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Studying Citizen Science Platforms from Within: A Walkthrough Analysis of iNaturalist[2]

Introduction

The advent of digital technologies has profoundly transformed the ways in which scientific knowledge is produced, disseminated and received, redefining both the internal dynamics of the academic community and the relationships between experts and the non-specialised public (Scanlon, 2014). This process can be interpreted as a phenomenon of co-evolution between science and digital technology, characterised by mutual reinforcement: digital technologies improved the collection, storage, analysis and sharing of scientific data, while science and technology have, in turn, contributed to the development of increasingly sophisticated digital tools, thus fuelling a virtuous cycle of interdisciplinary innovation (Burgelman *et al.*, 2010; Grand *et al.*, 2015). The advent of digital technologies has precipitated the democratisation of scientific resources, previously exclusive to a select academic elite, through the establishment of digital libraries, open-access archives and online platforms for the dissemination of research outcomes (Cranshaw & Kittur, 2011).

At the same time, scientific communication has undergone a significant transformation, moving from predominantly transmissive models to more dialogical and participatory forms. This is in line with the evolution of the public communication of science and technology (Kurath & Gisler, 2009; Alcíbar, 2015). However, this change is part of a complex communication ecosystem characterised by tensions relating to misinformation, audience polarisation, and the redefinition of traditional epistemic authority (Nowotny *et al.*, 2001; Bucchi, 2010). It is therefore particularly important to analyse communication practices that promote reflective, inclusive and situated participation.

In the context of contemporary transformations affecting the relationship between science, technology and society, scientific communication is increasingly being called upon to address issues of reflexivity, inclusion and participation. From this perspective, it is necessary to move beyond unidirectional and transmissive models of public science communication, while prioritising approaches based on the co-creation of knowledge and public deliberation. These approaches must recognise the plurality of actors involved and the political dimension of communication processes (Achiam *et al.*, 2022; Priest, 2010).

The increasing digitisation of scientific and communication practices has significantly contributed to the emergence and consolidation of the Open Science, or Science 2.0, paradigm (Nielsen, 2012; Könneker & Lugger, 2013), which champions transparency, openness, and collaboration while redefining the ways in which scientific knowledge is produced, circulated, and legitimised. Within this framework, Citizen Science is one of the most significant manifestations of this shift, as it challenges traditional epistemic divisions between experts and laypeople by involving citizens in scientific research.

First conceptualised in the 1990s as a citizen-led science (Irwin, 1994), Citizen Science has become increasingly central to STS debates due to its ability to reveal the social, communicative and political dimensions of knowledge production. By involving non-specialists in collecting, analysing and disseminating data, these practices contribute to the reorganisation of conventional epistemic hierarchies, making alternative forms of expertise visible and valuing local and situated knowledge. This process has largely been made possible by the widespread adoption of digital infrastructures, such as online platforms and dedicated applications, which mediate

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interactions between citizens, researchers and the subject of study (Haklay, 2013, 2015; Wynn, 2017; Kostadinova, 2011).

From a sociological perspective, Citizen Science projects can be viewed as an attempt to transcend the traditional model of public engagement in science, which primarily focuses on disseminating information or securing social acceptance of technological innovations. Conversely, they emphasise the active role of citizens, recognising their interpretative abilities and right to participate, with the aim of rebuilding relationships of trust between science and society. This openness is part of a broader process of redefining and renegotiating the governance of science and technology (David, 2008), which is supported by the proliferation of participatory initiatives at a global level (Gavelin, 2007). In this sense, Citizen Science has been defined as a set of practices aimed at informing, collecting data, generating ideas and producing feedback. This leads to the construction of shared agreements and guidelines around scientific and political decisions (Amsler, 2007). As Strasser *et al.* (2019) have noted, these practices are based on different, and sometimes competing, conceptions of public participation in science. From this perspective, Citizen Science provides an ideal vantage point from which to analyse the intersection between scientific communication and digital technologies. When considered not merely as an instrumental support for research, but as an active means of involvement in knowledge production processes (Irwin, 1994), it helps to redefine the boundaries between experts and non-experts. This promotes forms of scientific citizenship and distributed observation practices (Haklay, 2013; Bonney *et al.*, 2016).

