums, and civil society.

From the session focused on *learning, professional training, and difficulties and constraints in becoming a learner* raised the call for acknowledging that, in the various institutional training processes, people and their individual learning processes are deeply articulated with collective objectives. Listening to people's various experiences is thus crucial, and this can be done through interviews, questionnaires, or other tools. Other related themes addressed the experience of initial or continuing educational courses, community inclusion in the construction of knowledge, the role of families in teaching and learning, and the need to create stronger links between educational centers and other institutions and stakeholders.

The session on *pedagogical approaches* concluded that CS is best used if there is an evaluation of investments made (in education and museums), and the life experiences and previously constructed knowledge should be better integrated into learning. Both make the call to turn the process reflexive and become part of pedagogical processes. Other issues raised are the interconnections between the various dimensions of the territory and the school along with the various dimensions of social inequalities, which once better understood could be better integrated into learning, which in turn can lead to the creation of social identities.

To sum up the core of lessons and practical advice from the debates, we can see first, CS as an umbrella platform under which incipient issues and «old acquaintances» emerge and overlap. Second, the discussion and experiences stressed the importance of *participatory approaches* in all three areas (education, museology, and urban planning), and third, to face the challenges and opportunities digital advancements for the production of knowledge. This is especially important as digital and mobile technologies are increasingly becoming ubiquitous, and their usage is becoming more than task- and work-related, as pointed out in Smaniotto et al. (2019). *Digital and mobile technologies* are opening more and new opportunities to *facilitate participatory processes*; this is associated with both positive and problematic aspects, such as lack of access to technologies and unequal perception of ICTs' potentials. Under this guise the following needs are identified:

- To develop methodologies and strategies that help ensure processes that are really participatory.
- To establish the dialogue and sensitive listening, traced back to authors such as Paulo Freire (1987). This is also associated to the call for crafting dialogue strategies and joint activities between different stakeholders, museums, and schools, in order to foster and enhance mixed types of learning.

- Involve the community in the processes of collecting, interpreting, and reflecting on decisions and actions relating to them since the construction of the city, society and care for the environment are issues that concern every single person.
- The importance of deconstructing adult-centered actions and exploring the agency of vulnerable groups, such as children, elderly, native peoples, minorities, etc., for a more complex and wealthier socio-spatial development.
- The way in which collective artistic practices can be an efficient way to empower disadvantaged communities. Urban art projects can develop social relevance (through the visual and thematic content they produce and through the collective bond they create) and deliver important working principles for CS.
- To rethink the role of cinema in today's society, beyond entertainment, as a factor of critical thinking, of participation, and as a promoter of social relationships. The preservation of cinematographic heritage can be understood as critical citizenship.

Finally, the debates underlined the need to re-examine the philosophy and methodology at the base of each discipline. The awareness of these needs and the principle to return the results of studies and research to society calls for improving education and setting CS into a reflecting pedagogy, both reinforce the multidimensional nature of CS.

Operationalizing Citizen Science: the example of the Hackathon

CS in practice

In view of making this event both stimulating conceptually and theoretically but also practical and more lively, we decided to carry out a practical activity that would involve the participation and creativity of all. Since the CeiED is, above all, concerned with modes of learning, how these can evolve and under which circumstances, and how learning goes beyond educational science towards more interdisciplinary approaches (the CeiED is, indeed, the *Interdisciplinary* Research Centre for Education and Development), we focused on an activity where all of us would learn from each other. In our view, CS is mainly about this: improving our collective knowledge to improve decision-making in society (Vohland et al., 2021) and helping each other to improve our understanding of each other's' perspectives and needs.

The CeiED has not developed a specific CS method, or tool (yet). Contributory CS (Poisson et al., 2019), traditionally used in natural sciences, invites participants to provide specific discrete hard data (numbers, statistics) to contribute to overall research, for instance on biodiversity. In other cases, participatory GIS (Hacklay & Francis, 2017) can be used in which participants can provide on-the-ground information that cannot be collected otherwise very easily.

The literature on CS highlights the existence of various interpretations of what CS is about (Eitzel et al., 2017) and, also the fact that there is not one right way to carry out Citizen Science. However, as Heigl et al. (2019, p.1) have stressed, "*CS has amazing potential as an innovative approach to data gathering and experimental design, as well as an educational and outreach tool*". The CeiED aims to explore further how our research could contribute to CS and how we could use CS tools that already exist.

Table 3 gives an overview of terms that are being used during the practical workshop and will help the reader to get a better grasp on their meaning in the context of CS.

