



“Expli’CIT”: A New Serious Game to Strengthen Science-Society Dialogue Making Explicit Research Processes

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Abstract

The international movement for Open science promotes accessibility, inclusivity and transparency to help solve complex socio-economic and environmental challenges. An important perspective of this movement, is to provide access to the practices and tools of the research cycle. We present here a serious game designed by “Tous Chercheurs” to better understand science-in-the-making and facilitate dialogue of knowledge. The aim is to explore the pathways that lead to the production of new scientific knowledge. It makes visible the structuring elements of scientific activity (reasoning, practices, professions, values, ethics, temporalities ...). Players, supervised by a scientific tutor, use word cards magnets to create a fresco by sharing different representations of research and agreeing on a common language. This collaborative tool, named Expli’CIT, can be used with citizens and in all training courses from secondary school to doctorate. It was step-by-step designed through participant observation between 2020 and 2023 during 40 game sessions. We observed that the game greatly facilitated the dialogue between academics and non-research actors in a variety of intermediation situations. The participants better understood the answers that science is able to provide or not, and sharpened critical thinking skills. In higher trainings settings, the game has proved effective in promoting interdisciplinarity dialogue and reflexivity thanks to insights into the philosophy of science. Expli’Cit offers new perspectives both in formal science education and in the development of participatory science and research because it provides a solid basis to jointly explore problems with scientific rigor and integrity.

Keywords: *Critical thinking, serious game, interdisciplinarity, citizen science, research education, Tous Chercheurs*

1. Open science, post-truth era and education about research

The deepening of interactions between science and society is decisive for the progress of knowledge, for the trust placed in scientific research by the public, and to allows citizens to be involved in the production of knowledge on issues that concern them closely. The movement for Open Science, framed internationally by Unesco’s recommendations in 2021, is fundamentally transforming the academic landscape. It aims to make scientific research from all fields accessible to everyone by promoting the humanist values of equity, diversity and the free circulation of knowledge. The issues of training and education are fully considered. It is about involving the public in the research process, for them to better understand how it works, its constraints, its powers and its limits. In return, academics need to acquire new skills and attitudes to make science more accessible, transparent, inclusive, equitable and democratic.

An important lack of training in research methods and scientific approaches from primary school to higher education, among both teachers and learners, has recently been pointed out by the French ministries [1]. They recommend to go beyond the disciplinary content and purely manipulative and procedural dimension of science practical courses content, to open up to epistemic dimensions that concern the understanding of the nature and origin of scientific knowledge and foster interdisciplinarity. For decision-makers and journalists, increasing knowledge of the scientific process is another important democratic issue, especially in the global context of post-truth era [2]. Indeed, public denial of well-established scientific facts and claims along with acceptance of misinformation in line with ideological preferences, worldviews and personal opinions are increasing. Thus, education has to deal with the massive confusion over what is known, how to know, and who to trust [3]. Containing post-truth requires not only “epistemological vaccine” but also a post-positivist vision of science, considering its social and collective character, and the political, social, technological, cultural, ethical, economic contexts with which science is produced [4]. In this paper we present the design, the content and the use of a new collaborative game named “Expli’Cit”, which offers a view of a science-



in-action and in-practice. We expose how it allows to go deep into the scientific knowledge generation processes with a large diversity of audiences.

2. A continuous design-in-use within an open lab

"Expli'CIT" has been developed since 2020 within the Tous Chercheurs (TC) open lab of Nancy (France). TC is a national network of experimental spaces open to the public, rooted in academic research, that provide hands-on education and training in scientific approaches [5]. Its main missions are to: (i) educate the general public in the scientific process through practice; ii) train young researchers in the transmission of scientific approaches and in mediation; iii) support participatory science and research projects. The network is federated around a charter of values for open science and collaborative and active pedagogies. Learning-by-doing is a flagship practice at the heart of an original learning framework that involves citizens, students or teachers in 3-day immersive research projects in real research conditions.

