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How participants are integrated into community-driven research for accessibility: A systematic review

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Abstract

Community-driven research, including citizen science and crowdsourcing, offers effective approaches for addressing accessibility challenges. Given the user-sensitive nature of accessibility research — particularly when involving people with disabilities — it is essential to include individuals from the intended beneficiary groups. This study examines how community-driven research has been applied in accessibility-related contexts and identifies the issues explored. Through a systematic review, we analyzed the topics, mechanisms, participants, and beneficiaries involved. The findings reveal diverse engagement methods and three levels of participation: observers or data collectors, data providers, and task executors. Participants were involved based on professional expertise, personal characteristics, contextual relevance, or as general volunteers. Notably, many studies did not explicitly describe the role of the target population, making it unclear whether the intended beneficiaries were actively involved. This study concludes by proposing future research directions, emphasizing the importance of examining researcher–volunteer relationships through the lenses of ethics, trust, and role expectations.

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Introduction

Community-driven research, such as citizen science and crowdsourcing, has been recognized as a potential and powerful approach to addressing issues that people encounter in real-life contexts (Lukyanenko, *et al.*, 2020, 2017). Both approaches are effective for eliciting user-oriented needs and gathering requirements to support the development process in user-centered design, offering the potential to involve participants across a wide range of geographical and demographic characteristics (Bruun and Stage, 2015; Levy and Germonprez, 2017; Sturm and Tscholl, 2019). In addition, both of these approaches can be empowering and educational for participants (Dang, *et al.*, 2022).

While practices such as user-centered design and user participation are often considered as a *de facto* for capturing users' actual needs (International Organization for Standardization, 2019), there are still practical challenges to their implementation. For instance, there are challenges related to perspectives on the process of eliciting information from users is perceived by both participants and scientists (van Velsen, *et al.*, 2022), as well as from users' sense of influence and ownership in the process (Beresford, 2002; Leso and Cortimiglia, 2022).

Though the concepts of user-centered design and user participation focus on user centricity, in the context of citizen science projects, the term 'citizen science' refers to partnerships between scientists and members of the public who engage in scientific research as a part of their everyday lives (Mäkipää, *et al.*, 2020). By 'the public', we mean participants who voluntarily take part in research activities in various phases of the research life cycle such as in resource gathering, defining research questions or problems, collecting and analyzing data, disseminating results, and evaluating findings (Mäkipää, *et al.*, 2020). However, when user participation involves people with disabilities, user-sensitive considerations must be taken into account (Antona, *et al.*, 2009; Newell, *et al.*, 2011). For instance, communication between researchers and participants has been identified as a key challenge, particularly when participants struggle to understand what is expected of them (Henry, *et al.*, 2002; Joss, *et al.*, 2016).

Prior community-driven research projects have often involved volunteers without disabilities in monitoring and reporting observations of accessibility-related issues to initiatives aimed at improving accessibility; see, for example, the concept of social accessibility (Shinohara, 2012; Takagi, *et al.*, 2009, 2008). However, according to the act "Nothing about us without us" (Charlton, 1998), participation should always include individuals who are directly affected by the issues that are being addressed. To involve people with disabilities, Krüger, *et al.* (2023), proposed a methodological framework based on Arnstein's (1969) ladder of participation, in which individuals with disabilities, along with their representatives and stakeholders, are involved in research and development processes. Similarly, Paleco, *et al.* (2021), proposed practices for involving diverse citizens as experts in the field to address relevant issues. Varga, *et al.* (2023) suggested recommendations for fostering inclusion in citizen science initiatives, ranging from abstract principles — such as centering strategies around marginalized groups and embracing the possibility of mistakes — to practical actions, including partnering with intermediary organizations, using inclusive language, and publishing participant demographic data. In their study on occupational therapy and rehabilitation, Chapman, *et al.* (2022) emphasized the importance of including citizens with disabilities in the research lifecycle from the outset, to ensure that the research is guided by the community's most pressing priorities.