Table 3
Key terminology in the practical workshop

Term	Useful references	Description	Relevance for research in Citizen Science
Design thinking	Brown (2019); Razzouk& Shute (2012); Mueller-Roterberg (2018); NASEM (2018) www.sda.ac.uk	Design thinking is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems, and create innovative solutions to prototype and test.	Using design thinking is generally a participatory exercise and facilitates the exchange of knowledge, skills, expertise. It also allows the various participants to get to know each other and to understand different perspectives.
Divergent thinking	Brown (2019) and Service Design Academy https://asana.com/resources/convergent-vs-divergent	Divergent thinking involves creativity to generate ideas and develop multiple solutions to a problem.	The creative process encouraged by divergent thinking allows citizens to be open, to innovate, to take part in the creation of knowledge and to suggest policies and strategies.
Convergent thinking	Brown (2019) and Service Design Academy https://asana.com/resources/convergent-vs-divergent	Convergent thinking focuses on reaching one well-defined solution to a problem.	The narrowing-down process that characterizes convergent thinking helps to crystallize what, in the end, matters most and for whom, and to negotiate strategies.

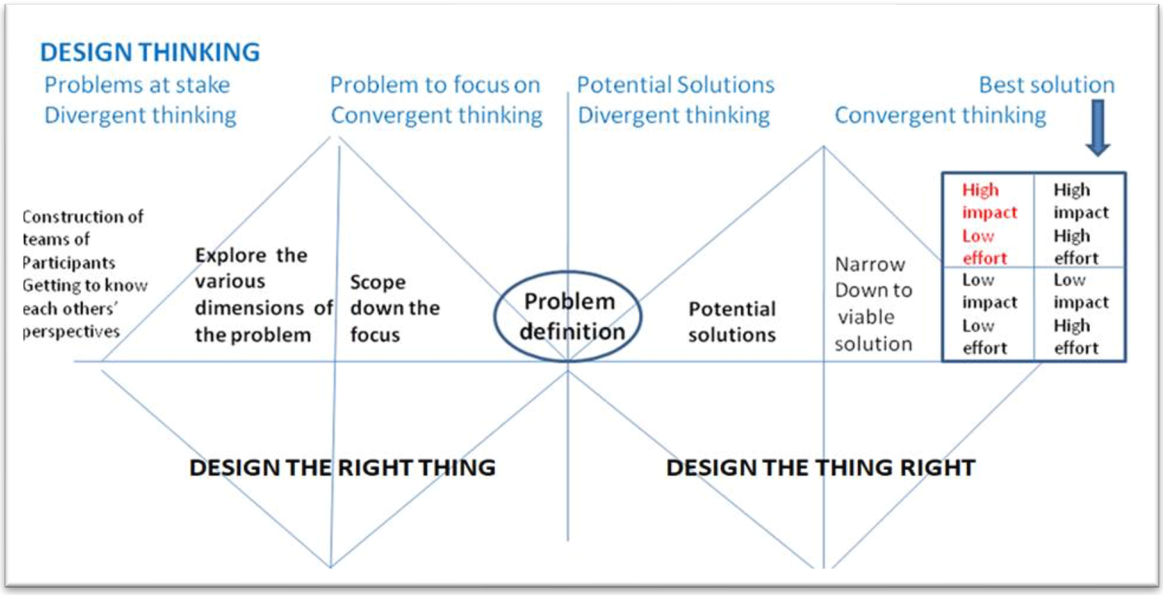
Methodology
The hackathon resorted to designing thinking methodologies and worked on concepts such as divergent and convergent thinking, leadership skills, the use of digital tools, and the ability to creatively present the proposals thought up by the participants for the problems they pointed out. Each team had the support of a facilitator, a member of the Organizing Committee, in guiding and supporting the various steps and tasks of the activity.

Design Thinking (Brown, 2019) can arguably, be considered one useful tool in CS. The use of Design Thinking (DT) (Brown, 2019) can help to identify which solutions could help to get out of a situation that seems to be going no-where by guiding how to both define a

problem (by refining its definition and understanding better various stakeholders' perspectives on this problem), and then, on how to identify a potential solution that responds to people's needs.

The Double Diamond model (Figure 1) derived from this is generally used to visualize the creation process in design thinking, namely, to grasp better the idea of how we move between divergent and convergent; first to understand the problem and then to create the solution.

Figure 1
The use of Design Thinking to identify a high impact – low effort solution.



