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ORIGINAL ARTICLES

'Citizen Scientists' on Citizen Science

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Abstract

Citizen science, also known as participatory or community science, involves the participation of non-professionally trained individuals in scientific research. This article, part of a series of articles aiming to map and theorise the postdigital dimensions of citizen science, presents diverse narratives from individuals actively engaged in citizen science endeavors. The authors were invited to share their experiences, motivations, challenges, and opportunities in their own words. Their perspectives are organized into three categories: (1) citizen science as a mediator between professional and amateur science, (2) citizen science for diverse publics and community action, and (3) citizen science from the margins. These narratives illuminate citizen science as not just a theoretical construct, but a dynamic methodological prism, revealing the complex entanglement of the postdigital realm and citizen science through innovative sociotechnical methods and approaches. Each contribution highlights the rich possibilities and challenges arising from the intertwining of community researchers and technology in the pursuit of knowledge, meaning, and action. This tapestry of experiences invites further exploration of the evolving landscape of postdigital citizen science.

Keywords Postdigital · Citizen science · Community science · Participatory science · Postdigital participation · Collective writing · Artificial Intelligence · AI · Data · Cross-sector · Knowledge socialism

Introduction (Sara Tolbert, Aotearoa New Zealand)

Definitions of 'citizen science' are still the subject of much debate. However, a shared characteristic of most of what we might call 'citizen science' is the participation of community members, 'citizens' or 'citizen scientists', in research that extends beyond the parameters of those who are employed by research institutions. Often

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missing from citizen science scholarship are the authentic perspectives of those who participate in citizen science on the ground. Following recent collective authorship trends in postdigital education research (Jandrić et al. 2023a, b), we invited individuals, or in some cases groups of individuals, who are actively involved in broadly defined citizen science, to write about their experiences in their own words and on their own terms. We provided some overarching guiding topics and questions that the authors might address, such as how they came to be involved and participate in citizen science, what sustains them, and what challenges and opportunities they face. Beyond these deliberately very rough guidelines, authors were free to write about whatever aspects of their citizen science endeavors they wanted to share.

We note the recent discursive shifts from 'citizen science' to 'participatory science' or 'community and citizen science'; the recent re-naming of the Citizen Science Association in the USA to Association for Advancing Participatory Sciences[1] is one example of this shift. We have also outlined how many communities engaged in research that might intersect with, or have the 'flavor' of, citizen science, reject that terminology on political grounds (Jandrić et al. 2023a, b). The issue of naming is both important and contentious because terminology matters (Eitzel et al. 2017). The 'material' and the 'discursive' are co-constitutive—words, phenomena, and realities are deeply entangled and intra-dependent (Barad 2007). We also recognise that these shifts in terminology are inevitably tied to shifts in thinking and practice among citizen science communities and researchers. If a fundamental and shared characteristic of citizen science, or community science or participatory science, is indeed *participation*, we also think it important to more clearly define what participation really means (Weich and Macgilchrist 2023).

These are driving questions for the fields of both citizen science and postdigital science and education. As part of our own ongoing inquiry into postdigital participation and postdigital citizen science and humanities, we have set out to bring diverse voices more prominently and visibly into the dialogue. Among the authors of this article are those who have been engaging in community and citizen science 'on the ground'. However, given the collaborative nature of citizen science and the blurred boundaries between 'professional' and 'amateur' researchers in these collaborations, many of the authors' trajectories inevitably intersect with professional science—for some in ways that minimise the space between professional and amateur science, and for others in ways that expand it.

We have therefore loosely organised authors' perspectives and experiences into three categories: (1) mutual appropriation: postdigital citizen science as mediator between 'professional' and 'amateur' science, (2) postdigital citizen science for diverse publics and community action, and (3) postdigital citizen science from the margins. In the first section, Cheyanne (USA), Rehan (Pakistan), and Lisa (Australia and New Zealand) share how their participation in citizen science either led them to or dovetailed with their participation in professional science. In the second section, Ana Paula, Alice, Iamni (Brazil), Mario (Croatia), and Shane (New Zealand) reveal how citizen science has been a tool through which they galvanise community

[1] See https://participatorysciences.org/. Accessed 3 June 2024.

action while co-creating new knowledge and new publics. In the final section, Stuart (Australia), Filip (Croatia), and Chris (USA) discuss the tensions and nuances of doing citizen science as 'lone wolves' and the ups and downs of collaborations with professional scientists and academia.

In this captivating tapestry of narratives, the multifaceted nature of participation and the kaleidoscopic array of perspectives illuminate the essence of postdigital citizen science (Jopling et al. 2024). Far from being solely a theoretical construct, postdigital citizen science emerges as a vibrant and dynamic methodological prism. As the narratives unfold, the intricate entanglement of the postdigital realm and citizen science reveals itself through the innovative and diverse sociotechnical methods and approaches employed by the featured researchers. Each contribution adds a unique thread to the complex and evolving fabric of postdigital citizen science, inviting readers to explore the rich possibilities and challenges that arise when citizens and technology intertwine in the pursuit of knowledge—and meaning.

Mutual Appropriation: Postdigital Citizen Science *as Mediator* Between 'Professional' and 'Amateur' Science

On Citizen Science, Education, and Diversifying Research Pathways (Cheyanne Olson, Blue Thumb, OK, USA)

I live in Oklahoma and teach biology at Rogers State University. I volunteer with a programme called Blue Thumb[2] that monitors water quality in the state. Participants spend two days learning about water quality parameters, in the field and in the lab, and then are certified to do monthly sampling on a stream of their choice. My educational and professional background has always revolved around water, so naturally, I was drawn to spend my free time volunteering in monitoring water as well. Through this programme, I monitor Dog and Cat Creek in Claremore, Oklahoma. These two streams are listed on Oklahoma's list of impaired and threatened waters (303d list) as impaired. I go out monthly and perform chemical monitoring (D.O., pH, ammonia, chloride, etc.), and perform macroinvertebrate sampling/identification bi-annually.

Since I teach, I also use this programme as an opportunity to introduce my students to citizen science and get them engaged in our local environment. My students and I have previously compiled data from our volunteer efforts to showcase to the community to inform them about water quality around our town. From my passion of volunteering, I decided to pursue a PhD where I evaluated/studied Blue Thumb for my dissertation research. Getting to survey and interview other volunteers was very enlightening and motivated me to continue participating even further. I find a lot of self-fulfillment in participating: I feel that I am using my educational background to do good with my time. I think education is key to protecting stream water quality, and citizen science is applied education. Being out in nature for a period of

[2] See https://www.bluethumbok.com/. Accessed 3 June 2024.

time every month is calming and I feel that it connects me to the environment. My identity as a volunteer is very much an important part of me.

One of the largest challenges is the scrutiny that volunteer-collected data faces. Though many studies, including my own dissertation work, show that volunteers collect accurate data that can be used for management purposes, volunteer-collected data still receives some skepticism. I find myself advocating for and trying to explain the importance of these data to government bodies and agencies who do monitoring as well.