The idea of creating a game arose from a common TC mediation practice which involves asking participants to share their vision of how research works and what researchers do. In our study, the figure of the researcher often took the caricatural form of an isolated mad old scientist! And the vision of the scientific process, was over simplified and modelled on controlled experimental approach. We also noticed a confusion between "ready-made-science" and research, to a large extent conveyed by a school habit of verifying "expected results". It contradicts the open, non-linear and exploratory research process and the scientific spirit of doubt and refutation. In line with the thinkers of the new sociology of science [6], we believe that the mediation of science should rather show "science-in-the-making", i.e make visible the intellectual, social, technical and material pathways. This is the entry point of the game "Expli'CIT", to explicit how scientific knowledge is constituted.

The game was developed between 2020 and 2023 using a pragmatic inductive approach based on "continuous design in use" within a cell of 4 regular practitioners of TC Nancy. The first version was conceived in September 2020 to facilitate mediation with an audience of non-French-speaking secondary school pupils. It was basically composed of a set of about twenty sheets of paper with simple words relating not only to the stages of the scientific process but also to the qualities and skills of the researcher. Since then, around forty sessions have been carried out, based on the use of prototypes. A thesaurus of research approaches was step-by-step improved, based on what posed problem and needed to be explained according to the different types of users. We practiced observant participation during the year 2023 (notes, audio recordings, photos) to capitalise on the game sessions and to stabilise a generic game format that can be used within a wide variety of contexts. We followed an iterative didactic engineering approach guided by the capacity of the game to make explicit "science-in-the-making", encourage dialogue, question the participants in their representations, and to accompany epistemic reflexivity.

3. A multifaceted tool for a better understanding of science-in-the-making

3.1 Components, objectives and principles of the game

Expli'CIT aims to improve understanding of the practices reasonings that lead to the production of new scientific knowledge. From simple discovery to in-depth reflection, it adapts to a wide audience: secondary to higher education, citizens, elected representatives and decision makers, journalists, professionals, academics (fig.1). It is a collaborative game for a small group of participants (4 to 8 people) led by a scientific tutor who is familiar with the world of research and trained in TC's mediation practices. The tutor guides the participants so that they can share their representations of research and construct a synthetic image from the various components of the game, which are all magnetised, on a magnetic board or a table (fig.2,3).