Source: adapted from Brown (2019) and service design Academy (www.sda.ac.uk)

The idea behind this methodology is to carry out a participatory process that allows stakeholders to think of both many aspects of a problem and many solutions (through 'divergent thinking', where brainstorming sessions are encouraged and people are free to open their imagination), and also to identify which specific aspects of the problem people should focus on and why (this happens during the convergent thinking phase during which more focus is required and understanding from which perspectives solutions will be identified needs to be discussed).An alternation between divergent and convergent phases of reflection, facilitated around specific questions, then leads to identifying the solution with the highest impact and lowest effort.It is on this approach that we decided to start experimenting.

The importance of this practical activity is illustrated by the fact that an entire day was dedicated to it (a third of the workshop event). The idea was to work together on finding a solution to a problem.

Teams
The practice of CS in the 'hackathon' (practical workshop with a presentation of the results at the end of the day) was organized in interdisciplinary teams made of undergraduate,

master's and Ph.D students and CeiED researchers. Throughout the day, the teams worked around a challenge launched by the Organizing Committee, with the objective of choosing a problem in a given context and present respective proposals for solutions to an interdisciplinary jury in three minutes. The activity took place online due to restrictions imposed by the COVID-19 pandemic.

At the end of the day, each team presented the result of its work to a jury made up of experts in the three scientific areas that make up CeiED – Education, Museology, and Urbanism. The jury commented on the proposals and forwarded several recommendations derived from them to the University's management bodies and course directors so that the voice of the participants was considered in the decisions for the following school year.

The challenge

The scenario we suggested our participants to focus on (and extract a problem and derive a solution from) is presented in Frame 1 below. We wanted to make sure that our students could relate to it, have various perspectives on it, and would be able and willing to work on it.

Frame 1

Scenario selected for our participatory activity

Challenge: the so-close/so-far dilemma

Many months have passed since the beginning of the COVID-19 pandemic, the successive confinements, and de-confinements and the abrupt leap to online education that we were forced to make. We are now experiencing a phase of progressive return to face-to-face activities, although we have to maintain a physical distance that the pandemic has imposed.

This dilemma forces us to rethink how we live together and share common spaces, like the university campus, for example. While we have developed strategies for teaching and learning with various online tools, the college campus experience continues to be important to the academic community. It is equally important that we take advantage of all the potential technological tools have to offer.

Within higher education, face-to-face and online approaches need to be carefully balanced so that the experience is enjoyable, productive, reflexive, and social. These precious years also need to encourage students to gain individual and professional confidence as they find their place within the young adult community and progressively build a professional network.

While it is possible to learn at a distance, individually and even collectively, aren't we missing some important dimensions arising from the experiences of «physically learning together»? What will be the new role of the university campus as a physical space in this new context of return to presence? How can we make new uses of this space? How does it mediate the various needs of students - those we have long been familiar with and others that may have emerged from the COVID-19 crisis?

Through this hackathon, we are invited to reflect on the various problems that going back to the university campus raises. We will work together to formulate creative and innovative solutions that can help give new impetus to how we use this physical space that welcomes us as members of a broader learning community.

We will exercise our creativity in small interdisciplinary teams, including undergraduate, masters, and doctoral students, with the aim of putting into practice participatory research

processes in citizen science but also highlight how collaborative research can strengthen our creative capacity, and the opening of mind to the new and the multidisciplinary identity of CeiED.

Guidelines and expected outcome
Some of the guidelines given to support creativity, divergent thinking, and generating lots of ideas included:

- Developing other people's ideas by starting to accept them and investigating possibilities to combine ideas.
- Actively listening to create opportunities to build and elaborate.
- Working on the basis that, to start with, 'more is more'; in the first (divergent) stage - it's all about quantity and it is important to focus on getting as many ideas as possible, rather than striving for really "good" ideas.
- Postponing judgment by suspending inner criticism and resisting the urge to evaluate ideas as soon as they appear. It is important, at that stage, to let the ideas flow and consider them all valid. Analysis time is for later.
- Remembering that the team is everything and therefore making full use of all potential, ensuring that every team member is included.

The expected outcome, out of this process, was twofold. Firstly, we wanted each team to collectively formulate a proposed solution to the problem they selected in the context of the proposed challenge. Each solution was presented to the jury, at the end of the day, in three minutes. Secondly, we also wanted to explore how such a participatory process could work and what lessons could be learned in the context of research on CS and research using Citizen Science.

Students were invited to connect to the conference zoom platform to communicate orally as well to a MURAL platform (resembling Figure 1, allowing people to enter the text as if they were writing on post-its and placing them on a wall during a workshop) to write down their thoughts and suggestions. Each team had its page on the MURAL platform – the interactive work platform where they found information for each process phase.

