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Gau, M., Greif-Winzrieth, A., and Maedche, A. (2022). Leveraging Digital Citizen Science for Research Problem Discovery: Insights from a Home Office Challenge Participatory Action. *Mensch und Computer 2022 – Workshopband, 04.-07. September 2022, Darmstadt*
DOI: 10.18420/muc2022-mci-ws05-314

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Leveraging Digital Citizen Science for Research Problem Discovery: Insights from a Home Office Challenge Participatory Action

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ABSTRACT

Design-oriented research typically involves some kind of research problem discovery activity in order to identify and understand the problem space. Researchers can apply different methods to explore the problem space, for instance, interviews or focus groups. However, these methods are time consuming and do not scale well. Especially when it comes to discovering socially relevant real-world problems they require access to the general public to reach domain experts that is often difficult to achieve for researchers. Citizen science offers a promising approach for research problem discovery by actively involving citizens into the scientific inquiry to access knowledge on a large scale. In this paper, we report on a participatory action following a digital citizen science approach by specifically exploring the topic "home office" and corresponding challenges along four different subtopics. We report on (1) our approach and process to involve citizens in the problem discovery phase, (2) the implementation of the process in the web-based digital citizen science application *MyResearchChallenge* to enable citizens to register, collect, discuss, and vote challenges, and (3) provide a summary on the collected challenges.

KEYWORDS

Citizen Science, Research Problem Discovery, Participatory Action

1 INTRODUCTION

Scientific inquiry is considered as an iterative and cyclical process with different phases in which different types of information are collected and continually revised [1, 7]. One of the first phases includes gathering information and resources through observations, definitions, and measurements of the subject of inquiry. In particular, in the context of design-oriented research the research problem discovery plays a critical role as solutions for real-world problems

should be suggested. For instance, Design Science Research (DSR) includes an explicit phase to explore and discover the problem space in order to get a comprehensive understanding of the problem in a defined application domain [21]. Most frameworks or process models guiding DSR researchers (e.g. [10, 18, 19]) include a problem awareness phase describing different activities to explore the problem space. Mainly qualitative methods such as interviews and focus groups are applied by researchers to get a deeper understanding of the problem space. These methods are well established and well accepted in many disciplines. Furthermore, there exist guidelines and process descriptions supporting researchers on how to conduct for instance interviews [16] or focus group studies [20]. However, qualitative methods often require domain experts or stakeholders with dedicated knowledge about the problem space [22]. For researchers it can be difficult to reach domain experts, particularly across different application fields and when it comes to topics that affect citizens in their everyday lives such that they should be considered to be the "real-world domain experts". Additionally, most of the qualitative methods are time consuming and do not scale.

Citizen science, "the (large-scale) involvement of citizens in scientific endeavors not only as participants but as co-researchers" [23, p. 273] represents a promising approach that is already well-established in many domains and of increasing relevance in the field of Information Systems (IS) [11]. Recent studies suggested innovative solutions in order to actively engage citizens for different purposes from urban planning to collecting observational data [2, 4, 17]. We believe that citizens are in a good position to provide valuable input for research problem discovery by sharing their expertise and real-world experiences. Already today, citizens articulate themselves on social media platforms by capturing their opinions and real-world experiences [12]. Such data is a rich source to identify research topics with societal relevance, explore problem spaces, and better understand problems on a broader scope. However, typically social media posts are not focused towards specific research topics. To the best of our knowledge, not much has been done on systematical and structured involvement of citizens in the research problem discovery phase following a digital citizen science paradigm. To fill this gap, we previously designed the digital citizen science application *MyResearchChallenge* [8] that enables citizens to actively participate in the problem discovery phase of given research projects. Following the DSR approach proposed by Kuechler and Vaishnavi [10] we applied a prototypical implementation of *MyResearchChallenge* in a public participatory action with the aim

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Veröffentlicht durch die Gesellschaft für Informatik e.V.

in K. Marky, U. Grünefeld & T. Kosch (Hrsg.):

Mensch und Computer 2022 – Workshopband, 04.-07. September 2022, Darmstadt

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<https://doi.org/10.18420/muc2022-mci-ws05-314>

to collect challenges related to working and studying from home - a topic that quickly gained increasing public and scientific relevance during the COVID-19 pandemic, but is also supposed to retain its high theoretical and practical relevance in the coming years.