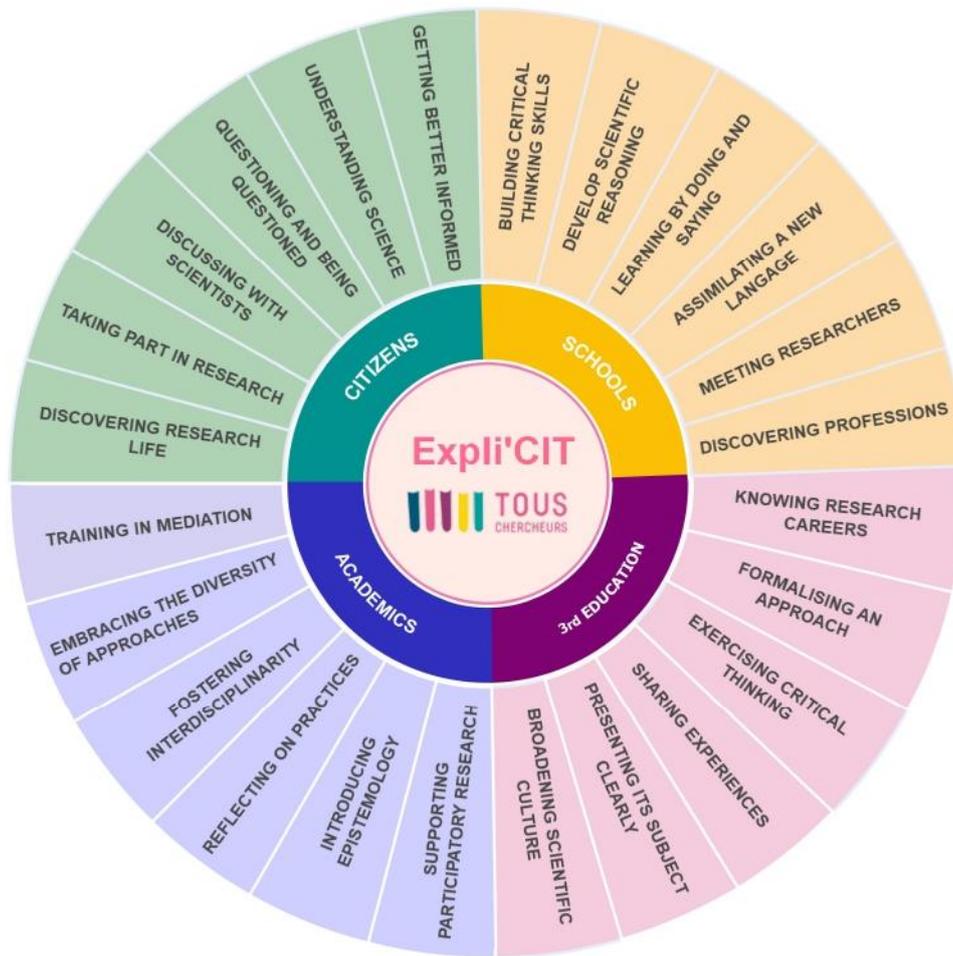


Fig.1. Aims of the game Expli'CIT according to the targeted audiences

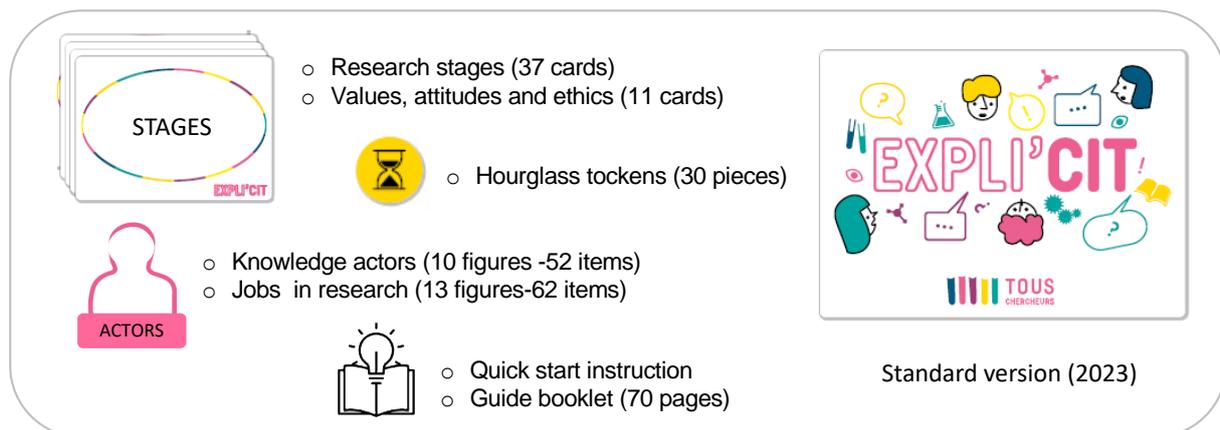


Fig.2 Expli'CIT's components of the full standard version (2023)

The workshop is divided into 5 possible sequences to answer those questions: 1) What could be the different stages in a research process? And how to organise them in a coherent way? 2) What are the attitudes, values and ethics of research? 3) What are the timeframes for the different stages of a research project? 4) Who are the different actors involved in the process of producing scientific knowledge? 5) What are the different jobs in academic research and what do they involve?



Games can last from 45 minutes to 4 hours depending on the audience, the time available and the issues to be addressed. With doctoral students, half a day may be needed to go deeper into epistemological issues. An in-depth guide is available in the game box for the tutor, where each term is defined in a glossary, supplemented by reference documents. However, the definitions are not set in stone and are open to interpretation. Nor is the position of the cards totally fixed, and white cards exist to enrich the lexicon. The aim is not to define a standard of “good research practices”, but to open the discussions and experience sharing around a rich ontology of research approaches, both foundational (description of very generic concepts and normative ideals) and applied (examples coming from the different backgrounds).



