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Change – The transformative power of citizen science

Designing (for) change: a taxonomy-based approach to project design

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Abstract

This paper presents insights into an ongoing research project, focusing on the application of a taxonomy for digital involvement projects to Citizen Science initatives. Extending the taxonomy to analog projects and conducting a survey on mit:forschen, this research aims to enable structured comparisons and insights into design patterns.

Keywords: citizen science, design taxonomy.

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Introduction

In the practice of Citizen Science (CS), projects are increasingly aspired to yield societal benefits. This includes endavours to democratize the scientific practice, foster learning, or promote social inclusion (Lewenstein 2022). However, the realization of transformative potentials hinges critically on the design of initiatives (De Albuquerque and Almeida 2020). Research underscores the significance of design dimensions, including communication and engagement modes or stakeholder relationships (De Albuquerque and Almeida 2020; Lewenstein 2022). Nevertheless, a structured approach to describe and evaluate these design dimensions remains absent. While numerous classifications exist detailing the degrees and forms of

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CS participation (Haklay 2013; Shirk et al. 2012), a comprehensive schema to guide project design is still lacking. Such a framework, however, is essential to facilitate structured comparisons between initiatives and foster dialogue among CS practitioners. Its application could ultimately guide project initiators in targeting their design to fit their purpose and realize desired benefits.

A suitable approach to structurally describe similarities and differenceses of a target domain is offered by taxonomies (Nickerson et al. 2013). While it would be an evident approach to develop a design taxonomy exclusively for CS projects, in this paper we argue, it may be more beneficial to adopt a broader perspective. The phenomenon of increasing demand for participation formats can also be seen in political and business practice. Thus, we propose the application of an existing taxonomy for (digital) involvement projects to CS, to enable structured comparisons within the CS field, while ensuring comparability with other participatory paradigms. In this paper we will present the theoretical foundations and methodological approach to the research project, highlighting potential challenges and benefits of a taxonomy-based approach to CS project design.

The DIP Taxonomy

In science, politics, and economics alike, the inclusion of lay people in formerly exclusive processes is gaining relevance. For citizens, various participation opportunities exist, particularly in the digital realm. While the field of science discusses this involvement as "Citizen Science" (Haklay et al. 2021), research on political participation examines the phenomenon of "E-participation" (Sanford and Rose 2007), and in the private sector, crowdsourcing processes are frequently mentioned (Estellés-Arolas et al. 2015). To better explore and classify participation projects across domains, Stein et al. (2023) aggregate these projects under the general term "Digital Involvement Projects" (DIPs) and develop a taxonomy of their key characteristics. They define DIPs as "projects that utilize digital platforms for the involvement of multiple external individuals in a defined participation process" (p.5) and derive, through an iterative process of theory and practice, 19 dimensions for describing DIPs (see Fig.1). The dimensions encompass sub-dimensions for the participation degree, the project's implementation process, incentives, communication structures, project stakeholders, and project outcomes (Stein et al. 2023).

Although the taxonomy aims to analyze the design of participation projects across domains, potential advantages may emerge when employing it within CS: In CS research, numerous endeavors have been made to theoretically distinguish CS practices. Early frameworks by Shirk et al. (2012) and Haklay (2013) employ the level of participation as a basis for differentiation. More recently, scholarly attention in the field of CS has shifted away from rigid definitions, adopting a more open and inclusive approach, advocating for the recognition of the plurality within CS endeavors (Haklay et al. 2021). For practitioners and policymakers to benefit from this diversity of approaches it is indispensable to create more awareness for and an understanding of their design differences (Andersen et al. 2007; Haklay et al. 2021). Compared to theoretical definitions of participation types, relatively little scholarly attention has been devoted to making actual design decisions of CS projects tangible. To this end, we suggest the DIP Taxonomy could be used. Scholars such as Monzón Alavarado et al. (2020) and Moczek et al. (2021) have already contributed project reviews. Extending their work by applying the DIP

Dim-ension	Sub-Dimension	Characteristics				
Degree of Participation	D1 Extend of participation	Information sharing	Consultative	Democratic		
	D2 Participation offer	Single task	Multiple tasks optional	Multiple tasks mandatory		
	D3 Type of participation	Active-effort	Active-ressources	Passive		
Implementation of Participation	D4 Format	Digital	Analog/ digital (paralell)	Analog/ digital (sequential)	Analog	
	D5 Implementation	Asynchronous-web-based platform	Asynchronous-mobile application	Synchronous	None	
	D6 Structure of participation	Team work/ participation	Individual work/ participation			
	D7 Time requirements	High	Low	Self-selected		
	D8 Prerequesites	Domain knowledge	Domain-specific equipment	Assumes preconditions		
Incentives	D9 Incentives for participation	Self-related extrinsic	Self-related intrinsic	Impact-related		
	D10 Reasons for the participatory design	Acceptance & legitimation	Funding	Access and ressources	Value-based	Profit maximisation
Communication	D11 Direction of communication	One-sided	Two-sided	Multi-sided		
	D12 Suggestions feedbacked	Expert feedback	Crowd feedback	No feedback		
	D13 Community building	Yes	No			
	D14 Moderation	Crowd	Individual from crowd	Organization/ expert (intern)	Organization/ expert (extern)	None
Project Stakeholder	D15 Project driver	Crowd	Individual from crowd	Organziation/ expert	Equal partnership	
	D16 Project owner	Crowd	Individual from crowd	Organization/ expert		
	D17 Target group	Open	Restricted	Closed		
Gains and Outcomes	D18 Project outcome	Product	Knowledge	Decision	Sharing things	
	D19 Publicity of the outcome	Public	Accessible for the participants	Non-public		

Figure 1. DIP taxonomy according to Stein et al. (2023) with adaptions for analog projects.

taxonomy, we can increase the number of design dimensions under review, providing a more complete picture of project design.