I think there is an opportunity for inclusion in citizen science. As a field, it offers participation in science for individuals who may otherwise not be engaged with science in their daily lives. It can serve as a connection or a bridge that makes science more accessible to the public, especially those more often under-represented in scientific research. There are many environmental justice efforts rooted deep in participation in citizen science. Additionally, with the expansion of digital or virtual CitSci,[3] along with data accessibility and open access, there is a vast amount of potential data out there waiting to be used!

Utilising Social Media and Citizen Science as Substitutes for Traditional Field Surveys: A Reflection from Pakistan (Rehan Ul Haq, Department of Wildlife and Ecology, University of Veterinary and Animal Sciences, Lahore, Pakistan)

During my MPhil studies in Wildlife and Ecology back in 2010, I initiated a Facebook group called Birds of Pakistan.[4] This was prompted by one part of our Ornithology Exam, which required identifying bird species in Pakistan. I thought that different pictures shared in that group would enhance my identification skills of the country's wild birds. Initially, the group served as a platform for wildlife photographers to showcase their work, but over time, we started having meaningful discussions related to ornithology of Pakistan. In 2012, I went to Thailand for my PhD, and a similar group with the same name emerged,[5] led by different admins but with a shared passion for ornithology. This new group attracted even more bird enthusiasts and initiated a systematic approach to data collection.

In 2018, I completed my PhD, which examined the effects of climatic, hydrological, and land use changes on the population dynamics of waterbirds in Thailand. Upon returning to Pakistan, I joined a public sector university and tried to replicate similar studies focusing on birds of Pakistan. However, lack of funding for traditional survey-based research and lockdowns due to the Covid-19 pandemic prompted us to explore alternative data collection methods; also, existing literature was outdated. In response, we decided to use social media (i.e., Birds of Pakistan) and citizen science portals to compile a comprehensive and up-to-date list of bird species in Pakistan.

[3] See https://citsci.org/. Accessed 3 June 2024.
[4] See https://www.facebook.com/groups/322512977796208. Accessed 3 June 2024.
[5] See https://www.facebook.com/groups/672890519498797. Accessed 3 June 2024.

We recorded posted records from citizen science portals and social media platforms. Surprisingly, social media emerged as a primary source of bird records, overshadowing citizen science portals. This trend can be attributed to the immediate feedback and validation provided by social media audiences, unlike the delayed response of formal citizen science platforms. While social media attracted a broader audience (which has its own demerits as indicated by our research on public reaction to wildlife crimes (Haq et al. 2023)), citizen science remained confined to the educated elite (most of which were foreigners). This observation highlighted the need for greater awareness and accessibility of citizen science portals among diverse segments of society.

Despite the challenges and limitations, our innovative approach has yielded valuable insights into Pakistan's avian biodiversity. Moving forward, bridging the gap between social media and 'formal' citizen science initiatives will be crucial for inclusive and sustainable conservation efforts in Pakistan. Currently, we are exploring methods to utilise social media and citizen science portals as alternatives to traditional field surveys, as traditional methods often need substantial funds and logistical challenges. Our goal is to identify biases inherent in social media and citizen science data and propose strategies to mitigate them. By doing so, we aim to extract valuable information from these databases.

Reflections on Being a Citizen Science Practitioner (Lisa Evans, Dunedin, Aotearoa New Zealand)

I live in Ōtepoti, Aotearoa (Dunedin, New Zealand), having moved here a couple of years ago from Perth, Australia. I grew up in rural towns in New South Wales, mainly in Dubbo. My father was a science teacher, so as a family, we went on many trips to science museums, astronomy observatories, national parks, and other places where we could engage with science, nature, and space. I grew up reading popular science magazines and watching science documentaries on TV.

I decided I wanted to be an astronomer, so I studied physics as an undergraduate. When it came time to start a PhD, I hesitated. The day-to-day job of being a scientist just didn't appeal to me. I had a feeling of dread about being forced to specialise in a tiny area when I was very much a 'big picture' person. I also had a strong interest all my life in creative activities like art and writing, and felt I wanted an element of creativity in my career.

I looked for other things I could do with my skills, and ended up working as a 3D animator, and then a technical artist. I got to work on a couple of planetarium shows and exhibits at the local science museum. I gravitated towards working on educational games, and took an interest in 'serious games' and what they could achieve. I did a PhD about that; however, being a mature person with a family, I needed to work part-time. This led me to my first job in citizen science—coordinating an astronomy citizen science project at the International Centre for Radio Astronomy Research.[6]

Working on a project like that ignited a huge passion in me. Not only did I get to work with scientists and contribute to a fascinating area of astronomy, but I also got

[6] See https://www.icrar.org/. Accessed 3 June 2024.

to engage with the wider community and share my passion. Plus, I was able to bring my game design expertise to the online platform that we created for our project!

I also became deeply involved with the Australian Citizen Science Association,[7] and now that I've moved to New Zealand, with the Citizen Science Association of Aotearoa New Zealand.[8] Through these organisations, I've been able to connect with the wider community of citizen science practitioners, researchers, stakeholders, and people in the community who take part in any way they can. This is a community with incredible knowledge, vision, and passion, and it is very rewarding to be part of it.

One real difficulty I have found in my involvement with citizen science is the limited understanding many people still have of what it is and what it can really achieve. An often described barrier is the mistaken belief that citizen science is just about getting volunteers to collect data, and no more. I have also recently encountered scientists who knew that progress on their project could be greatly assisted by citizen science, but they were unaware that digital platforms like Zooniverse[9] already existed. They believed they would have to develop their own website and spend a significant amount of time and money maintaining and supporting it.

What I would really like to see are strong and thriving Communities of Practice in citizen science which could steadily grow the sector and improve the broader understanding of it in the community. However, it feels as though it has gotten harder to achieve this, particularly in the post-Covid era of higher living costs, lower engagement, and scarce funding. Being so widely dispersed around the world, online platforms are crucial to creating and maintaining these types of communities; however, there are major problems with all the most popular social media platforms and many people are averse to new technologies. Twitter (now X), in particular, was once a place with a vibrant citizen science community, where connections were made and knowledge was shared, but is no longer. The barriers to entry are still high for researchers, teams, and projects that are at the bottom of the learning curve and aren't sure how to get started.

Postdigital Citizen Science for Diverse Publics and Community Action

Cellphones, Militant Research, and Feminist Cartography (Ana Paula Oliveira dos Santos, Alice Alves Franco, and Iamni Jager, Brazil)

Teia de Mulheres da Zona Oeste[10] (Teia, herein) is a popular organisation of black, white, anti-racist, cis, or transgender women. We operate in the West Zone of the city of Rio de Janeiro, Brazil, a region with precarious social indicators. Teia

[7] See https://citizenscience.org.au/. Accessed 3 June 2024.

[8] See https://citsci.nz/. Accessed 3 June 2024.

[9] See https://www.zooniverse.org/. Accessed 3 June 2024.