Within STS, these practices can also be interpreted as forms of situated scientific communication, where data production is inseparable from processes of symbolic mediation, negotiation of meanings and construction of socio-technical relationships. Citizen Science overcomes the deficit model (Wynne, 1991) by providing a form of horizontal, dialogical communication capable of reorienting power relations between scientific communities, citizens, and technological infrastructures (Bucchi & Trench, 2014). As Strasser *et al.* (2019) point out, participation can take on different forms, ranging from activities that promote scientific citizenship to contributions that support institutional research.

Digital platforms play a crucial role in this scenario, acting as socio-technical spaces in which communication practices, human and non-human actors, and forms of situated participation intertwine (Punziano, 2022). In particular, they can facilitate the formation of online communities of practice, where continuous interaction between citizens and researchers promotes collective learning and the joint creation of scientific knowledge (Triezenberg *et al.*, 2012).

Starting from these theoretical premises, this contribution begins with the following research question: Can Citizen Science, with its opportunities for cooperation and collaboration in projects, promote the development of online communities of practice? To answer this question, the walkthrough technique (Light *et al.*, 2018) is employed to analyse a digital environment from the user's perspective, focusing on its communicative potential. The selected case study is the iNaturalist platform, chosen for its emblematic role in the citizen science landscape and the centrality of communicative interactions between citizens and researchers that characterise it.

1. Digital technologies and participation in Citizen Science between democratisation and algorithmisation

In the context of Citizen Science projects, the widespread adoption of digital technologies is widely recognised as a key factor in encouraging and sustaining public participation in scientific activities (Haklay, 2013, 2015; Wynn, 2017). However, rather than being interpreted exclusively as enabling tools, these technologies can be analysed as socio-technical media that structure the conditions for participation and shape forms of interaction, regimes of visibility and processes of attributing value to the knowledge produced. From this perspective, Citizen Science emerges as a distinct mode of public scientific communication, where digital media, participatory practices, and knowledge production are deeply intertwined (Bucchi & Trench, 2014).

Research in the field of public communication of science and technology has demonstrated that communication processes cannot be reduced to straightforward channels of information transmission. Instead, they must be understood as situated social practices through which meanings, roles, and forms of epistemic authority are negotiated (Bucchi, 2010; Peters *et al.*, 2013). From this perspective, Citizen Science strongly highlights these dynamics, since it incorporates data production activities and communication processes within digital environments that continually mediate interactions between citizens and scientific communities.

In line with the criticism of the traditional deficit model within the Public Communication of Science and Technology (PCST) framework (Wynne, 1991; Bucchi & Trench, 2014), Citizen Science projects can be interpreted as an attempt to redefine the relationship between experts and the public. This involves shifting the focus from simply transmitting information to creating shared communication spaces. However, numerous studies have shown that such processes do not eliminate epistemic and communicative asymmetries; rather, they tend to reconfigure them. Issues such as the reliability of citizen-produced data, scientific validation criteria, and inequalities in digital and scientific skills remain central critical concerns (Bucchi, 2010; Haklay, 2015).

Digital platforms used in Citizen Science projects, which are often based on mobile applications and web environments, integrate technologies such as geolocation, environmental sensors, and automated data classification systems. This significantly expands opportunities for citizen engagement, particularly in areas such as environmental and urban monitoring (Silvertown, 2009; Cappa *et al.*, 2021). From a media studies perspective, these platforms can be analysed as communication infrastructures that not only facilitate data collection, but also the guidance of observational practices, the standardisation of contribution methods and the definition of specific participation grammars.

However, the emergence of big data and the growing integration of artificial intelligence systems within these platforms raise further epistemological and communicative questions that are representative of the current post-digital phase (Jandrić *et al.*, 2023). In particular, the automation of data classification and validation processes can make scientific procedures difficult for non-expert participants to understand, creating new forms of symbolic distance between citizens and the scientific community. This calls into question the participatory nature of Citizen Science, emphasising the role of platforms as mediators and translators between different knowledge systems.