Analyzing CS with the DIP taxonomy

To utilize the DIP taxonomy for analyzing the realm of CS two prerequesites must be met. First, we note, that although online CS is trending throughout recent years, there is still a large quantity of projects that operates analgogously. For the DIP taxonomy particularily the dimensions “Format” and “Implementation” (Stein et al. 2023), are exlusively focused on the digital realm. To not exclude the variety of analog projects, we adapt the DIP taxonomy by adding a characteristic “analog” or “none”. Second, building upon experiences from

Monzón Alvarado et al. (2020) and Moczek et al. (2021) a direct contact to the project initators may be beneficial to accurately describe projects according to the taxonomy's dimensions. Thus, methodologically, we conduct a survey using a web application (Stein et al. 2023), working together with the German CS Platform "mit:forschen", to reach a diverse set of CS projects.

Through our methodological approach we obtain project classifications that present a descriptive view on CS project design. Focusing on the distribution of projects onto the taxonomy we are able to evaluate homo- or heterogeneity of CS projects within the individual design dimensions while also differentiating CS from the design in other participation domains (e.g. through absence of design features). Furthermore, we use hierarchichal clustering methods to identify relations and patterns within the projects' design approaches (Kassambara 2017).

Conclusion

In this paper, we present insights into an ongoing research project focusing on a taxonomy-based approach to project design. Drawing upon a taxonomy for DIPs, we aim at making the design decisions in CS projects tangible. Instead of creating exlusive definitions of CS, our approach focuses on describing the design of projects identifying as CS and to ultimately identify potential patterns and clusters to be able to discuss CS in a more differentiated way. Adopting the broader perspective of the design of (digital) involvement across domains, ensures applicability and enables comparability also to non-CS projects. We believe that providing this structural basis to compare and discuss project design across the CS landscape is indispensable to advance our understanding of the societal benefit different CS projects can achieve.

Refererences

Andersen KN, Henriksen H, Secher C, Medaglia R (2007) Costs of e-Participation: The Management Challenges. Transforming Government: People, Process and Policy, 1: 29–43.

De Albuquerque J, Almeida A (2020) Modes of engagement: Reframing "sensing" and data generation in citizen science for empowering relationships. In: Davies T, Mah A (Eds) Toxic truths: Environmental justice and citizen science in a post-truth age. Manchester University Press, 267–281.

Estellés-Arolas E, Navarro-Giner R, Guevara FG (2015) Crowdsourcing Fundamentals: Definition and Typology. Advances in Crowdsourcing, 33–48.

Haklay M (2013) Citizen science and volunteered geographic information: Overview and typology of participation. In: Sui D, Elwood S, Goodchild M (Eds) Crowdsourcing geographic knowledge Springer, Dordrecht, 105–122.

Haklay M, Dörler D, Heigl F, Manzoni M, Hecker S, Vohland K (2021) What Is Citizen Science? The Challenges of Definition. In: Vohland K, Land-Zandstra A, Ceccaroni L, Lemmens R, Perelló J, Ponti M, Samson R, Wagenknecht K (Eds) The Science of Citizen Science, Springer International Publishing, 13–33.

Kassambara A (2017) Practical guide to cluster analysis in R: Unsupervised machine learning (Vol. 1). Sthda.

Lewenstein BV (2022) Is Citizen Science a Remedy for Inequality? The ANNALS of the American Academy of Political and Social Science, 700(1), 183–194.

Moczek N, Hecker S, Voigt-Heucke SL (2021) The Known Unknowns: What Citizen Science Projects in Germany Know about Their Volunteers—And What They Don't Know. Sustainability, 13(20): Article 20.

Monzón Alvarado CM, Zamora Rendon A, Vázquez Pérez AS (2020). Integrating public participation in knowledge generation processes: Evidence from citizen science initiatives in Mexico. Environmental Science & Policy, 114: 230–241.

Nickerson R, Varshney U, Muntermann J (2013) A Method for Taxonomy Development and its Application in Information Systems. European Journal of Information Systems, 22.

Sanford C, Rose J (2007) Characterizing eParticipation. International Journal of Information Management 27.

Shirk JL, Ballard HL, Wilderman CC, Phillips T, Wiggins A, Jordan R, McCallie E, Minarchek M, Lewenstein BV, Krasny ME, Bonney R (2012) Public Participation in Scientific Research: A Framework for Deliberate Design. Ecology and Society, 17: 29–48.

Stein C, Straub T, Jachimowicz J, Fegert J (2023) Same same but different – Towards a taxonomy for digital involvement projects. In: ECIS 2023 Research Papers.