Therefore, we formulate the following research question: *How to design a research problem discovery system engaging citizens to participate on a publicly available digital citizen science application in the specific context of home office challenges?*

In this paper, we report our insights collected within a participatory action focusing on collecting home office challenges. We illustrate the use of *MyResearchChallenge* in order to share, discuss, and vote challenges reported by citizens. During a period of four weeks 948 citizens visited the web application and submitted 26 challenges along four different subtopics. Furthermore, we invited citizens to vote for challenges they perceive as important and relevant for further scientific investigation. The remainder of the paper is as following: First, we shortly describe the digital citizen science application *MyResearchChallenge* and its functionality. Subsequently, we describe the key steps carried out within the home office challenge participatory action. Third, we report preliminary results of the participatory action with a specific focus on analyzing the actual behavior of citizens. Finally, we summarize and provide an outlook on future research activities.

2 THE DIGITAL CITIZEN SCIENCE APPLICATION

The identification of relevant real-world problems requires the involvement of those affected already in the initial problem identification phase [14]. In order to engage with different stakeholders we invited citizens and collected problems and challenges using the digital citizen science application *MyResearchChallenge* [8]. *MyResearchChallenge* is a web-based platform that allows creating different research topics and collecting challenges and problems regarding the topic from citizens. Each topic contains a short description explaining the core of the topic and defining the boundaries of the problem space [21]. Furthermore, the system provides information about the participatory process and the corresponding dates and duration of the phases. Ensuring data quality is a main issue in citi-

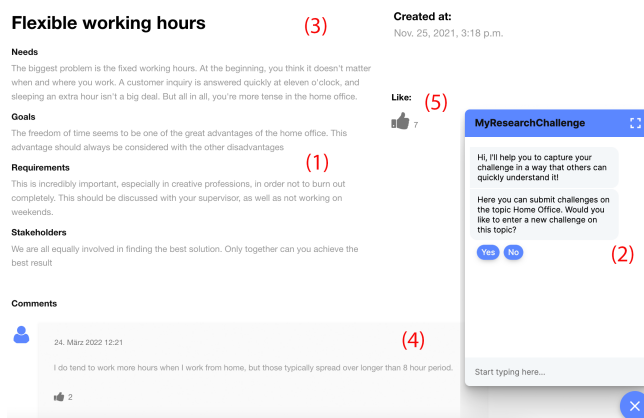


Figure 1: Core features of *MyResearchChallenge*.

zen science projects because of the heterogeneity of contributors [12]. *MyResearchChallenge* provides features to collect challenges in a structured manner to ensure data quality. The underlying conceptualization is based on the four principles namely Needs, Goals, Requirements, and Stakeholders (1) described by the conceptual model of the problem space proposed by Maedche et al. [13]. To capture new challenges on the application a conversational agent (CA) provides guidance (2). CAs are used in many fields such as supporting problem-solving tasks [24] or to collect data in an interactive way [6]. The CA asks questions based on the conceptual model. Each challenge requires a title and a general description. Optionally further details regarding the four concepts described by the problem space model can be added. Furthermore, to reduce spam submissions the CA asks for a valid email address of citizens were the system sends an activation link to publish the challenge and share the description with other citizens. After submitting a challenge, the owner of the challenge can edit the descriptions or directly confirm the challenge to get the description published on the *MyResearchChallenge* platform.