Finally, comparing Citizen Science with the literature on digital social innovation (Novak *et al.*, 2018) enables us to interpret it as a complex socio-technical phenomenon requiring transdisciplinary analytical approaches that can integrate technological, organisational, and communicative dimensions (Spasiano *et al.*, 2021). Citizen Science cannot therefore be reduced to a practice of distributed data collection or a simple engagement strategy; it must be understood as a space for experimenting with contemporary forms of the public communication of science and technology, in which the meanings, roles, and legitimisation of scientific knowledge are negotiated.

The introduction of increasingly sophisticated digital technologies, such as mobile applications, environmental sensors, remote sensing systems, and automated analysis tools, has led to new modes of scientific participation and redefined the relationship between institutional research and civil society. Digital platforms now play a central role in supporting distributed participation, enabling citizens to contribute to the collection, interpretation and dissemination of scientific data (Benkler & Nissenbaum, 2006; Ostrom, 2010).

However, rather than considering these platforms exclusively as technical infrastructures or engagement tools, an increasing amount of research highlights the importance of analysing them as socio-technical communication environments that can influence practices, interactions and processes of knowledge legitimisation (Bucchi & Trench, 2014). From this perspective, Citizen Science is a particularly relevant field in which to observe how public participation in science is

mediated by specific digital architectures that not only structure what citizens can do, but also how they communicate, learn and negotiate meanings with the scientific community.
Recent studies have highlighted the mechanisms that Citizen Science platforms use to regulate participation, such as classification, feedback and contribution validation systems, which significantly influence the user experience and the visibility of different types of contributions (Nov *et al.*, 2014; Giardullo, 2022). Often supported by algorithmic systems, these mechanisms are not neutral, but contribute to defining roles, priorities, and forms of epistemic recognition within projects (Wiggins & Crowston, 2011). Despite the widespread attention given to the potential for participation offered by digital technologies in Citizen Science, there is still limited empirical understanding of how platforms actually structure scientific communication from the users' perspective. In particular, little research has been conducted into how the interfaces, functionalities, and communicative affordances of platforms guide interactions between citizens and researchers, and contribute to the formation of online communities of practice.
This study therefore aims to analyse a Citizen Science platform as a communicative environment. The walkthrough technique (Light *et al.*, 2018) will be adopted to examine the user experience and the communicative potential of its digital architectures. The case study is iNaturalist, which was selected for its emblematic role in the Citizen Science landscape, as well as for the centrality of communicative interactions between citizens and researchers that characterise it.

2. Methodological framework

In line with the STS theoretical framework, this study takes a methodological approach to examining the role of digital platforms in shaping the participatory and communicative practices of Citizen Science. In line with existing literature, technological innovation is recognised as a key factor in changing the ways citizens engage in scientific knowledge production processes (Bowser *et al.*, 2013). However, rather than assuming a deterministic role for technology, this research considers digital platforms to be both tools for data collection and processing and effective mediators of interactions, communicative practices and forms of participation (Latour, 2005).
To investigate these dynamics, the study employs the walkthrough technique (Light *et al.*, 2018) -a qualitative, systematic approach to evaluating digital interfaces and systems based on analysing potential user interactions and the cognitive and communicative processes they activate. Originally developed in the fields of human-computer interaction and software design, walkthrough techniques have been widely applied to the analysis of digital applications, collaborative environments and complex systems. They have proven particularly effective in identifying critical interface issues and revealing the underlying design logic of analysed systems.
The main strengths of walkthroughs include the ability to conduct an early evaluation of the project in the absence of empirical testing with end users, low methodological cost, and highlighting significant usability, affordance, and interaction-related problems (Rieman *et al.*, 1995). Furthermore, the flexibility of the technique means it can be applied to different contexts, such as software, groupware and domain-specific digital environments. Different variants of the walkthrough are recognised in the literature, including cognitive walkthroughs, interface walkthroughs, and approaches oriented towards collaborative contexts. However, studies emphasise that the effectiveness of the technique largely depends on the researcher's experience and the rigorous analytical implementation.
In the context of Science and Technology Studies (STS) and the public communication of science, this study reinterprets the walkthrough as an analytical tool capable of revealing the socio-technical logics embedded in digital platforms. This allows them to be analysed not only as tools for data collection and processing, but also as communicative configurations that influence behaviours, define roles, and structure relationships between citizens, researchers, and digital infrastructures.