In the context of citizen science, previous systematic literature reviews have examined citizens' perceptions of citizen science application usability (*cf.*, Skarlatidou, *et al.*, 2019), as well as applicability of citizen science in fields such as information systems (Dang, *et al.*, 2022; Mäkipää, *et al.*, 2020). However, there is still a limited amount of knowledge on how citizen science and crowdsourcing are utilized in accessibility-related research, particularly regarding how researchers involve people with and without disabilities. This gap motivated us to explore the practices scientists have employed to engage users — both with and without disabilities — in accessibility-focused citizen science projects, and to analyze how these studies are conducted.

To address the established research question (*RQ*) — *How is community-driven research utilized in accessibility-related topics?* — we conducted a systematic literature review, considering the instructions provided by Kitchenham and Charters (2007), to collate and synthesize prior knowledge on the subject. We investigated research topics, mechanisms used to involve participants, who the participants were and what roles they played, as well as who were identified as the intended beneficiaries in each study. Taken together, this study presents the following contributions:

- Presenting how community-driven research is utilized in accessibility-related studies and identifying the specific subjects that have been explored.
- Illustrating how participants (other than scientists) have been involved in the research and the roles they have assumed.
- Highlighting the importance of explicitly articulating how beneficiaries are involved in community-driven research.
- Providing future research directions for community-driven studies that address accessibility-related issues.

The next section presents the prior literature, followed by the research methodology of this study. Then, the findings and a synthesis of current practices are presented. Lastly, the discussion and aspects for future research conclude the paper.

Related prior literature

Digital services, including Web sites and mobile applications, are legally required to be accessible to the widest possible range of users with the widest range of tasks and contexts (Lazar, *et al.*, 2013; Olalere and Lazar, 2011; European Union, 2016; Section508.gov, n.d.). There is a relatively large body of literature that seeks to understand how to elicit accessibility problems effectively (Mack, *et al.*, 2021; Mäkipää, *et al.*, 2022; Paiva, *et al.*, 2021). Research aimed at developing techniques to improve the accessibility and usability of user interfaces (UI) has often incorporated user-centered design (UCD) practices to involve users with disabilities (Paiva, *et al.*, 2021). UCD focuses on interactive systems development with the goal of making systems usable by focusing on users' needs and requirements by applying human factors/ergonomics as well as usability knowledge and techniques (International Organization for Standardization, 2019). The main principles of UCD consist of understanding of user needs and context of use; involvement of users; evaluation by users; and the iteration of development solutions (Sturm and Tscholl, 2019). User participation, however, exists with varying degrees. Arnstein's (1969) ladder of citizen participation — frequently referenced in studies on citizen participation and design involvement (Botchwey, *et al.*, 2019) — categorize participation into three levels: nonparticipation, tokenism, and citizen power. Nonparticipation is characterized by forms such as therapy and manipulation that enable powerholders to 'cure' or educate the participants. Tokenism involves consultation, and informing, where users adopt giving roles. Citizen power includes citizen control, delegated power, and partnership, with bi-directional and multi-directional information sharing. Partnership involves reciprocity protocols, advocacy, and consent.

Practitioners, however, often have limited resources to elicit users' perceptions of accessibility and usability within real-life usage contexts (Bruun and Stage, 2015). In software development, the emphasis on accessibility has predominantly centered on software testing and design, thereby neglecting the development of methodologies that address the human dimensions of interaction among diverse user groups (Paiva, *et al.*, 2021). To efficiently elicit user requirements that are relevant to everyday life, there have beeen efforts to identify accessibility issues whenever and wherever they arise. Technology makes it possible to collect information and design tasks for parties by using virtual platforms (Brady and Bigham, 2015).

Drawing on user participation in citizen science, it is evident that citizen science or crowdsourcing can serve as effective mechanisms identifying and addressing accessibility issues. For example, Miyata, *et al.* (2021) crowdsourced the detection of accessibility issues in non-digital environment for citizens to identify and resolve for citizen transporting in their surrounding environment. Similarly, Alqadi, *et al.* (2020) justified crowdsourcing potentiality as a beneficial tool to rate accessibility issues in built environment for a population with disabilities. A study by Aly, *et al.* (2021) presented an application that generates crowdsourced extensions for digital maps to provide information on accessible routes in indoor and outdoor places. Similarly, Mobasheri, *et al.* (2017) developed a platform to crowdsource geographical information about wheelchair-accessible places to improve access and stimulate multimodality in transportation.