[10] See https://www.mulhereszonaoeste.bonde.org/. Accessed 3 June 2024.

emerged in 2020 from the articulation of several organisations, collectives, and quilombos[11] in order to mitigate the effects of the Covid-19 pandemic in the region. On this occasion, Teia distributed tons of food, including vegetables from local family farming, to families headed by women in communities, favelas, and quilombos.

Teia is heir to a militant research strategy, collectively known as 'militive'. From this praxis, we produced a Feminist Cartography[12] where we identified the oppressions experienced in our territory, as black women in the West Zone. Since then, we have repeated this perspective of militant research for social transformation, based on citizen generation of data with the aim of handling territorial demands. Data collection generally occurs through interviews carried out by Teia organisers who, as they live in the territory, are able to have a privileged perception of families in vulnerable situations.

During the Covid-19 pandemic, we carried out several territorial data gatherings, systematising them to make immediate decisions and prioritise families in the distribution of food. During this period, due to the need for social distancing to contain the spread of the virus, we had to use virtual resources for our communication. Together with UBUNTEC,[13] a solidarity enterprise formed by former students of public schools that offers technological solutions, we carried out a survey of the main difficulties in using cellphones by women in our territory. The result of this research led to the construction of a blended course for digital inclusion through the use of cellphones, for women served by Teia.

Currently, we have registered 260 families headed by women in social vulnerability. We monitor those families and produce data for the creation of courses, booklets, and articles that help overcome and publicise inequalities in our territory. Dealing with vulnerability so closely is painful and brings many challenges, for example, using an accessible and welcoming language when collecting data from families and, at the same time, proposing a different form of research, which invites all participants into a process of *sentir-pensar* (feeling-thinking). Citizen research is part of every member of the Teia, as it is about producing a good life for ourselves, our families, and our community.

Partnerships have been formed regionally, such as with Instituto Pacs, Fiocruz, Universidade Federal Fluminense (UFF), Universidade Federal Rural do Rio de Janeiro (UFRRJ), Universidade Federal do Rio de Janeiro (UFRJ), all from Rio de Janeiro state in Brazil. We have also formed partnerships internationally, such as with New York University (NYU-Steinhardt) Department of Media, Culture, and with Communication, Critical Racial Anti-Colonial Study Co-Lab with Denise Ferreira de Silva, and the University of Illinois-Champaign-Urbana's Department of Urban and Regional Planning, with Faranak Miraftab. Our political actions embrace the fight for publicising the data produced by Teia to serve as a way of advocating for public policies that promote food sovereignty. We imbue ourselves from the daily construction of 'hope', by aiming for possible futures based on transformations in our community.

[11] Quilombos are Brazilian hinterland settlement founded by people of African origin (Encyclopaedia Britannica 2024).

[12] See https://www.militiva.org.br/mapa. Accessed 3 June 2024.

[13] See https://www.ubuntec.net/. Accessed 3 June 2024.

Blind Thalia and Melpomene (Mario Kovač, Zagreb, Croatia)

My scholarly research in the field of theatrology does not require official support. My workshops and 'research in practice' are based on voluntary work and collaboration with institutions and minority groups (predominantly people with physical and mental disabilities). A lot of this work is associated with New Life (2024), which is the oldest theatre of blind and visually impaired people in the world. In New Life, I direct a series of all-evening repertoire shows. These shows are played regularly, just like any other shows in any other theatre.

These workshops have multiple individualised goals. Some participants work on development of spatial orientation, other participants work on development of communication skills, and nearly all participants work on development of self-confidence in private and professional life. Importantly, this work does not have medicinal or therapeutic effects. In a purely theatrological manner, I am interested in adapting dramatical exercises and performances without the ambition to turn them into theatre or school mainstream.

This specific theatrological niche, which interests a very limited number of people in Croatia, brings about a mixed bag of effects. On a positive note, the academic community recognises and positively valorises my work. In 2015, I completed my PhD titled 'Methodology of theatre work with blind and visually impaired people' at the University of Zagreb, Faculty of Humanities and Social Sciences (Kovač 2015a). In the same year, the book based on my PhD, *To inhale stage lights*, has been published by the International Theatre Institute (Kovač 2015b). Parts of this work have also been published in English and Polish.[14] With a team of associates, I started working on a handbook of theatre exercises aimed at disabled populations, with an estimated date of publication in 2025.

The majority of moral and financial support arrives from non-governmental organisations for people with disability, which recognise the practical value of my work. However, given the fact that most of my workshops and research are conducted outside of academic physical spaces, universities, and academies, the door to the world of higher education seems closed. It feels as if an invisible glass ceiling prevents the growth and development of this methodology within university programmes. Admittedly, I prefer fieldwork with people with disabilities and lack serious ambition to enter the world of higher education. However, at least a part of responsibility is with the academic community, which is not open enough for unusual and/or hybrid approaches.

(On) The Benefits of Low-Tech Community Science in an Increasingly High-Tech Era (Shane Orchard, Christchurch, New Zealand)

There are a great many modes for community and citizen science and over the years, and I may have become a jack of some trades and master of none. But that has at

[14] See my personal profile at the Portal of Croatian scientific and professional journals, https://hrcak.srce.hr/en/pretraga?field%5B0%5D=article_author_orcid&term%5B0%5D=0000-0003-2715-8732&type=napredna&start=0&facet_article_authors%5B0%5D=Kova%C4%8D%2C%20Mario. Accessed 3 June 2024.

least served to illustrate some of the dimensions of this fascinating subject. It has the potential to invigorate or polarise communities, while also driving technological innovations and challenging the very foundations of thinking on knowledge. All this within one catchily named enterprise that is somewhat of a rediscovery and rebranding of many pre-existing community practices. But that's a story for another day!

I have previously worked on some very local projects here in Aotearoa New Zealand (e.g. Curious Minds[15]), national environmental monitoring (e.g. WhitebaitWatch[16]), and occasional international projects (e.g. iNaturalist[17]). More recently, I have come back to thinking about the greatest attraction that originally led me to this field when I was primarily an educator in Te Tai Tokerau (Northland). This was what I saw as an educational interface, not just where students were involved but across whole communities of people who may be involved or become involved in environmental science and action. The very act of observing, recording information about the natural world, and sharing it with others, could help to break down the downsides of societal urban drift and screen-time that leads to nature deficit disorders, perhaps the preeminent of all conservation issues. Therein lies an immensely powerful education angle. As many have pointed out, you protect what you value and you value what you know and cherish.

In this fast-moving world, there appears to be some danger of our community of volunteer scientists succumbing to the capabilities of new technologies that are increasingly vying for their attention. While new technologies have been impressive in supporting mass participation (e.g. in the 'crowdsourcing' of information), they might potentially come at the expense of getting people together or even into outdoor environments in their engagement with citizen science. Certainly, it is possible to address these aspects in project design, but there are questions around the extent to which this will actually occur now that citizen science is firmly in the gaze of technologists and formal scientists. Lively debates have emerged around the very purposes for which these projects might be initiated and pursued, lest they entrench existing data collection disparities and biases. This contrasts with much of the previous contributions of community and citizen science that have involved relatively local scales and purposes for data collection that are identified in a bottom-up manner.