Following the model proposed by Light *et al.* (2018), the analysis is divided into two complementary phases.

The first phase involves analysing the intended environment of use to examine the institutional and discursive context in which the platform is designed and presented. During this phase, the stated objectives, governance models, participation policies and implicit user representations are analysed to understand the socio-material conditions that influence the adoption of the platform.

The second phase consists of a systematic analysis of the technological and communicative mechanisms, conducted through guided exploration of the interface. This phase focuses on the affordances offered to users, the modes of interaction provided, the feedback and recognition systems, and the engagement strategies that structure communication between citizens and researchers. This phase allows us to observe how specific design choices contribute to the guidance of participatory practices and the shaping of the communicative experience of users.

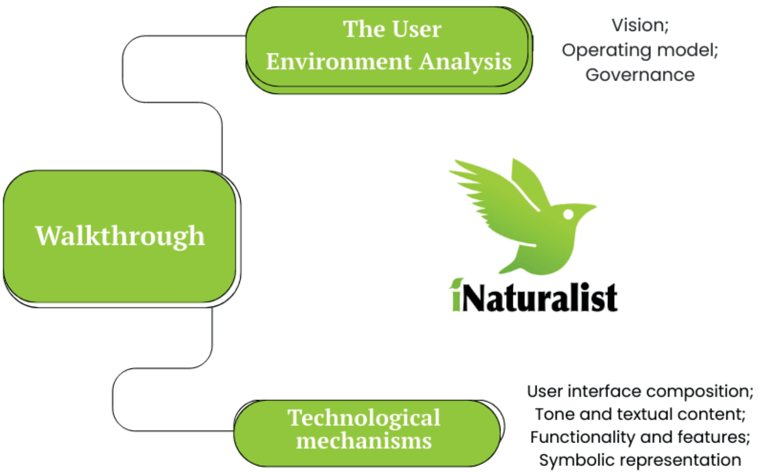

Figure 1 Source: author's elaboration based on analysis of iNaturalist platform walkthrough.

The empirical object of the investigation is the iNaturalist platform, selected for its centrality in the digital Citizen Science ecosystem. The analysis combines an examination of design logic with participant observation of usage dynamics, following the methodological model proposed by Light and colleagues (2018). This dual approach highlights both the underlying intentions of developers and the practical outcomes arising from user-platform interaction. From an epistemological perspective, the study contributes to the critical discourse on digital technologies as sociocultural artefacts (Aragona & Felaco, 2020), offering a more nuanced comprehension of their function in the (re)configuration of participatory scientific practices. The adoption of the walkthrough is in response to the necessity to develop methodologies that are sensitive to the relational and processual nature of digital platforms, moving beyond deterministic views to embrace a perspective that recognises the co-constitution of technology and society.

2.1 The case study: iNaturalist Citizen Science platform

The iNaturalist[3] platform is one of the most significant Citizen Science initiatives for biodiversity monitoring. Developed in collaboration with the California Academy of Sciences and the National Geographic Society, it is a global platform that enables comprehensive biodiversity documentation (Saito et al., 2024). This is achieved through user-generated observations, which

3 https://www.inaturalist.org (last visited 10/10/2025)

makes participation in scientific research accessible to a wide and diverse audience (Mesaglio et al., 2021). With a global community of over 5 million active users (iNaturalist, 2023[4]), the platform has been described as a hybrid between a scientific social network and a crowdsourcing tool for biodiversity monitoring (Forti, 2023).

Thanks to mobile applications for iOS and Android and an intuitive web interface, anyone with a smartphone can contribute to the collection of naturalistic data, significantly lowering the barriers to scientific participation (Boone *et al.*, 2020). In quantitative terms, iNaturalist has reached a significant global scale, involving over a million users and collecting tens of millions of observations distributed internationally. This growth not only increases the volume of available data, but also enhances its scientific usefulness. Recent studies have shown that observations collected through iNaturalist document a significantly higher number of species than traditional structured ecological surveys, with a detection capacity between 1.2 and 5.5 times greater, particularly for rare or cryptic species (Roberts *et al.*, 2022). Similarly, research conducted in localised contexts, such as university campuses, has shown that community involvement can lead to the documentation of high biodiversity, including the identification of species not previously reported at the regional level (Baker *et al.*, 2024).