Studies related to social accessibility explored the power of communities to improve accessibility. For example, Shinohara, *et al.* (2018a) examined accessibility through design workshops. They incorporated user-centered design activities with a perspective emphasizing social aspects of accessibility. They investigated how professional designers could leverage social factors to include accessibility in design. Takagi, *et al.* (2013, 2008) proposed a social accessibility crowdsourcing platform enabling users encountering accessibility problems on the Web or in a workplace to report those issues. To address these issues, volunteers were asked to contribute to resolving specific problems. Similarly, Sato, *et al.* (2010) developed a collaborative platform for social accessibility, bringing together screen reader users, Web developers, Web site owners, and volunteers interested in assisting users who encountered accessibility challenges. In their project, approximately 70 percent of improvements were initiated by user requests. Although the productivity of volunteers was commendable, they faced difficulties in fully understanding the reported issues, partly due to users' limited familiarity with the nature of the problems. Consequently, encouragement, support, and quality management played a critical role in facilitating effective data collection and problem resolution.

The nature of citizen science can also encompass an educational dimension (Dang, *et al.*, 2022). For instance, in their study involving higher education students, Shinohara, *et al.* (2018b) found that designing for individuals with and without disabilities enhanced students' awareness of the value and diversity of accessibility for all. Thus, participation in citizen science may offer educational benefits, including knowledge acquisition and personal empowerment (Dang, *et al.*, 2022; King, *et al.*, 2020).

Previous systematic literature reviews have examined factors in IT development that influence accessibility (Mäkipää, *et al.*, 2022; Paiva, *et al.*, 2021), as well as current and historical trends within the accessibility research domain (Mack, *et al.*, 2021). Wiggins and Crowston (2015) identified key features of citizen science project design and management — such as funding sources, project goals, participant activities, data quality processes, and social interaction — but did not consider the inclusion of people with disabilities as participants. Skarlatidou, *et al.* (2019) explored volunteers' usability needs and requirements in relation to citizen science applications. Mäkipää, *et al.* (2020) conducted a systematic literature review on citizen science within the field of information systems, aiming to understand how scholars conceptualized and conducted research related to citizen science more broadly. Dang, *et al.* (2022) proposed an episode framework for managing long-term citizen science projects, offering guidance on design, implementation, adaptation, and post-implementation activities. While they addressed strategies for motivating and engaging volunteers, accessibility issues and the inclusion of people with disabilities were not considered.

Positioning this study within the context of prior literature, we reviewed existing research to consolidate the knowledge base on citizen science and crowdsourcing practices that specifically addressed accessibility-related issues.

Methodology

In this study, we considered instructions provided by Kitchenham and Charters (2007) to conduct a systematic literature review process in three phases: planning the review, conducting the review, and reporting the review. These phases are described in detail in the following sub-sections.

Planning the review

In the planning phase, we formulated a search string, selected a database, and defined a set of eligibility criteria. To construct the search string, we identified relevant search terms based on keywords from prior studies that addressed topics aligned with our research question. The final search string included the following terms and their variations: *crowdsourc** (*e.g.*, crowdsourcing, crowdsourced, crowdsource), *accessib** (*e.g.*, accessibility, accessible), and the exact phrase "*citizen science*." We did not include synonyms or alternative spellings for "citizen science," as our focus was specifically on studies that explicitly use this well-established term. This decision is supported by its consistent use in the literature (*e.g.*, Dang, *et al.*, 2022; Lukyanenko, *et al.*, 2020; Mäkipää, *et al.*, 2020), as is the case with "accessibility" and "accessible" (*e.g.*, Mäkipää, 2023; Persson, *et al.*, 2015).

Next, we constructed a Boolean search string to connect the selected keywords, resulting in the following general form: ("citizen science" OR *crowdsourc**) AND *accessib**. To ensure broad disciplinary coverage, we targeted a wide range of scientific fields by searching for peer-reviewed journal articles and conference proceedings indexed in two major multidisciplinary databases: *Web of Science* [1], and *Scopus* [2]. We included studies that contained the search terms in the title, abstract, or author keywords.