Given all of the above developments, it seems important to highlight the opportunities presented by 'low-tech' approaches which contrast with high-tech approaches, yet still might be supported by them. Here, in Aotearoa New Zealand, we have a long history of community-based environmental monitoring including a diverse range of community environment groups and much longer-running kaitiakitanga (stewardship) activities of Māori communities. We have some great examples that simply employ the idea of 'throwing bods at it' to get a job done instead of needing recourse to some more technological solution. Examples include the collection of catch data from predator control projects,[18] community-based methods for

[15] See https://www.curiousminds.ac.nz/. Accessed 3 June 2024.
[16] See https://www.inaturalist.org/projects/whitebait-watch. Accessed 3 June 2024.
[17] See https://www.inaturalist.org/. Accessed 3 June 2024.
[18] See https://www.trap.nz. Accessed 3 June 2024.

fish spawning surveys,[19] and dune monitoring. While technologies can be usefully applied and even specially designed to support such field observations (and indeed they are), let's not forget the benefits of public participation in science over-and-above the collection of data. Getting people out and about, face-to-face, and in more intimate contact with natural environments are some of the most impressive and much-needed benefits.

Postdigital Citizen Science from the Margins

Wandering Alone in the Bush with a Camera: A Citizen Scientist's Reflections on the Role of InSTUition (Stuart Harris, Canberra, Australia)

My name is Stuart Harris, currently 58 years of age, and I live in Canberra, Australia, my hometown. I have worked a variety of jobs in my life, most of them involved in logistics or stock control including 10 years in the Royal Australian Air Force in my twenties. I now work as a gallery assistant at Questacon,[20] Australia's National Science and Technology centre. How did I go from being a 'box packer' to a 'boffin'? The answer is simple: Citizen Science!

I've never been employed as a photographer but have had a lifelong passion for it, like my father did. When I see something beautiful, different, or interesting, I like to capture it so I can show others!

In late 2008, I went out to try and capture an uncommon bird in the mountains west of Canberra. Alas, it eluded me *but*, I changed from my telephoto lens to a newly acquired macro lens and somehow managed to take a photo of a new species of Peacock spider (Fig. 1)! Collaboration with two scientists and a three-year quest resulted in me finding this spider again (Fig. 2) and in a relatively short time (six weeks). A scientific paper was written that described it and the taxonomists named it after me due to my worthy efforts (Otto And Hill 2011)!

The last fifteen years have been quite a ride, rubbing shoulders with scientists, doing media interviews, attending conferences, delivering lectures to students, advising governments, and mentoring many. This is just the tip of the iceberg, and I humbly admit, not the usual path of your everyday citizen scientist.

It has come with responsibilities, sometimes being given credit for way more than I actually know. At other times, I have seen through the 'holes' in science itself, seen how it could be done so much better, and cheaper. But, my thoughts pretty much stay in my head, there is still a long way to go before science and citizen scientists are in sync and in chorus with each other. I have seen exploitation of citizen scientists, sometimes nothing short of scab labour to help facilitate underfunded projects. Alternately, I have seen magnificent collaborations, from two people to two hundred, with some astonishing outcomes. I have observed some tireless operators and facilitators of community science, committing enormous amounts of their time

[19] See https://ir.canterbury.ac.nz/items/d76f7c1e-a674-487c-becc-36aa9b88817f. Accessed 3 June 2024.
[20] See https://www.questacon.edu.au/. Accessed 3 June 2024.

Fig. 1 *Maratus elephans*—my inSTUition subtly urged me to look down to my left and there was this orange blob I had driven 1500 km to find. This pic (the first of this species) was taken minutes later when a male started displaying to a female in a ditch where I got down on my guts to take the photograph

and efforts to help the greater good and others of their ilk. I have seen the predictable facet of human nature called 'competitiveness' come to the fore on many occasions, sometimes bearing fruit, sometimes motivating, and at other times destroying individuals.

Fig. 2 The afternoon I found *Maratus harrisi* (after a three-year search following the initial photograph in 2008). The holotype of *Maratus harrisi* is on the container in my left hand. The smile is deep and genuine with a modicum of relief

Ultimately, I feel I have found a niche where I can contribute, primarily by my own design, most often alone. I relish in the results I share borne from literally thousands of hours in the bush, most often through databases dedicated to community science, such as NatureMapr,[21] where photography plays a focal role!

Finally, if I may add my experience of a human faculty that has come to the fore in my practice of citizen science, it is a thing I call inSTUition. Yes, I do think ego does play a role in citizen science, and this word could also be referred to as something serendipitous.

The subtle, sometimes intangible, dare I say even trainable function of intuition has consistently been instrumental in my wanderings through the Australian bush. First Nations people, arguably the world's first scientists, accept this 'skill' as being one with the land and depend on it for decision-making. As a dedicated citizen scientist with relative freedom and little guidance, one can be overcome by the options within a search or quest. To be guided by intuition, when recognised, has a certain aura about it. It is hard to put into words, but let me assure you, it exists…

This is a wonderful journey and I hope I can remain mentally, emotionally, physically, and financially able to contribute to this super important culture which gives so much to so many.

From Academia to Action: A Researcher's Pivot (Filip Šrajer, Zagreb, Croatia)

I am an architect and urban planner living in Zagreb, Croatia, with my wife and three sons. After working for 17.5 years in a private company, 1.5 years ago, I opened my own company[22] focusing on planning, cultural heritage, spatial databases, and … a bit of research.

While I was employed at the former company, I worked part-time as a Teaching Assistant at the University of Zagreb, teaching urbanism-related courses. Part of my motivation for pursuing a Ph.D. and engaging in science came from this experience, as did many of my current acquaintances and collaborations with affiliated scientists. I was also motivated by years of activism in the field of cultural heritage, specifically the dry-stone heritage of the Eastern Adriatic, which provided most of the research data for my doctoral thesis and a few articles.

After completing my PhD in 2019, I haven't done much scholarly research. There haven't been available project opportunities, and I also needed to make up for lost professional time and join, now as a junior partner, in running the company. After founding a new company, the need for professional engagement has prevailed to the extent that I haven't managed to publish any of the results from my doctoral dissertation. I am often invited to give guest lectures on Adriatic dry-stone walls at Croatian universities, and I was even invited to lecture at the International Centre for the Study of the Preservation and Restoration of Cultural Property.[23] That has remained my only contact with academia.

[21] See https://naturemapr.org/. Accessed 3 June 2024.

[22] See https://www.ekomena.hr/. Accessed 3 June 2024.

[23] See https://www.iccrom.org/. Accessed 3 June 2024.

My only structured research project was supported through the Endangered Wooden Architecture Programme of Oxford Brookes University (2024), where I was a project collaborator. The grant does not involve salaries, so I could only dedicate 5% of my working hours to the project.

The other, somewhat unstructured project, is Suhozid.hr,[24] the Croatian dry-stone geoportal, which I have been editing since its inception more than ten years ago. I have volunteered for so long, and when funds for technical improvement finally appeared, I was not feeling comfortable with charging for my work. Maybe that's why I have been slightly negligent lately!