From a socio-technical perspective, the platform embodies the principles of citizen cyberscience (Haklay, 2013) by combining extensive public participation, community validation mechanisms and an openness to data that encourages its circulation within global scientific networks.

As Giardullo (2022) notes, iNaturalist is a prime example of a socio-technical platform that can translate amateur-oriented observation practices into scientifically relevant data by using gamification tools and reputation-based systems to guide and organise user participation. Specifically, when a user records and publishes an observation of an organism in a given spatial and temporal context, the platform systematically collects comprehensive information, including the user ID, geographical coordinates (latitude and longitude), the name of the observation location, the date and time of the observation, and metadata associated with any uploaded multimedia content (images or audio tracks).

The nature, granularity and extent of the data acquired depend strictly on the interaction modes activated by the user within the platform. This information may be shared with third parties, such as contractors, service providers, consultants, and affiliated organisations, but only to the extent that it is necessary for the data processing activities carried out on behalf of iNaturalist. However, it is important to note that these parties are bound by preliminary agreements that limit their use of the data and prevent its disclosure to further third parties. These agreements outline a regime of controlled information circulation that lies at the intersection between collaborative knowledge production and digital data governance.

However, while large-scale data collection offers many opportunities, the literature has also highlighted some critical issues. In particular, user-generated observations may be distorted by uneven geographical coverage and by observers' preferences for documenting certain species over others (Forti *et al.*, 2023). While these limitations do not diminish the scientific relevance of the platform, they raise questions about how digital infrastructures, interfaces and participation mechanisms contribute to the structuring of data production and visibility.

In this context, iNaturalist – other than a tool for the distributed collection of biodiversity information – is also a socio-technical communication environment in which observation practices, validation processes, learning dynamics and collaboration between citizens and researchers are intertwined. The present study uses iNaturalist as a case study to analyse the extent to which Citizen Science platforms can foster the development of online communities of practice, based on this configuration.

The present study proposes a three-tier verification system, comprising observers, the community, and experts.

4 Report iNaturalist 2023, https://www.inaturalist.org/stats/2023

The methodological decision to analyse iNaturalist using the walkthrough method (Light *et al.*, 2018) is based on three fundamental factors:

1. Representativeness: it is the most cited platform in the STS literature on Citizen Science (Pocock *et al.*, 2017);
2. Socio-technical complexity: it integrates image recognition algorithms (Computer Vision) with community dynamics (Van Horn *et al.*, 2018);
3. Scientific impact: it has generated over 500 peer-reviewed publications (iNaturalist Research-grade Observations, 2023[5]).

The analysis was conducted by separating the analysis of the usage environment from that of the technological mechanisms.

This methodological choice allows us to capture the hybrid nature of iNaturalist as a "socio-technical system" (Latour, 2005) where human and non-human components (algorithms, databases, protocols) co-constitute scientific practices.

3. The User Environment Analysis

The analysis of the user environment of iNaturalist, conducted using the walkthrough method (Light et al., 2018), highlights the socio-technical dynamics that structure and condition the user experience within the platform. This methodological approach, which aims to explore the functional and symbolic elements of a digital application, is particularly well suited to investigating the configurations of meaning, power relations and epistemic visions embedded in the media architecture of Citizen Science platforms.

The first analytical level, relating to the platform's vision, reveals how iNaturalist presents itself as a paradigmatic device for the convergence of expert knowledge and lay knowledge, redefining the epistemic boundaries of scientific production. The platform facilitates the collection and sharing of naturalistic observations, positioning itself as a data collection infrastructure that supports environmental science. The institutional rhetoric – found in promotional materials and app descriptions in digital stores – promotes an idea of open and participatory science, in which researchers and citizens act as co-producers of knowledge, in a framework of apparent horizontality (Giardullo, 2022). However, the analysis reveals that this co-production is structurally asymmetrical. Citizens' contributions are primarily limited to collecting, classifying and validating observations, while epistemic control remains anchored to standardised taxonomic categories, verification procedures incorporated into algorithms and established reputational hierarchies. In line with Haklay (2013), a form of guided co-production emerges where, while participation is encouraged, it is channelled within predefined epistemic and operational frameworks.

