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The difficult relationship between science, citizen science, and mass communication. A negative example

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1. Introduction

Recently, an article titled “The Big Compost Experiment: Using citizen science to assess the impact and effectiveness of biodegradable and compostable plastics in UK home composting” (Purkiss et al., 2022) caused quite a stir. I must acknowledge that I was a reviewer of this article and after a long exchange with the authors, I advised the Editor to publish it. Afterwards, I was appalled at how this article was misrepresented when it was released to the public. When this citizen science experiment was communicated to citizens, it became a media tsunami that defamed a system based on standards and accredited certifiers.

Purkiss et al. (2022) describe the results of a citizen science experiment involving the treatment of plastic items certified as “home compostable” in home composting bins by volunteers. As known, garden and kitchen wastes can be composted in composting bins. Compostable paper or plastic bags are sometimes used to collect and carry kitchen waste into the composting bins for reasons of convenience and hygiene. These are bags made with materials that have characteristics of biodegradability, disintegrability, and ecotoxicity (tested and certified according to standards) such as to enable biodegradation in home composting systems. Obviously, the certification indicates that the home compostable items have a verified potential for composting that can express when they are exposed to a well-managed composting treatment.

To be effective, no matter the scale, composting needs some essential aspects to align (Insam and de Bertoldi, 2007). Typically, the smaller, the less ventilated the bin, the more difficult it is to create compost. There needs to be a good balance of carbon and nitrogen in the feedstocks and such feedstocks need to be managed with regards to moisture and aeration to activate the microbial metabolisms (Mathur, 1991). Needless to say, a neglected pile of organic waste forgotten in a corner of the garden or one which is not enabling a microbe friendly environment does not allow for a relatively rapid degradation not only of the compostable bags but also of the orange skin. Every citizen practices home composting as they want and it is not generally subjected to any control or verification. This obviously creates a potential problem between the product certified for a certain performance and the performance itself that depends not only on the product’s characteristics but also a great deal on the process management methods, assigned to individuals.

Home composting is an elusive activity, which lies on the border between amateur gardening and citizens’ experiences of packaging waste management, a gray area that sometimes creates misunderstandings and wrong expectations. The article “The Big Compost Experiment” collected the experiences of a group of volunteers involved in this activity. I found the idea of using citizen science interesting to get a global, albeit fuzzy, picture of the interaction between citizens doing home composting, home compostable products, and a gardening activity, in order to understand areas for improvement.

2. A citizen science experiment

The Oxford English Dictionary definition of citizen science is “scientific work undertaken by members of the general public often in collaboration with or under the direction of professional scientists and scientific institutions” (Haklay et al., 2021). Citizen science is a growing practice as shown by the increasing number of publications (Vohland et al., 2021). In environmental and ecological sciences, the application of citizen science spans from biodiversity research and land cover assessment to forest health monitoring and marine pollution (Fraisl et al., 2022). In The Big Compost Experiment, interested citizens were asked *via* a website to take part in an experiment. In this case, the citizen science activity aimed at analyzing elicited data rather than existing phenomena. In practice, this experiment consisted in recruiting a group of volunteers and ask them to: find home compostable plastic items and nets (e.g., net bag for supermarket fruit), take pictures of the items (optional), place the items in the nets, place the nets in their composters, leave the samples there for the “usual time,” recover the nets, carry out a visual analysis of the residues by using a “degradation scale,” and sending the results *via* the website. The researchers’ idea was to use the group of unknown volunteers as if it were a black box. This is acceptable to the extent that it is well understood that we are dealing with a *qualitative* and not *quantitative* approach.

The figures shown by Purkiss et al. (2022) are not accompanied by any statistical analysis, because they are the result of a deliberately qualitative approach. It is not an experiment that studies the interaction of materials with a composting process. In short, we are not dealing with an experiment of material science or biodegradation; it is a citizen science experiment. This does not mean that citizen science cannot be made with quality criteria. There are many thoughts and proposals regarding how to implement quality criteria in citizen science (Adams et al., 2019; Heigl et al., 2020; Balázs et al., 2021). In this specific case, the real object of study was the group of citizens who were involved in the survey, how they were ready to be involved and the type of information they sent. It is a black box where the output is a survey. The black box is not just the home composting process, but also the input products, the assessment of disintegration, and the citizens. The compostable items tested were not provided to the volunteers, but each furnished themselves independently. The nature of the tested material (whether home compostable, industrial compostable, or non-compostable at all) is therefore indefinite. No control item e.g., a material expected to normally compost was recommended in order to check the proper functioning of the process. The disintegration results are also indefinite. As a matter of fact, the voluntary citizens have been used as a “scientific tool,” to probe reality and provide data. However, any scientific instrument must be calibrated, even if the *instrument* is a group of citizens i.e., it is necessary to understand the relationship between the measured phenomenon and the response. The volunteers were not “calibrated,” e.g., they did not follow a training course where they learned to distinguish the different compostable items and detect the fragments and to respond homogeneously with respect to the observations made, even if using an *ordinal scale*. Furthermore, the group of citizens was not a statistically representative sample. In quantitative research, sample size and sampling considerations usually are made with the goal of making statistical generalizations, which involve summarizing findings and inferences from a representative statistical sample to the population from which the sample was drawn

(Prashanth and Ahire, 2020). On the contrary, the Big Compost Experiment was a phenomenological research project focused on the meaning of an experience for a number of individuals. There was no respondent validation, a step that occurs during the period of data collection when feedback is obtained from the participants about the accuracy of the data they have given. Finally, there was no evaluation of the relationship between the input and retrieved output. Interpretation of results differs if the fragments recovered are a substantial portion of the initial sample or are only a small percentage of a sample that is otherwise completely gone. All this was done on purpose, was part of the study.