We predefined the following eligibility criteria for the study selection phase:

1. Only studies written in English were included;
2. Publications dated between 2000, and September 2024 were included;
3. Only journal and conference papers were included. Literature reviews were excluded to avoid potential duplication of primary studies. Editorials, opinions, commentaries, book chapters, and poster-type of papers were also excluded;
4. Only studies addressing topics relevant to the research question were included.

Conducting the review

We conducted the study selection procedure through the following steps:

- Step 1: We executed the search query using the established search string in *Web of Science*, which yielded 398 results, and in *Scopus* which provided 389 results.
- Step 2: We applied filters for publication date (2000–September 2024), language (English only), and document type (journal articles and conference proceedings). This filtering excluded 40 papers from*Web of Science* and 52 from *Scopus*.
- Step 3: We removed 125 duplicate records, resulting in a total of 427 unique papers.
- Step 4: We screened titles and/or abstracts to exclude studies unrelated to our research question.
- Step 5: We excluded studies whose primary focus was not on accessibility research or the promotion of accessibility. We included studies that addressed accessibility, human abilities, disabilities, human characteristics, or other diversity-related human factors, and that employed citizen science or crowdsourcing approaches. We also included studies from the perspective of human-computer interaction (*e.g.*, Web, UI, digital services), as well as those addressing accessibility in transportation or the physical environment (*e.g.*, spatial data). Studies were excluded if the term "accessibility" referred to non-human factors, such as data accessibility or availability. At this stage, 390 papers were excluded, and 37 papers were retained for full-text review. After detailed reading, we excluded additional studies that did not provide relevant information for our purposes. The final selection included 22 primary studies (PS), which are labeled with IDs PS1 to PS22 and listed in the Appendix. Figure 1 presents a visual illustration of the selection flow of primary studies.