The user interface, through a visual design that recalls naturalistic elements – the leaf-bird logo, the green colour palette – performs a performative function: it is not a neutral element, but contributes to constructing a specific perception of nature as a knowable, classifiable and measurable order. This construction is indicative of what Bowker (2000) has termed the "biodiversity imperative", that is to say, the tendency in contemporary science to naturalise classification and archiving practices as objective tools for representing living beings. The interface's availability in 32 languages, while signalling a global vocation, also raises critical questions about the universality and cross-cultural validity of the taxonomic categories used (Trisos et al., 2021).

The analysis of the operating model reveals an inherent conflict between the declared principles of a non-profit platform and the integration of iNaturalist into the data-driven economy characteristic of digital capitalism. The value produced through citizen science activities is primarily generated by the collection, processing and circulation of user data, including personal and geolocated information. As Van Dijck (2013) notes, such models are based on an economy in which services appear to be free, but value is extracted through the ability to aggregate and

5 https://www.inaturalist.org/posts/88062-new-inaturalist-observations-for-2023 (last visited 10/10/2025)

circulate large amounts of data. In this context, information is largely shared with technical and institutional partners outside the direct control of users, raising important questions about the distribution of value and the transparency of co-production processes.
The option to personalise profiles, with the possibility of adding nicknames, photographs and biographies, not only responds to a need for individualisation, but also plays a decisive role in the process of building epistemic credibility within the digital community (Giardullo, 2022).
Another important element is the presence of the iNatStore, which allows users to purchase branded gadgets. While this aspect may appear negligible in comparison to the platform's primary function, it introduces an additional commercial dimension that contributes to the delineation of the evolving boundaries between civic participation and consumption.
From a governance perspective, iNaturalist can be regarded as an illustration of algorithmic governmentality (Ruppert, 2012). In this paradigm, formal rules – such as the Terms of Service – are intricately interwoven with informal norms and automated moderation and surveillance mechanisms. The notion of user empowerment, entrusting individuals with the responsibility of independently monitoring compliance with the established rules and overseeing the security of their personal accounts, aligns with the tenets of digital neoliberalism (Couldry & Mejias, 2019). This paradigm shift signifies a transfer of regulatory responsibility from infrastructural entities to the individual user. The development of a positive reputation is contingent upon the perceived quality of contributions and interaction between users. This is based on a logic that tends to reward compliance with the prevailing codes of the platform. The possibility for platform operators to remove content that is considered unsuitable introduces an additional level of control, which is seldom rendered transparent to users.
Thus, iNaturalist embodies the structural ambivalences of digital citizen science platforms. While it broadens access to scientific practices and makes citizens' contributions to knowledge production visible, it also reproduces epistemic asymmetries, forms of discipline and processes of social infrastructuring (Star & Ruhleder, 1996). In light of these findings, Citizen Science platforms must be rethought as spaces for reflective co-production, capable of making participatory practices, epistemic categories, modes of governance and research goals negotiable. From this perspective, participation can be considered not just operational, but also critical and situated, oriented towards redefining the relationships between science, technology, and society.

4. The analysis of technological mechanisms

The second phase of the socio-technical analysis, as envisaged by the walkthrough technique, allows us to go beyond a functional description of the platform and to highlight the epistemic and political implications of the envisaged modes of interaction. The systematic exploration of the user experience shows how the interface, algorithms, and reputational mechanisms work together in the co-production of knowledge, shaping specific forms of participation and scientific citizenship. From this perspective, the platform does not merely facilitate citizens' contributions to scientific research, but actively structures the conditions through which these contributions become legitimate, visible, and scientifically relevant. (Light *et al.*, 2018).
This procedure facilitates the deconstruction of the technological mechanisms that govern the configuration of interaction, participation processes and territorial representation through the use of the application.
The initial step in the interaction is the creation of a user account, which necessitates the input of fundamental personal information (name, email address, date of birth, time zone) and is followed by a confirmation notification that is transmitted via email. At this stage, the system encourages users to personalise their profile by adding an image, a short biography and a nickname.