All confirmed challenges are publicly available and can be accessed by other citizens (3). Additionally, citizens can comment (4) on published challenges and provide further details, experiences, or any other comment regarding the challenge descriptions. Challenges and comments can be liked (5) if citizens perceive the submissions interesting or relevant. Figure 1 illustrates the core features of *MyResearchChallenge*.

3 THE HOME OFFICE CHALLENGE PARTICIPATORY ACTION

In times of COVID-19, home office is a possible means to reduce social contacts. Over the last two years, many citizens had to work from home and experienced problems and challenges regarding this situation. Working and studying from home became a daily business for most of us. However, this situation presents many workers and students with new challenges and unexpected problems [3, 9].

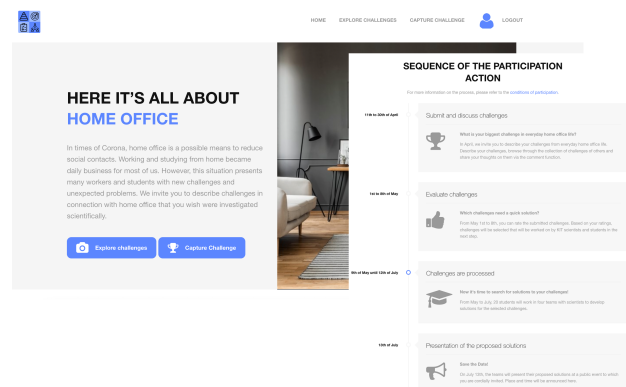


Figure 2: Home screen of *MyResearchChallenge*.

We invited citizens to describe challenges in connection with home office that they wish were investigated scientifically by a team of researchers. We defined four different subtopics of particular relevance within the home office topic. During the submission process,

Table 1: Citizens submissions in the home office challenge

Submission	Physical Activity and Health	IT Security	Motivation and Leadership	Collaboration Tools	Total
Challenges	5	2	11	8	26
Likes	9	6	27	27	69
Comments	3	2	1	4	10

citizens could select one of the following subtopics to submit their challenge: Physical Activity and Health, IT Security, Motivation and Leadership, and Collaboration Tools. One or two experts out of the team of researchers were responsible for each of these subtopics during the participatory action. All experts introduced themselves on the web application by providing a short statement about their expertise and research interests. Figure 2 depicts the landing page of the home office topic and its description on *MyResearchChallenge*.

Based on the framework introduced by Ghezzi et al. we derived a process structuring our citizen involvement action [5]. The process consists of five different phases including a collection and discussion, voting, selection, design, and presentation phase. We defined a linear process flow and each phase had a specific start and end date. In the collection phase citizens could use the CA to submit new challenges. Moreover, citizens could browse through existing challenges on the web application to get inspired by other challenges or discuss challenges with other citizens by adding comments. In the voting phase citizens could vote for challenges they find interesting or relevant and they wanted to be further investigated scientifically. In the selection phase a team of four experts of the different subtopics evaluated the feasibility of the most voted challenge in each subtopic and initiated the design phase. For each subtopic one team of five students was working on a prototypical solution for the selected challenges. Each team was supervised by the experts of the corresponding subtopic. Applying a design-oriented research approach the teams aim to propose a solution for the citizens' challenges. Detailed description and duration of the phases were available on the landing page on *MyResearchChallenge* and made transparent for the participating citizens. *MyResearchChallenge* supports all phases of the proposed process. However, in our participatory action we focused on the problem-finding phase where citizens can contribute to the home office topic and interact with the system. To submit challenges or comments citizens had to accept the privacy policy and confirm that they are older than 18 years.

4 PRELIMINARY RESULTS

In order to invite citizens to submit their challenges regarding the home office topic and the four predefined subtopics we used social media channels from the university and the city, local newspaper announcements, and the institute's website to engage citizens with a call to action [15]. During four weeks 948 citizens visited *MyResearchChallenge* and 3,318 page loads were requested. Citizens submitted 26 challenges including 10 comments and 69 likes on the web application. 26 citizens participated during the collection and commenting phase and another 30 citizens participated in the rating phase. Table 1 summarizes the results of the collected submissions in the four different subtopics.