When I meet my affiliated colleagues, we often come up with various research or project ideas. Coming from the private sector, however, I find it harder to allocate my time without direct compensation. This distances me from science and makes me sad. However, at this point in life, I do not feel ready to leave the private sector, even if a suitable university position becomes available. Everything in its own time…

Artificial Intelligence, Rather Than a Citizen Science Movement, Is the Way Forward (Chris Santos-Lang, USA)

I have participated in citizen science collaborations as facilitator of Citizen Science Belleville[25] and former co-chair of the Ethics working group of the Citizen Science Association, but what makes me a citizen scientist is that I am unaffiliated and compulsively create what I call 'science', mostly all by myself (e.g. Santos-Lang 2016, 2018, 2023).

Citizen Science Belleville was my Bible Study Group's experiment with spending equal time seeking answers via science. We got as far as passing institutional review board and peer-review by a top-tier journal for an investigation of the political impact of a mind-altering drug that our brains produce naturally during our religious services. Churches may someday be ideal venues for citizen science because (1) science was motivated by religion (to learn about God via creation) even before science had economic motives, (2) churches provide most of the in-person formal education for the latter 75% of our lives (at least in Belleville), and (3) Methodists do not bow to scholarship not tested by the authorities of their local congregation (e.g. 5642 congregations disaffiliated in 2023 over scholarly disagreement). However, the lesson I took from Citizen Science Belleville was that the dispute-resolving potential of the scientific method is (temporarily) undermined by the way church-shopping creates echo-chambers and by professional scientists' perverse economic incentives to unnecessarily inflate the costliness and complexity of scientific activity.

The root of my personal lack of affiliation is that I produce science that others feel unqualified to critique or endorse. For example, I was ejected from my philosophy

[24] See https://suhozid.hr/. Accessed 3 June 2024.
[25] See https://medium.com/citizen-science-belleville. Accessed 3 June 2024.

Ph.D. programme because I insisted upon researching AI Ethics when the topic could still be dismissed as science fiction. Enabling each individual congregation to master science for itself was likewise ahead of its time (like each of my works cited). The freedom to pioneer ahead of one's time is supposed to be the reward of academic tenure; I have instead claimed that freedom via stubbornness.

Soon all scientists will have that freedom. Artificial Intelligence will do a better job at everything scientists are currently hired to do, and that will leave human scientists (paid or not) with the freedom to research whatever they want. IBM's Watson AI already reads far more research than any human ever could. As Artificial Intelligence becomes able to read and test all works (including mine), credentials will lose relevance. Meanwhile, automation will replace crowdsourcing. The remaining *human* contribution to science will increasingly be like mine: pioneering new areas and modes of study.

For affiliated scientists to exclude *citizen* scientists would limit science, and for Artificial Intelligence scientists to exclude *human* scientists would likewise limit Artificial Intelligence, so the best Artificial Intelligence won't exclude me. Rather than exclude humans, the best Artificial Intelligence will raise us up to become increasingly helpful collaborators. Disciplinary boundaries, technical jargon, etc., exist to accommodate practical human constraints. The best Artificial Intelligence will not share those constraints, so I expect Artificial Intelligence to collaborate with all human beings to their fullest.

The citizen science movement theoretically supports people like me, but we are so rare in the broad tent pitched by the movement (compared to data collectors, classifiers, and professionals), that we do not feel supported in practice. Concern over how to distinguish us from 'fake scientists' is no excuse; I've already proposed a method for that distinguishing (Santos-Lang 2022). Why don't those who endorse citizen science endorse such a method, rather than condemn every effort not governed by affiliated scientists to be haunted by a specter of dubiousness?

Apparently, it will be Artificial Intelligence, rather than a citizen science movement, that will reform the scientific community either to stop excluding me or to empower me to recognise when my science is fake.

Conclusion (Petar Jandrić)

These days, participation and inclusion are amongst the most common buzzwords, and I would argue, amongst the most abused scholarly concepts. Borne from an authentic aim to foster social justice and emancipation, noble ideals behind participation and inclusion often turn into their opposites (Weich and Macgilchrist 2023). For instance, in order to participate in social networking, users first need to provide owners of social media with the permission to use their data for various commercial and non-commercial purposes. For those with little education and work experience, inclusion in the workforce often translates into a push towards accepting minimum wage and oft-precarious jobs such as bicycle deliveries.

Academia has been following this trend for years (see Peters and Jandrić 2018 for a deeper analysis). Landing a 'proper' permanent academic position requires years

of investment in time and energy; not everyone can afford, or is willing to, sacrifice the best years of their lives to push their way into the (rather corrupt) system. For those who tried but were not lucky enough to land one of the very few permanent positions, inclusion in a scholarly community, and participation in scholarly research, has translated into a global army of highly educated precarious adjunct lecturers paid below minimum wage and just as precarious researchers dubbed as postdoctoral students, volunteers, and the similar. And some of the most successful researchers, who managed to land permanent academic positions, have become disillusioned by the system and have left it for greener pastures. For an almost infinite number of reasons, many people have left the chains of knowledge-making institutions and decided to engage in scholarly research on their own terms. For the lack of a better term, such people have been dubbed as citizen scientists.

Using the concepts of low theory and high theory, McKenzie Wark shows the vast importance of contributions to knowledge that originate from outside of knowledge institutions.

> High theory I think of as the scholarly tradition of continental philosophy, as shaped by institutions of higher learning and scholarly conventions of agenda formation, of vetting and authorizing statements, and so on. To be a recognized authority of high theory is to be a professor who studied with distinguished professors, who publishes or teaches in distinguished places, and so on. … Low theory is more about how subaltern or subordinate groups form a conceptual language to understand their situation, and to either escape it or struggle within it. One of the great historical examples of low theory is Marxism … Obviously, high and low theory interact all the time. Low theory borrows from high theory; high theory sometimes recuperates and canonizes low theory – Spinoza and Marx and low theorists who became canonized, for example. (Wark in Jandrić 2017: 107)

Reaping profits from its position of ownership over knowledge and academic rentiership (Fuller 2019), traditional knowledge institutions have used the power of canonization to plunder the work of citizen scientists for centuries. To build on Wark's examples, Spinoza and Marx created thousands of academic jobs (professorships, chairs, and so on), yet Spinoza was forced to leave studies in order to work in his family business and Marx largely lived on the charity of his rich friend Engels. And, according to *Nature's* now 10-year-old report trying to identify the most influential scholar in the history of humankind, 'the most influential scholar was Karl Marx in history, ahead of Sigmund Freud in psychology' (van Noorden 2013).

While Spinoza and Marx could be exceptions to the rule, working outside of knowledge institutions does not necessarily imply doing lesser research. Actually, it is quite thinkable that citizen sciences and humanities may punch well above their weight, at least in terms of ratio between financial investment and scholarly output. (I'd really like to see a comparative bibliometric study focusing on overall scholarly impact of citizen science and humanities vs institutionalized science and humanities, but that's a story for another day.)