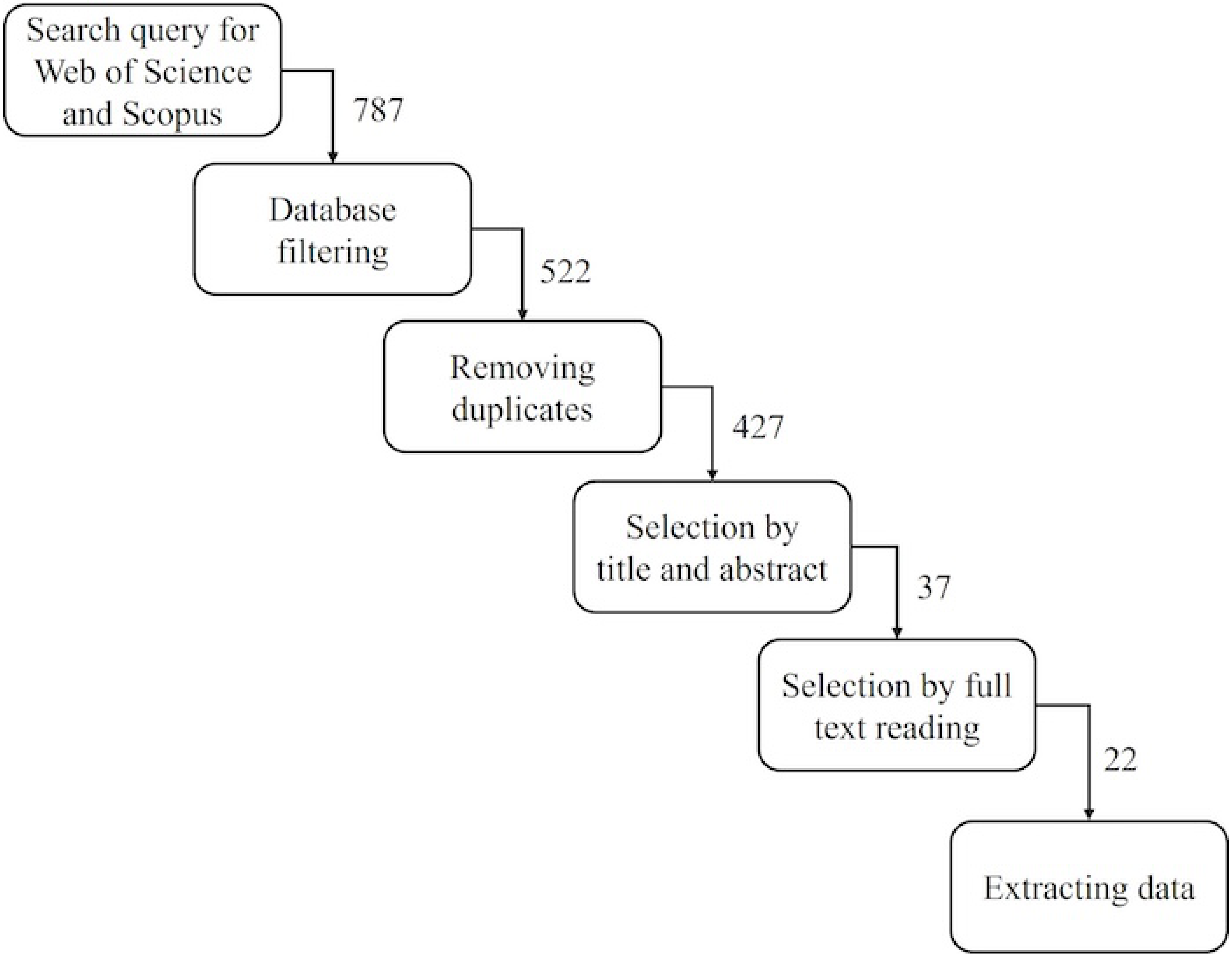

Figure 1: Selection flow of primary studies.

To conduct a comprehensive review and analysis of the selected papers, we extracted items related to the mechanisms employed in each study. Initially, we collected general metadata — such as title, year of publication, authors, and publication venue — which, while not directly related to the research question, provided contextual information for understanding the temporal and disciplinary distribution of the studies. Subsequently, we extracted data aligned with the established research question. The final coding framework included the following elements: context, the beneficiaries of the study, workers, and methods and/or techniques used in the study. To guide the coding process, we constructed a data extraction form (Table 1) including the posed questions.

Table 1: Data extraction form.

Data item	Question posed for the study (if any)
Title	—
Author(s)	—

Year	—
Name of publication venue	—
Context	What is the context or the topic of the study?
Beneficiaries of the study	Who are the intended beneficiaries?
Workers	Who are the contributors or "workers" in the community-driven project?
Methods and/or techniques used	What mechanisms (methods or techniques) are used to engage participants?

The first author of this paper independently completed steps 1–3. Subsequently, steps 4 and 5 were carried out by the first and second authors together, during which all paper exclusions were presented in a meeting to the third and fourth authors, who acted as critical reviewers. Data extraction was evenly divided among all four authors, after which the identified items were presented to each other in a joint meeting. The first and second authors then re-reviewed all articles to double check that all necessary items were extracted.

Reporting the review

We analyzed both quantitative and qualitative studies qualitatively. Thus, also the contributions of quantitative studies were qualitatively interpreted and included in the synthesis. We extracted data based on pre-defined data extraction form which was collated in spreadsheets. Then data items were shorted by topic and described in the following section.

Findings

In this section, we present the findings of our SLR, starting with an overview of the topics covered in the PSs. Then we describe, for each topic, how PSs utilized community-driven research; *i.e.*, we describe what kind of mechanisms (methods, techniques) were used, who was involved, and who the intended beneficiaries were.

Overview of topics

In our SLR, we extracted the context of the PSs, which we then categorized into four main topics: (1) Accessible environment; (2) Application accessibility; (3) Digital content accessibility; and, (4) Societal inclusiveness. *Accessible environment* encompassed various subtopics such as urban accessibility, sidewalk accessibility, accessible housing, and public transportation accessibility. *Application accessibility* included studies on user interface accessibility, online citizen science applications, and the usability of Web-based citizen science tools. *Digital content accessibility* covered areas like image captions, assistive technology such as conversational agents, synthetic speech and human listening rates, e-book accessibility, and image accessibility. *Societal inclusiveness* dealt with workplace inclusion and age-friendliness, dignity as the acknowledgment of personhood, involving elderly people in the development of apps for citizen science project data collection, and the introduction of universal design in museum contexts. In Table 2, we list the main topics, including subtopics, along with their references.