The 26 submitted challenges contain different aspects of the four subtopics regarding the home office topic. With regard to the subtopic Physical Health and Activity citizens described challenges concerning healthy diet, lack of physical activity as well as work-life-balance. In the IT security subtopic challenges related to accessing emails and resources from a remote work place as well as the topic of authentication came up. In Motivation and Leadership citizens mentioned challenges regarding the relationship between team leaders and teams as well as within the team and the challenge of coping with distractions in the home environment. In the Collaboration tools subtopic citizens reported missing opportunities for informal communication but also technical obstacles. Overall, 62% of the challenges contained the optional details about Needs, Goals, Requirements, and Stakeholders described by the conceptual model of the problem space [13].

During the voting phase citizens could select important and relevant topics they wanted to be investigated scientifically by clicking a "Like"-Button. In the subtopic Physical Activity and Health the challenge entitled "Lack of commuting" was rated as most important. Citizens reported that the lack of commuting is perceived as a challenge and leads to reduction of movement especially in the case for those citizens who travel by bike or walk to the office on a daily basis. In the subtopic IT Security citizens reported that the access to encrypted e-mails in the home office environment is a challenge and causes issues. Furthermore, they underline various aspects regarding this issue including security awareness of employees, technical issues, and lack of clear governance structure. In the Motivation and Leadership subtopic citizens voted the challenge with the title "Staying in touch with employees as a manager" as relevant and important. Citizens reported that in many cases the exchange for understanding, opinion-forming, and cohesion no longer takes place in home office settings. In the subtopic Collaboration Tools citizens selected the challenge describing the lack of short informal and often spontaneous interactions as most important. Interpersonal communication and brief exchanges among colleagues are perceived as an important part of everyday work and is often missing in home office environments.

From a methodological point of view, we learned that a sound and extensive communication concept is crucial to reach citizens and motivate them to participate. During the collection and voting phase many citizens visited *MyResearchChallenge* but only few challenges were submitted. Only 5.9% of the visitors actively contributed to the participatory action by submitting, commenting, or liking a challenge. One citizen submitted a challenge but did not confirm it to publish the description. None the less, we consider the quality of the submitted challenges to be high. All submitted challenges were rated as relevant by the experts and related to the home office topic and to the respective subtopic. The descriptions of the challenges

provided by the citizens were easy to understand and contained many details.

5 SUMMARY

Based on existing open source design knowledge we derived a process including five phases to get citizens involved in the problem discovery phase of the scientific inquiry. In this paper we report insights from a public participatory action where we applied the web-based digital citizen science application *MyResearchChallenge* that enables citizens to actively contribute to the problem discovery phase of a given research project. We applied *MyResearchChallenge* to collect citizens' challenges occurring from working and studying at home. Therefore we invited citizens to report and discuss their challenges in order to share their needs and participate in the process of scientific inquiry. Citizens submitted 26 challenges, 69 likes, and 10 comments regarding the submitted challenge descriptions. Based on the results presented we cannot yet compare the approach using *MyResearchChallenge* to other approaches like interviews and focus groups. However, we argue that *MyResearchChallenge* presents new opportunities in cases where other methods are not feasible (e.g., due to temporal or spacial restrictions). In the same vein we do not claim that citizens can replace professional domain experts in any research project but that their expertise can add value to the process of identifying socially relevant research topics. In future research we plan to further investigate how to design problem discovery systems in order to involve citizens in the scientific inquiry. We aim to deliver design knowledge such as design principles and design features supporting researchers and citizens in the problem exploration phase which is a central part of research projects following the scientific method [1]. Additionally, future research could investigate on how citizens could participate in design science research beyond the problem discovery phase.

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