Fig.3 Expli'CIT game sessions with different audiences

3.2 Analysis of the learnings about the background to research

As a preliminary window into participant's learnings, we focused our analysis on academic audiences, during four workshops in 2023 with respectively bachelor's, master's and PhD's students, and heads of scientific departments (Aix-Marseille University). During debriefings, participants were asked to share 3 astonishments about the game (Fig.4). Among the testimonies we identified 10 categories which show a strong match with the game design objectives. Reflective enrichment through contributions in epistemology was highlighted for all participants, they stressed that the tool had enabled them “to go beyond the obvious”, and “to ask themselves new questions that they had never asked before”.

The teachers were logically marked by the pedagogical dimension, and students were very keen to find out more about careers in research. The dialogical dimension and interdisciplinarity was also emphasised by doctoral students and lecturers, especially regarding differences in “methodological benchmarks”, “evaluation standards”, “thought structuring” and “worldviews” between disciplines and individuals. For the most part, they have very few conceptual tools for tackling ethical issues, which have only recently appeared in doctoral courses. Participatory science and research were globally poorly known, and participants were surprised by the possibility of involving non-scientists not only to collect data but also to co-construct research questions, define and implement a scientific approach and jointly analyse their results.

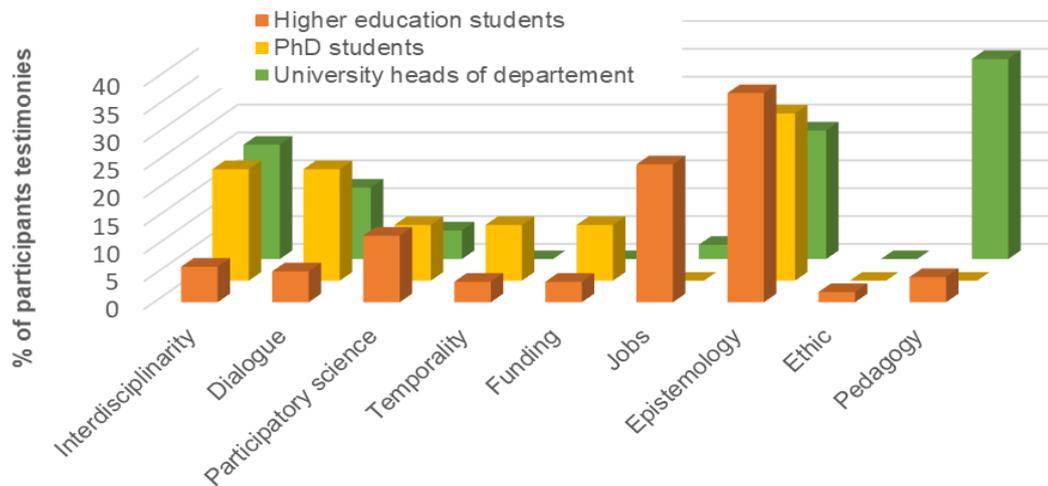


Fig.4 Categories of astonishments expressed by participants (n = 87) during debriefing sessions with academics

4. Conclusion

Expli'CIT offers an original exploration into knowledge production processes, "in and through" research in educational, academic, professional, and third-places environments. It helps to strengthen science-society dialogue, gain a better understanding of the reality of different research practices and foster greater epistemic vigilance and critical thinking. The different game sequences allow to clarify the nature of scientific knowledge, how it is intertwined with society and how it is developed, stabilized without overlooking its limitations. The genericity of the tool makes it possible to address inter/transdisciplinarity issues. It also has proven very useful to support dialogue in hybrid groups bringing together academics and non-academics, to co-construct all or part of the stages of the research process together, and to specify the possible contributions of stakeholders at each stage. The collaborative dimension of Expli'Cit nurtures a socio-cultural approach of contemporary science as a way of sowing the seeds for participatory science and research toward a democracy of knowledge.

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