Table 2: Topics of primary studies.

Topic of study	Subtopics
Accessible environment [PS2; PS6; PS10; PS13; PS14; PS16; PS17; PS18; PS19; PS20; PS22]	• Urban accessibility [PS2; PS6; PS16; PS17; PS22] • Sidewalk accessibility [PS13; PS14] • Accessible housing [PS18] • Public transportation accessibility [PS10; PS19; PS20]
Application accessibility [PS9; PS12; PS21]	• User interface (UI) accessibility [PS9] • Online citizen science app [PS12] • Usability of Web-based CS tool [PS21]
Digital content accessibility [PS1; PS4; PS7; PS15]	• Image captions [PS1] • Assistive technology [PS4] • E-book accessibility [PS7] • Image accessibility [PS15]
Societal inclusiveness [PS3; PS5; PS8; PS11]	• Dignity as the acknowledgement of personhood [PS5] • Involvement of community members [PS8] • Universal design [PS11]

Next, we present each topic individually, beginning with on overview of the main topic, followed by a detailed description of the mechanisms employed in the research, participants involved, and intended beneficiaries of the research objectives.

Accessible environment

Accessible environment encompassed subtopics related to urban accessibility [PS2; PS6; PS16; PS17; PS22], sidewalk accessibility [PS13; PS14], accessible housing [PS18], and public transportation accessibility including studies [PS10; PS19; PS20]. Table 3 illustrates, for each topic, the mechanisms used in the research, participants involved, and intended beneficiaries. We use the term volunteers for those participants who were not explicitly assigned to any specific group in the primary studies (Dang, *et al.*, 2022).

Table 3: Mechanisms, workers, and intended beneficiaries utilized in topics of accessible environment.

Topic	Mechanisms used in study	Workers who participated in study	Intended beneficiaries reported in study
Urban accessibility [PS2]	- On-site field survey - Online forum - Virtual accessibility audit - Workshop	- Elderly people - Parents with pushchairs - People with mobility limitations	- Universal - People with reduced mobility - People with mobility impairment
Urban accessibility [PS6]	- Workshop - Audio notes - Photographing - Result dissemination by presentation	- Elderly people	- Elderly people
Urban accessibility [PS16]	- User reports - Obstacle annotation	- Volunteer experts (*e.g.*, local administrations, disability rights organizations, hotel associations, etc.) - Volunteers	- People with disabilities - People with reduced mobility
Urban accessibility [PS17]	- Data validation (by experienced moderators volunteers) - Obstacle labelling - Obstacle mapping	- Volunteers	- People with mobility impairment - People with visual impairment - Blind people

Urban accessibility [PS22]	- Obstacle annotation - Questionnaire	- Elderly people - Volunteers without disabilities as a control group - Wheelchair users - Persons with visual impairments	- Universal - People with reduced mobility - People with mobility impairment - People with visual impairment - Elderly people
Sidewalk accessibility [PS13]	- Group discussion	- ADA coordinators and urban planners - Caregivers - People with mobility limitations - People with visual limitations	- People with disabilities - Universal
Sidewalk accessibility [PS14]	- Sidewalk data mapping	- Volunteers (some of them are people with reduced mobility or people with mobility impairment)	- People with mobility impairment - People with reduced mobility
Accessible housing [PS18]	- Survey	- Elderly people - People with disabilities - Volunteers	- Elderly people - People with reduced mobility
Public transportation [PS10]	- Image labelling - Interview	- Blind people (interviewees) - Crowd workers (data collection (bus stop labelling with bus stop CSI tool)	- Blind people - People with visual impairment

Public transportation [PS20]	Real-time data collection	Volunteers	People with disabilities

One of the subtopics of accessible environment covered **urban accessibility**. In our review we identified five studies which utilized community-driven research (including approaches such as citizen science and crowdsourcing) to improve urban accessibility.