Inviting users to make biographical and identity information public introduces a performative dimension that directly affects their epistemic credibility. The possibility - but also the implicit expectation -of showcasing scientific abilities, affiliations or interests suggests that participation is not neutral, but rather oriented towards a logic of reputation that rewards forms of self-representation that align with the codes of institutional science. The result is a model of scientific citizenship that, while formally open, favours individuals who can translate their experience into the language and signals recognisable to the community.
When navigating the application, a procedural sequence emerges with the aim of encouraging interaction and the progressive activation of advanced features, such as the ability to access private messaging. This access is contingent upon the fulfilment of specific objectives, namely the uploading of observations and the participation in the identification of other users' content. This constitutes a form of "algorithmic meritocracy", which establishes a correlation between activity, visibility, and the ability to exercise influence within the platform. Over the course of a week, twelve original images depicting local flora and fauna were uploaded and sixteen identifications of content produced by other users were made. This process enabled users to obtain the status necessary to enable the chat function and interact directly with other participants, particularly within geolocalised projects in Italy.
A recurring challenge was the lack of specialist naturalistic skills, a condition that highlights the cognitive barriers implicit in participation, despite the inclusive rhetoric of the platform.
When uploading content, users can choose to associate images with specific geographical coordinates and detailed temporal information. However, species identification is not left solely to human judgement. The platform uses artificial vision models that have been trained using proprietary datasets. These models provide automatic suggestions during the upload phase and perform an initial classification of observations. These suggestions do not autonomously validate the data, but rather guide contributions within a collective verification process. In this process, an observation is recognised as "scientifically relevant" when a plurality of participants agree on its validity.
From an STS perspective, this socio-technical architecture can be interpreted as a device for dynamic boundary work, through which the boundaries between expert and amateur knowledge are continuously redefined. Therefore, the criticisms historically levelled at Citizen Science -particularly those relating to the reliability and quality of data produced by non-professionals -do not emerge as a specific effect of algorithmic automation, but constitute a structural tension within this field of practice. Introducing automatic classification systems does not eliminate these tensions; rather, it reorganises them by redistributing expertise between human and non-human actors, thereby making the processes of attributing scientific credibility more complex.
In this context, epistemic authority is not concentrated in a single entity, but emerges from the interaction between algorithmic devices, reputational mechanisms, and collective validation practices. The platform therefore presents itself as a space for producing knowledge, in which scientific legitimacy is not assumed, but continuously performed and negotiated. This shifts the focus from individual skills to the socio-technical governance of epistemic processes.
The "Explore" function enables users to access a map displaying observations by geographical area, thereby enhancing the territorial dimension of the experience. These visualisations translate the territory into data, thereby redefining it as a surface that can be observed and shared in real time. The "Projects" section facilitates the identification and participation in collective initiatives operating at local or global levels, with many of these initiatives achieving visibility through quantitative metrics such as the number of observations or participants. These metrics are not neutral; they establish implicit criteria of relevance and success, helping to define which practices and areas are considered 'important' or 'scientifically productive'. This creates a tension typical of participatory digital contexts: the call for inclusion coexists with an evaluation system that may favour users who are more competent, present or located in more "observable" and infrastructure contexts. Furthermore, the social nature of the platform is selectively mediated:

access to other users is limited to nicknames and basic profiles, and direct interaction is subject to progressive feature activation mechanisms, which reinforce a hierarchy of participation, linking recognition and relational access to contributory performance.
Complementary features such as "Guides" and "Site Statistics" provide additional tools for understanding biodiversity from a technical and scientific perspective, promoting a view of living organisms that is oriented towards quantification, classification and data circulation. The statistics section, in particular, reveals the rate at which the community validates observations, emphasising an ideology of collective efficiency.
In summary, this phase of the analysis reveals how the technological mechanisms of iNaturalist are not limited to offering tools for collection and sharing, but actively shape the way users observe, represent and narrate the territory and nature. The interface does not simply provide tools for observing and sharing, but shapes what can be observed, how it can be described, and which contributions acquire value. In a co-production framework, nature and territory emerge as the results of an intertwining of digital infrastructures, algorithmic classifications, and community validation practices, in which scientific legitimacy is continuously performed and negotiated.