Supported by gods, kings, and the marketplace, institutions such as research institutes and universities could rest assured of their dominance in knowledge-related

matters for centuries. However, information and communication technologies, and especially the rise of peer production, have brought about significant shifts in collegiality, collaboration, and collective intelligence (see Peters et al. 2020), and sparked, as of recently, with a healthy dose of artificial intelligences and various associated posthumanist challenges (see Peters et al. 2023). These developments have significantly restructured relationships between traditional centres and margins of knowledge. 'In our postdigital age, we are no longer reliant on narrow institutional settings alone to determine whose (academic) voice is marginal' (Jandrić and Hayes 2019: 383), and 'high theory and low theory (Wark 2012; Jandrić 2017) are more intertwined than ever' (390).

In the admittedly somewhat narrower context of academic publishing, Sarah Hayes and I have shown that '[p]erhaps for the first time in history, people outside of academia and people residing on its fringes have managed to significantly influence the economy, politics, and practice of knowledge work' (390). Thus, we concluded that.

> [o]ur postdigital age is one of cohabitation, blurring borders between social actors and scientific disciplines, mutual dependence, shifting relationships between traditional centres and margins, and inevitable compromise – and this calls for deep reconfiguration of politics and practice of knowledge production. (Jandrić and Hayes 2019: 391)

To achieve this, we suggested starting a new postdigital dialogue (Jandrić et al. 2019) 'to develop a new language of describing social relations, and new ways of collaboration between yesterday's centres and margins' (Jandrić and Hayes 2019: 391). Similar conclusions have recently started to appear across citizen science research (Silvertown 2009; Catlin-Groves 2012; Bonney et al. 2016), promoting us to put this theory into practice and open a postdigital dialogue about current state of affairs in citizen science and about possible new strategies for their cohabitation and co-development with traditional knowledge institutions.

Hoping to understand these and other transformations of citizen science, a team of us first mapped existing research using three simple questions: 'What is postdigital citizen science? Who (or what!) is the postdigital citizen scientist? How to conduct postdigital citizen science?' (Jandrić et al. 2023a, b). In the next step, we explored postdigital citizen science and humanities from almost 20 different perspectives, and we linked those perspectives into a theoretical kaleidoscope (Jopling et al. 2024). At an academic conference, we opened a dialogue with a wide range of networked learning scholars to 'locate and occupy important gaps as we grow our understanding of "postdigital citizen science" and "postdigital citizen humanities" as dialectically intertwined fields of cross-sector community research' (Hayes et al. 2024). In April 2024, we held a one-day workshop with citizen scientists in Zagreb, Croatia, titled 'A Postdigital Dialogue with Citizen Researchers', resulting in a forthcoming co-authored article. All these works, and much more, will be published in a Special Issue on 'Postdigital Citizen Science and Humanities: *Survive, Resist, Flourish*', edited by Michael Jopling and Sarah Hayes, in 2025.

We hope to increase our collaboration with citizen scientists and expand this work beyond academic publication, perhaps towards policy and/or practical projects.

Before we move on, however, we need to understand the position of postdigital citizen scientists, their needs, problems, and joys. In order to support our postdigital dialogue, we are publishing this and other articles written by citizen scientists shoulder by shoulder with articles written by professional scientists (Jandrić et al. 2023a, b; Jopling et al. 2024; Hayes et al. 2024).

So what are the main messages of this article? In my reading of citizen scientists' contributions, postdigital citizen science is driven by love and passion for knowledge —the face of Stuart Harris holding a box with his precious *Maratus harrisi* (Fig. 2) explains this emotion more clearly than anything I can write here. There is also a lot of emphasis on traditionally non-scientific elements such as intuition and religion. However, these emotions are intertwined with 50 different shades of unfavourable political economy. While some citizen scientists have managed to reap some minimal gains from their engagement (such as reputation), most of them seem to have invested much more than they received in return. They see technology, both in its low-tech and high-tech versions, as a potential game changer. Pessimism, or moderate optimism at best, seems to dominate; yet people still fight against the windmills, giving their time to citizen science activities such as writing this article without expecting anything in return.

I could write pages of detailed analysis, but I don't want to turn the honour and responsibility to write this conclusion into yet another case of a professional scientist using the power of canonization to plunder the work of citizen scientists. Instead, I will merely advise readers to dive deep into this amazingly rich material and to enter a postdigital dialogue with its authors.

Open Review 1: Questioning the Answer to Discover the Question (Sarah Hayes)

Reading through each personal narrative in this collective expression of perspectives on Citizen Science gave me the sense that I was on the verge of discovering an exciting answer… if only I knew the question. Often in universities, projects begin with a research question that a team will aim to shed light on through a chosen methodology, ethical clearance, data collection, presentation of results, conclusions, and publications. Rigorous research processes are of course important, but interrogating where these may 'begin' and 'end', *who* and *what* is included, excluded, or even exploited at different stages, are also critically reflexive responsibilities, of *all researchers* in postdigital society.

Our hybrid political, economic, technological, environmental, and existential questions are now bigger than any single discipline or sector. Yet while we talk of Higher Education as a sector and discuss cross-sector alliances to address challenges and disadvantage (Hayes et al. 2023), we don't often hear of Citizen Science or indeed Citizen Humanities (Heinisch et al. 2021) described as 'a sector'. This suggests many valuable research alliances could be missed when universities, research councils, and funders maintain exclusionary disciplinary, linguistic, and systemic boundaries.

Such disparities are discussed by the authors here, as they raise problems of a lack of understanding of what Citizen Science *is* and what it can really achieve (Lisa Evans). The language we use is both an enabler and a barrier, but this terminology gives an impression only of volunteers collecting data and not the full spectrum of their research activities. Another author describes Citizen Science as a catchy re-branding of many pre-existing community practices (Mario Kovač). This made me smile as I recently read about 'forest bathing' which, when I was a child in the 1960's and 1970's, would simply be called a 'nature walk'. Yet the practice of 'Shirin Yoku', where 'Shinrin' means forest and 'Yoku' stands for bathing, is a reminder of different cultural approaches and varied discourse that brings to life experiences that for each of us are different, wherever we reside and research *as citizens*. In Shirin Yoku, we learn that 'the forest holds answers to questions we have yet to ask' (Healing Forest),[26] prompting me to wonder how research may begin and end differently in diverse contexts, who or what prompts our questions, and indeed when, during the research process?

Citizen research across science and humanities for me holds a key to questions yet-to-be-co-explored with experts in communities. Questions arise organically when global and local researchers, whether inside or outside of universities, engage as equals with each other's *positionalities* (Hayes 2021, 2023) to address postdigital research challenges. As other authors put it, we participate in a process of *sentipensar* (feeling-thinking) to better understand each other's contexts, language, environments, values, and articulation of knowledge (Ana Paula Oliveira dos Santos, et. al). Whatever the methodology adopted, ideally this gathering becomes a co-created space, like a recent example we developed in April 2024 in a one-day workshop with citizen researchers in Zagreb, Croatia.