Results
The tables below summarize the results of the work developed by the different teams themselves, based on the challenge launched:

Table 4
Results Teams 1

	Team 1
Problem	There is a lack of socialization with equity, considering the physical and social distances and the different needs involved.
Proposal	Develop a support network for the technological transition, so that you can become familiar with the different digital platforms and have a virtual environment for interaction by video call, with scheduling for groups.

Benefits	The trait of innovation and understanding of social and cultural differences associated with emotional intelligence as a way of offering interaction through digital platforms, enhancing the use of digital tools, re-establishing social skills.
Competitiveness	Some constraints: Access to digital media; Lack of training for the use of digital tools.

Table 5
Results Teams 2

	Team 2
Problem	Social exclusion at the university in the face of new contexts.
Proposal	Greater solidarity among the university community and economic support for the most vulnerable people. For example, expand the help already provided. The most important thing is to contribute with technological literacies, carry out campaigns to collect food, clothing, make monthly payments more flexible, and help with access to technology.
Benefits	Time for students to organize themselves in general terms, improving their daily lives and adapting to the new social context.
Competitiveness	The team did not comment on this issue.

Table 6
Results Teams 3

	Team 3
Problem	How to guarantee the safety of groups on campus, and maintain a quota of physical presence, of students and teachers, during the school year?
Proposal	. Conduct lectures with students, faculty, and staff. to contribute with their testimonies, on the importance of vaccination. . Raise awareness of the importance of complying with hygiene and safety rules, so that everyone can physically be in college. . Give hygiene and safety kits to students. . Give an incentive in the tuition fee to students who get vaccinated and provide proof of the same, for example 5% of the tuition fee, and that a part of this amount, for example 2.5%, reverts to the fund for vaccination in the PALOPs. . Guarantee a minimum quota of face-to-face classes for those who can attend classes physically, depending on the state of the pandemic.
Benefits	. Education on the problems; . Increased level of trust and security. . Contribution to increasing collective well-being within the university.
Competitiveness	The team did not comment on this issue.

Table 7
Results Teams 4

	Team 4
Problem	How can we get back together at ULHT?
Proposal	. Facilitating the mobility of foreign students: Develop ULHT's interaction with the Ministry of Foreign Affairs and other entities to speed up student mobility. . Respect physical distance needs: Delimit the number of students per square meter. Alternate class days according to each training area . Disseminate information about health care: Post information boards in strategic places. Promote debates on new forms of contact. Improve common hygiene spaces . Implement more friendly procedures in the administrative and academic fields: Improve student service. Expand dialog channels
Benefits	The team did not comment on this issue.
Competitiveness	The team did not comment on this issue.

Table 8
Results Teams 5

	Team 5
Problem	Insecurity
Proposal	Provide accurate and scientifically correct information on bios security measures to address the issue of insecurity for the entire educational community. Raise awareness of the risks and the need to adequately address the pandemic. Improve communication within the school community. Increase the adhesion of the educational community to the return of school activities. Reducing the emotional impact of the pandemic.
Benefits	Avoiding the impact of COVID-19 transmission for the healthy permanence of educational activities.
Competitiveness	The team did not comment on this issue.

Note that the information given in Tables 4-8 was provided by the teams themselves and that the 'competitiveness' component – which really referred to constraints – was only addressed by Team 1. We do feel that the term '*competitiveness*' suggested by the methodology was somehow unclear.

Lessons learned

The collective activity took the whole day, including the presentation of results to the jury. It was a very rich experience that students enjoyed because their opinion was valued and because teams took time to know each other and to understand each other's perspectives. The challenge proposed for the hackathon and the work methodology used was intended to provoke the participants to extrapolate the barriers of the predictable and imagine possible and viable futures for the use of the university campus. At the technical level, it required the simultaneous use of two work platforms, one of which was never used by them. In terms of teamwork, it was necessary to listen to and respect different opinions and reach a consensus in choosing the problem to be worked on and its respective intervention proposal. To all these requirements, we must add the time management of tasks, which must be fulfilled.

Considering this scenario, we noticed difficulties in achieving the proposed objectives, namely in the innovative nature of the proposals, which in general remained at the predictable level, in the context of the personal difficulties of the team members and existing interventions, very focused on the immediate fight against the pandemic. It is possible that the different types of activity requirements, specifically those of a technical level, and the short execution time, influenced these results. On the other hand, another possibility of interpretation can be evoked: our concrete actions are conditioned by the work methodologies of our area of training and performance. In Education, one issue discussed by participants in the activity, the «time-lapses» are longer, and the conceptual changes envisaged over the long run are more difficult to imagine, given the relatively crystallized nature of the effectiveness of educational models in societies and the necessary critical reflection around new educational models and contents.