First Conclusion

Rather than simply considering the iNaturalist platform as a tool for data collection, this study analysed it as a socio-technical and communicative environment. Using the walkthrough method, the research demonstrated how citizen science digital platforms actively contribute to shaping observation practices, participation methods, and processes of epistemic recognition. From an STS perspective, iNaturalist is a prime example of contemporary transformations in scientific communication, epistemic authority and public participation in the post-digital era.
A key feature that distinguishes iNaturalist from other citizen science platforms is its hybrid architecture, which combines automatic classification systems, community validation mechanisms and reputation systems within an environment similar to a scientific social network. Unlike projects that are primarily based on standardised micro-tasks or highly expert-centric validation processes, iNaturalist is based on a distributed epistemic regime in which scientific credibility emerges from the interaction between human actors (observers, identifiers and experts) and non-human actors (algorithms, databases and interfaces). In this sense, the platform not only supports participation, but also actively structures it by guiding observation practices and progressively differentiating roles, visibility and influence within the community.
A second distinctive feature is the importance of communication. On iNaturalist, participation does not end with the submission of data; it continues through processes of discussion, negotiation and collective learning. These processes are made possible by feedback, collaboration and commenting systems within projects. The platform can therefore be interpreted as an infrastructure for building online communities of practice, in which learning is situated, progressive and socially mediated. However, this participatory dimension is fraught with tensions. While the mechanisms of algorithmic meritocracy and reputational visibility encourage engagement, they also risk reinforcing implicit hierarchies and excluding individuals with less scientific knowledge, digital skills, or available time. Another significant aspect concerns the territorial dimension of the platform. The iNaturalist platform utilises geolocation tools, interactive maps and the possibility for the development of localised projects. In this manner, the iNaturalist not only serves as a representation of the territory, but also symbolically produces it, thereby transforming it into an observable, monitorable and, ultimately, governable surface. This digital territorialisation of nature, however powerful at the operational level, carries the risk of reducing ecological complexity to a set of standardised and classifiable data, according to logics that reflect Western and universal epistemic models.

At the policy level, the potential of digital Citizen Science cannot be fully understood without institutional recognition of the value of citizen-generated data. In order to transform participation into a truly inclusive and generative process, it is essential that such data be integrated into public information systems and valued in the definition of environmental, urban and health policies. This suggests that the conventional separation between expert knowledge and lay knowledge must be transcended, and that principles of interoperability and transparency in information management must be embraced. In accordance with the most recent European Union guidelines on Open Science[6] and Responsible Research and Innovation, there is a necessity for political and institutional reflection on the role of digital platforms as devices for the production and regulation of knowledge to be promoted.

Some limitations of the study must be acknowledged. Firstly, while the walkthrough method enables the analysis of the platform's affordances and design logic, it does not permit a comprehensive understanding of the range of actual usage practices, motivations, and forms of appropriation or resistance among users. Secondly, as the analysis focuses on a single case study, the results are not generalisable to other Citizen Science platforms with different technological, disciplinary or governance structures. Thirdly, the absence of interviews or direct ethnographic observation of users means it is not possible to explore thoroughly the subjective experiences and dynamics of meaning attributed to participation.

These limitations open up several prospects for future research. Comparative studies between Citizen Science platforms could facilitate the understanding of how different design choices, validation models, and forms of governance influence participation and knowledge recognition. Integrating walkthroughs with digital ethnographic approaches, qualitative interviews, or interaction data analysis would make it possible to connect technological affordances with concrete social practices. Finally, future research should explore the political and institutional dimensions of Citizen Science, questioning how citizen-generated data is integrated into decision-making processes and how platforms can be redesigned to be more transparent, inclusive, and accountable in terms of algorithmic governance.

In conclusion, iNaturalist represents the potential and limitations of digital citizen science. Although it provides new avenues for collaboration between citizens and scientific communities, contributing significantly to knowledge production about biodiversity, it also perpetuates asymmetries, algorithmic control mechanisms and forms of epistemic exclusion that undermine the concept of a fully democratic science. Recognising and critically analysing these tensions is a fundamental step towards developing more thoughtful, responsible and socially robust models of scientific participation.

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