The general picture that emerges from the survey is that (1) most likely many of the items tested were not certified for home compostability, probably many were not even compostable and (2) several citizens reported the presence of residues on the net at the end of their composting cycle. The exact number of non-compostable items tested cannot be said, but it appears to be substantial. The exact magnitude of residues found in the nets cannot be said. The effect of the net on the degradation, even if acknowledged by the authors, was not tested and quantified.

In a nutshell, it seems that the volunteers’ ability to distinguish between compostable and non-compostable products is not very accurate. This data is important not only because it highlights a potential generalized problem regarding the ability of citizens to recognize different products, but it is also an indication of the accuracy of the experiment. Nothing can be said about the performance of the certified home compostable products, because the experimental scheme of this test does not allow it. The questionnaires tell of an experiment carried out by proxy whose contours are necessarily undefined.

3. From scientific communication for insiders to the general public

Unfortunately, and hence the reason for my brief intervention, this article has passed from the field of experts (who can well understand the difference between a qualitative trial based on *citizen science* and research carried out using a quantitative scientific methodology) to the mass media where some statements present in the article have been taken as scientifically proven “truth.” Nuance is simplified either through ignorance or misunderstanding, throw away quotes become “facts proven by science” all of which spirals into the rabbit hole which is social media. One example from this study being from the UK Guardian newspaper “‘It’s greenwash’: most home compostable plastics don’t work, says study.”¹

All this is unpleasant and testifies to a phenomenon that is spreading, namely that of the popularization of scientific contents (in principle a commendable activity) which in the passage from the scientific journals for experts to mass publication lose all the reservations, the premises, the limits, the weaknesses of the original study to suddenly become apodictic truths. Indeed, within many modern articles, the concept of admitting and discussing weaknesses with the science itself has all but been eliminated.

This is unacceptable, because it creates havoc and instills ideas that have no scientific basis that everything, which is published, is

1 <https://www.theguardian.com/environment/2022/nov/03/greenwash-home-compostable-plastics-dont-work-aoe?>

perfect, repeatable to gain the same results and the conclusions drawn are therefore beyond question.

This problem is the subject of intense study by the sociology of sciences, a branch of sociology that seeks to understand the implications that exist when different worlds (“functional systems”), using different languages and addressing different audiences, overlap. Communication addresses different “publics.” In the case of science, the “public” is that of the respective disciplinary or sub-disciplinary practitioners. Weingart (2012) concludes that “the expansion of this public to the mass media poses questions such as what happens to the choice of research questions, to quality control of research findings, to the criteria of relevance and reliability, i.e., to self-referentiality of science in general.” There is a large bibliography for the reader interested in delving into the subject (Nelkin, 1995; Anderson, 1997; Peters et al., 2008; Bucchi and Trench, 2021; Blum et al., 2022).

4. Discussion

The article in question reports the results of *citizen science*, which is stated by the authors in a clear and straight way. If one knows the meaning of the term and looks at the data and the applied methodology, one understands very quickly that it is not a scientific study that deals with the interaction between materials and a biological process, but rather it is a scientific study on the attitude and behavior of a group of volunteers regarding home composting and compostable items. The real object of the study here is the group of volunteers that can give us a rough but still interesting idea of the general behavior of people when it comes the moment of doing composting and using home compostable items. With this experiment of *citizen science*, one enters the branch of social science even when applied to waste management. This seems to be clear to all the experts who read it (at least it was clear to me). Unfortunately, it does not seem clear when the article ends up in the hands of journalists.

The lesson we take home is: apparently there is a lot of confusion about items suitable for home composting since even the volunteers are not able to use only certified home compostable products into the system and therefore a lot of training and communication is still needed on the subject. In this regard, citizen science could be very useful for increasing citizen engagement. Second point: it is

important that when we talk about qualitative research and *citizen science* the term be explained in a comprehensive way. We need to make everybody understand the limits of this approach where formalization and intuition fight for an equilibrium. This article was about a study of the behavior of a social group where questionnaires were a proxy for experience. This approach can certainly reveal interesting scenarios but it definitely cannot be considered itself a calibrated “scientific tool.” This was completely clear to the authors and to the reviewers, unfortunately it is not clear to those who stop at the title without going into the contents. However, if this message does not emerge clearly from reading the article, then I take some responsibility for it as a reviewer.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

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Conflict of interest

FD-I was employed by Novamont S.p.A. He declares that he is a consultant for a company producing home and industrially compostable plastic materials.

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