Despite a few difficulties in carrying out the practical exercise, several positive outcomes should be highlighted. With the hackathon, we witnessed an exercise in the simultaneous mobilization of different skills, from the use of digital tools, the ability to take leadership initiative, to reflect on a current topic, to present intervention proposals in reality, taking a more active and critical stance, and making the voice of students heard.

The role of the facilitator proved to be crucial since negotiation is key to the whole process: people need to learn to clarify their statement(s) and idea(s) and to ask other people to clarify theirs, if needed. Also, even though the mural is quite intuitive and easy to use, this mode of operates is not familiar to everyone and occasionally needed to be further explained. Interestingly, creativity requires time – sometimes more than expected, since people are less used that one would hope to open their imagination and come up with 'as many ideas as possible'. Self-imposed constraints or else constraints imposed by society or others, often limit the range of options and scenarios one could imagine or hope for. Developing the 'divergent thinking' phase, whilst staying focused on the issues at stake, is an exercise itself. 'Converging' seems more in our habits, even though both selecting one specific problem and then, later, one specific solution, still presents its own difficulties – notably that of remaining within the remit of the scenario originally presented.

There is, of course, a high level of subjectivity both in the reduction of all inter-connected problems characteristic of the presented scenario and in the presentation of potential solutions and the selection of the high-impact / low-effort solution. Further research could be carried out to better document these choices, and, of course, a citizen project would not, a priori, exclude this.

Conclusion

The 11th 'Encontro' of the CeiED researchers, which took place in July 2021, focused on learning and the (co)creation of 'knowledge' and chose to do so by exploring to what extent research being carried out at the CeiED does relate, could/should relate, and might contribute to research in an emerging field – that of Citizen Science. Since CS focuses on various forms of participation of citizens in the construction of knowledge, the scientific research process, and even on the policy impacts, exploring it further in the context of research on education, museology, and urban studies makes perfect sense.

To some extent, introducing this idea in a meeting primarily targeted at graduate, master, and doctorate students was important too: it attempted to empower further young researchers who belong to a generation who is so respectful of the education system and experts behind it that it hardly dares questioning it. Yet, both educational structures and how knowledge is being approached need reforming.

The context in which we are working is one within which online learning and exchanges, digital tools, and open-access abundant information are in use and circulation. In our view, working at identifying clear objectives concerning the ethics and scientific rigor behind the construction of knowledge, as well as constructing co-operative tools (Herodotou et al., 2018) to identify the objectives behind the construction and use of knowledge, deserve special and careful attention – a whole new research agenda, indeed, both in formal and informal educational settings (Mitchell et al., 2017; Hitchcock et al., 2021).To this end, generating a dialogue between theory and practice is crucial since it values a type of knowledge that is 'experienced', contrary to expert, 'generalized' knowledge that occasionally drifts away from the 'true, gritty reality'. CS can help in doing so, and so do the three areas of CeiED – education, museology, and urbanism – which, despite their diversity, all point to topical and urgent areas for the 21st century: social learning, creativity, and the co-creation of public spaces.

Although we agree with the fact that "the future of how CS will be integrated into education and learning will continue to be influenced by globally-accessible digital platforms" (Roche et al., 2020:7), the outcomes of the conference we organized (both from a theoretically and from a practical perspective) taught us that the challenges presented by the COVID-19 pandemic on learning and the creation of knowledge go well beyond this. At the heart of it is the question of whether students, through becoming more autonomous learners throughout the COVID-19 pandemic, aspire to be more independent and individualists or whether they value 'communities of learners, the power of negotiation and of cooperating in learning and, ultimately, the extent to which they believe that what they learn at university must realistically emerge from the collective co-creation of knowledge.

Keeping an overview on research in CS that is contextualized, critical and interdisciplinary has been the editors; objective of a comprehensive book on CS (Vohland et al., 2021). Herodotou et al. (2018) put a special emphasis on iterative processes observed in learning processes developed through CS. Simon et al. (2022) focused on identifying

research pathways in CS. Furthermore, Schaefer et al. (2021) helped understand the difficulties in evaluating the outcomes and processes of CS, itself a 'moving target'. More than ever, CS allows us to remind ourselves that learning, knowledge, and education are not static and that, instead, they constantly evolve as triggers to, or consequences of, societal changes. The critical lesson to capture from this is that higher education needs to ensure that it becomes more flexible and receptive to such changes to facilitate the co-creation and the recognition of up-to-date and 'inclusive knowledge'.

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