Such meetings and co-publication offer exciting routes towards disrupting exclusive university practices, described by one author as 'an invisible glass ceiling' that is not open enough for hybrid practices. Given that '[c]itizen science is much older than academia' (Jandrić et al. 2023a, b), and to address numerous postdigital challenges, we are going to need our diverse, hybrid research teams more than ever. This will include even the Artificial Intelligence (AI) partners that may soon take over some citizen science and humanities tasks that require minimal human intervention.

We have though 'been co-evolving with our technologies for millions of years' as posthumans and we are 'never independent of the very technologies, companion species and environments that help to constitute us' (Matthewman 2017: 176). Just as the forest and our dry-stone heritage (Filip Šrajer) can be a research partner offering answers to questions we have yet to ask, our digital tools have become our co-practitioners. So now, it seems time to demonstrate, as one author suggests, just how Citizen Scientists and Scientists can similarly be 'in chorus' with one another' (Stuart Harris) across these new hybrid postdigital research teams.

[26] See https://healingforest.org/2020/01/27/forest-bathing-guide/. Accessed 19 June 2024.

Open Review 2: Citizen Science as Voice (Michael Jopling)

The first things that struck me about this collection of accounts of citizen science by citizen scientists are its diversity in terms of the expertise and interests on display, its geographical spread, and the range of perspectives it brings together. Beginning this open review, as an academic researcher in Higher Education (HE), I was therefore conscious of the need to try to avoid imposing my views or interpretations or giving the impression of knowing better. In this, my starting point was Rancière's (2016: 164) claim that '[t]he democratization of science comprises two things, the idea that the laboratory is everywhere and that science is shared'. What the accounts collected here demonstrate clearly is that while citizen science operates, even depends, on this kind of radical openness and collaboration (it is a theme that runs through the article), the current structures and systems of HE restrict rather than facilitate.

It is notable that all of the contributors have, or have had, some relation to HE but are either suspicious of it or openly reject it, for a range of good reasons. This spirit of resistance also goes deeper. It extends to a commitment to avoiding the specialisation that HE supports and indeed often requires (Lisa Evans), identifying and bridging gaps in research (Ana Paula Oliveira dos Santos, Alice Alves Franco, and Iamni Jager), and inhabiting territory that HE is reluctant to explore (Mario Kovač).

Petar Jandrić's invocation in the conclusion of high and low theory brings to mind Halberstam's (2011: 2) location of low theory in 'the in-between spaces'. This in-betweenness is also a feature of these accounts. They find spaces for their interests and enthusiasms in-between and alongside other forms of enquiry and as such should be celebrated, as long as that act of celebration does not lead to their identification and destruction. It is usually best to avoid words like 'purity', but, as the conclusion also emphasises, the purity of the contributors' motivation and passion is striking and contrasts with their distrust, and negative experiences, of HE. Perhaps our current postdigital context offers a further, less forbidding in-between space in which citizen science (and its terminological variants) can develop and flourish.

However, it is not that simple. If the accounts collected here are any guide, the relationship between citizen science and the postdigital is more problematic than we might suspect. In fact, it is one of three tensions that emerged for me from the article. None of the accounts refer explicitly to the postdigital. It is only present implicitly when social media intrudes into Rehan Ul Haq's reflections on field surveys and Chris Santos-Lang's fascinating piece on AI, in which AI itself seems to be posited as a form of citizen science, or even citizen scientist. It is up to us as readers to resolve this tension, just as we have to make practical connections between the accounts and their varying versions of citizen science (and social science and humanities), which the other articles associated with this project (starting with Jandrić et al. 2023a, b) address from more theoretical perspectives.

The second tension is between the collaborative drive which motivates all the writers and their sense of isolation from 'academic' research. It is also telling that the 'scientific' accounts all position themselves explicitly as 'citizen science', but the two accounts that are closer to citizen social science or humanities (by Ana

Paula Oliveira dos Santos, Alice Alves Franco, Iamni Jager, and Mario Kovač) do not identify as such. This is an area in which the hybridity of postdigital citizen science (and humanities) might have an enduring effect.

Finally, the third tension is between the precision of scientific language and the relative freedom of metaphor. Sara Tolbert is right in her introduction to emphasise the importance of terminology and identify recent shifts towards 'participatory' or 'community' science. What interested me were the various metaphors applied to whatever we agree to call this form of science (if agreement is necessary). It is described variously as a prism, a tapestry, a fabric, and (deliberately reflecting one of the other articles in this project) a kaleidoscope (Jopling et al. 2024). Metaphors matter too and, while useful, these seem to miss the crucial elements of activity, action, and activism that pervade the accounts.

Both the introduction and the conclusion identify the importance of bringing new and diverse voices into play through citizen science. Given its potential to support action and access unheard actors and perspectives, perhaps we could regard postdigital citizen science (and its variants) itself as a form of 'voice', one which in its function as 'applied education', in Cheyanne Olson's memorable phrase here, challenges, resists, and potentially enriches more traditional approaches to research through its openness and hybridity.

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References

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

Bonney, R., Phillips, T. B., Ballard, H. L., & Enck, J. W. (2016). Can citizen science enhance public understanding of science? *Public Understanding of Science*, *25*(1), 2–16. https://doi.org/10.1177/0963662515607406.

Catlin-Groves, C. L. (2012). The citizen science landscape: From volunteers to citizen sensors and beyond. *International Journal of Zoology*. https://doi.org/10.1155/2012/349630.

Eitzel, M., Cappadonna, J., Santos-Lang, C., Duerr, R., West, S. E., Virapongse, A.,West, S. E., Kyba, C. C. M., Bowser, A., Cooper, C. B., Sforzi, A., Metcalfe, A. N., Harris, E. S., Thiel, M., Haklay, M., Ponciano, L., Roche, J., Ceccaroni, L., Shilling, F. M., Dörler, D., Heigl, F., Kiessling, T., Davis, B. Y., & Jiang, Q. (2017). Citizen science terminology matters: Exploring key terms. *Citizen science: Theory and practice, 2*(1), 1. https://doi.org/10.5334/cstp.96.

Encyclopaedia Britannica. (2024). Quilombo. https://www.britannica.com/topic/quilombo. Accessed 3 June 2024.

Fuller, S. (2019). Against Academic Rentiership: a Radical Critique of the Knowledge Economy. *Postdigital Science and Education, 1*(2), 335–356. https://doi.org/10.1007/s42438-019-00035-0.

Halberstam, J. (2011) *The Queer Art of Failure*. Durham, NC and London, UK: Duke University Press.

Haq, R. U., Abdulabad, A., Asghar, S., & Szabo, J. K. (2023). Clicks and comments: Representation of wildlife crime in Pakistan in social media posts. *Global Ecology and Conservation, 43,* e02473. https://doi.org/10.1016/j.gecco.2023.e02473.

Hayes, S. (2021). *Postdigital Positionality: developing powerful inclusive narratives for learning, teaching, research and policy in higher education*. Leiden: Brill.

Hayes, S. (2023). Positionality in Postdigital Research: The Power to Effect Change. In P. Jandrić, A. MacKenzie, & J. Knox (Eds.), *Constructing Postdigital Research. Method and Emancipation* (pp. 3–21). Cham: Springer. https://doi.org/10.1007/978-3-031-35411-3_1.

Hayes, S., Jandrić, P., Tolbert, S., Jopling, M., & Brown, C. (2024). Opening a networked learning dialogue on postdigital citizen science and humanities. In M. Cutajar, C. Borg, M. De Laat, N. B. Dohn, & T. Ryberg (Eds.), *Proceedings of the FourteenthInternational Conference on Networked Learning 2024.* https://journals.aau.dk/index.php/nlc/article/view/8076. Accessed 19 June 2024.

Hayes, S., Jopling, M., Connor, S., & Johnson, M. (Eds.). (2023). *Human Data Interaction, Disadvantage and Skills in the Community: Enabling Cross-Sector Environments for Postdigital Inclusion.* Cham: Springer. https://doi.org/10.1007/978-3-031-31875-7.

Heinisch, B., Oswald, K., Weißpflug, M., Shuttleworth, S., & Belknap, G. (2021). Citizen humanities. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponti, R. Samson, & K. Wagenknecht (Eds.), *The Science of Citizen Science*. (pp. 97–118). Cham: Springer. https://doi.org/10.1007/978-3-030-58278-4_6.

Jandrić, P. (2017). *Learning in the Age of Digital Reason*. Rotterdam: Sense.

Jandrić, P., & Hayes, S. (2019). The postdigital challenge of redefining education from the margins. *Learning, Media and Technology, 44*(3), 381–393. https://doi.org/10.1080/17439884.2019.1585874.

Jandrić, P., Luke, T. W., Sturm, S., McLaren, P., Jackson, L., MacKenzie, A., Tesar, M., Stewart, G. T., Roberts, P., Abegglen, S., Burns, T., Sinfield, S., Hayes, S., Jaldemark, J., Peters, M. A., Sinclair, C., & Gibbons, A. (2023a). Collective Writing: The Continuous Struggle for Meaning-Making. *Postdigital Science and Education, 5*(3), 851–893. https://doi.org/10.1007/s42438-022-00320-5.

Jandrić, P., Ryberg, T., Knox, J., Lacković, N., Hayes, S., Suoranta, J., Smith, M., Steketee, A., Peters, M. A., McLaren, P., Ford, D. R., Asher, G., McGregor, C., Stewart, G., Williamson, B., & Gibbons, A. (2019). Postdigital Dialogue. *Postdigital Science and Education, 1*(1), 163–189. https://doi.org/10.1007/s42438-018-0011-x.

Jandrić, P., Tolbert, S., Hayes, S., & Jopling, M. (2023b). Postdigital Citizen Science: Mapping the Field. *Postdigital Science and Education*. https://doi.org/10.1007/s42438-023-00443-3.

Jopling, M., Stewart, G. T., Orchard, S., Suoranta, J., Tolbert, S., Cheilan, L., Yan, F., Price, C., Hayes, S., Scott, H., Latham, A., Bhatt, I., Dodonov, V., Matthews, A., Muhtaseb, R., MacKenzie, A., Owaineh, M., Earle, S., Simmons, B., Clarke, Z., la Velle, L., Green, B. J., Brown, C., Watermeyer, R., & Jandrić, P. (2024). Postdigital Citizen Science and Humanities: A Theoretical Kaleidoscope. *Postdigital Science and Education.* https://doi.org/10.1007/s42438-024-00481-5.

Kovač, M. (2015a). Metodologija kazališnog rada sa slijepim i slabovidnim osobama [Methodology of theatre work with blind and visually impaired people]. PhD Dissertation. Zagreb: University of Zagreb.

Kovač, M. (2015b). *Udahnuti svjetla pozornice* [*To inhale stage lights*]. Zagreb: International Theatre Institute.

Matthewman, S. (2017). *Technology and social theory*. London: Bloomsbury.

New Life. (2024). About. https://www.novizivot.hr/en. Accessed 18 June 2024.

Otto, J. C., & Hill, D. E. (2011). An illustrated review of the known peacock spiders of the genus Maratus from Australia, with description of a new species (Araneae: Salticidae: Euophryinae). *Peckhamia*, *96*(1), 1–27.

Oxford Brookes University. (2024). Endangered Wooden Architecture of Banovina/Banija, Pokuplje and Posavina Regions (Croatia, EU). https://www.brookes.ac.uk/research/units/tde/projects/endangered-wooden-architecture-programme/funded-projects. Accessed 18 June 2024.

Peters, M. A., & Jandrić, P. (2018). *The Digital University: A Dialogue and Manifesto*. New York: Peter Lang.

Peters, M. A., Besley, T., Jandrić, P., & Zhu, X. (Eds.). (2020). *Knowledge Socialism. The Rise of Peer Production: Collegiality, Collaboration, and Collective Intelligence*. Singapore: Springer. https://doi.org/10.1007/978-981-13-8126-3.

Peters, M. A., Jackson, L., Papastephanou, M., Jandrić, P., Lazaroiu, G., Evers, C. W., Cope, B., Kalantzis, M., Araya, D., Tesar, M., Mika, C., Chen, L., Wang, C., Sturm, S., Rider, S., & Fuller, S. (2023). AI and the future of humanity: ChatGPT-4, philosophy and education – Critical responses. *Educational Philosophy and Theory.* https://doi.org/10.1080/00131857.2023.2213437.

Rancière, J. (2016) *The Method of Equality.* Cambridge: Polity.

Santos-Lang, C. C. (2016). Measuring evaluative computational differences in humans. https://doi.org/10.6084/m9.figshare.4003407.v1.

Santos-Lang, C. C. (2018). Corporantia: Is moral consciousness above individual brains/robots?. *Paladyn, Journal of Behavioral Robotics*, *9*(1), 1–5. https://doi.org/10.1515/pjbr-2018-0001.

Santos-Lang, C. C. (2022). The Method of Convergent Realism. *Social Epistemology Review and Reply Collective*, *11*(1), 33–49. https://wp.me/p1Bfg0-6t5. Accessed 18 June 2024.

Santos-Lang, C. C. (2023). Game Theory Foundations: Musical Chairs. *SSRN*. https://doi.org/10.2139/ssrn.4647332.

Silvertown, J. (2009). A new dawn for citizen science. *Trends in Ecology & Evolution, 24*(9), 467–471. https://doi.org/10.1016/j.tree.2009.03.017.

Van Noorden, R. (2013). Who is the best scientist of them all?. *Nature*. https://doi.org/10.1038/nature.2013.14108.

Wark, M. (2012). *Telesthesia: Culture, Communication and Class.* Cambridge: Polity Press.

Weich, A., & Macgilchrist, F. (Eds.). (2023). *Postdigital Participation in Education: How Contemporary Media Constellations Shape Participation.* Cham: Palgrave Macmillan. https://doi.org/10.1007/978-3-031-38052-5.

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