Allahbakhshi (2023) [PS2] engaged 80–100 community members, including older adults (65+), parents with pushchairs, and mobility-disabled individuals (*e.g.*, wheelchair users), to conduct virtual accessibility audits via an online citizen science platform. Their findings were supplemented by virtual audits from volunteers with geographical data expertise and on-site field surveys by research assistants. Chesser, *et al.* (2020) [PS6] recruited 10 citizen scientists aged 68–78 to document accessibility barriers and supports on a university campus through data collection walks, where the citizen scientists recorded their observations by photographs, and supplementary audio commentaries. Furthermore, Chesser, *et al.* (2020) [PS6] pointed out that citizen scientists also participated in data analysis sessions and presented their findings to stakeholder and decision-makers from different campus units.

Other community-driven studies examined geo-crowdsourcing and mobile applications to collect accessibility data. Prandi, *et al.* (2018) [PS16] developed a mobile application that provided personalized urban routes using accessibility data collected from volunteers and expert volunteers (including local administrations, disability rights organizations, and hotel associations). Volunteers annotated obstacles, provided reviews, and reported on accessibility features. Qin, *et al.* (2016) [PS17] proposed a geo-crowdsourced solution for mapping transient navigation obstacles, where volunteers labeled accessibility constraints using a Web application. Quality assessment was performed by experienced volunteer moderators. Zeng, *et al.* (2017) [PS22] also studied environmental accessibility data collection, analyzing how volunteers, including elderly individuals, wheelchair users, visually impaired people, and those without disabilities, annotated obstacles while traveling in an experimental study.

Studies chosen for our review focused on the involvement of community members, volunteers, and stakeholders in accessibility research. Allahbakhshi (2023) [PS2] facilitated workshops where academics and community members discussed project objectives and findings, with additional engagement through online forums and social events. Chesser, *et al.* (2020) [PS6] highlighted the importance of including beneficiaries in both data collection and analysis, to ensure that research objectives and outcomes are informed by lived experiences. In Chesser, *et al.* (2020) [PS6], citizen scientists presented their findings to stakeholders and decision-makers, thus fostering institutional engagement as well.

All PSs under the topic emphasized the broader societal benefits of improving urban accessibility. Allahbakhshi (2023) [PS2] identified individuals with disabilities and those with restricted mobility as primary beneficiaries, while also recognizing that an inclusive urban environment benefits society as a whole. Chesser, *et al.* (2020) [PS6] pointed out that accessible campuses benefit not only elderly people but also individuals of all ages with diverse physical accessibility needs. Prandi, *et al.* (2018) [PS16] noted that their research supports people with physical and sensorial disabilities, although they did not specify the demographics of who volunteers. Qin, *et al.* (2016) [PS17] explicitly stated that their research benefits blind individuals, visually impaired individuals, and those with mobility impairments. Zeng, *et al.* (2017) [PS22] though not explicitly mentioning beneficiaries, indicated that their study provides valuable insights for designers and developers working on collaborative environmental accessibility solutions, ultimately benefiting the volunteer groups involved in their research.

Related to the topic of **sidewalk accessibility**, there are two mechanisms used in the PSs including group discussion and sidewalk data mapping. Labbé, *et al.* (2023) [PS13] used a series of iterative community workshops on accessibility data. Particularly, Labbé, *et al.* developed a sidewalk tool to help people reflect on the possibilities of use and application of sidewalk accessibility data. Those involved in the study included people with mobility limitations, visual limitations, caregivers, Americans with Disabilities Act (ADA) coordinators, and urban planners. They engaged in the study by participating in a total of seven workshops. The workshops were conducted online via Zoom, using various interactive tools like whiteboards, survey polls, and chat functions to facilitate engagement and capture participants' thoughts and feedback. Each group engaged in different ways: People with mobility limitations, having two groups of 12 people contributed their perspectives on accessibility information and tools, and shared their experiences and challenges with using technology for gathering accessibility data. People with visual limitations, having two groups of 14 people, discussed similar themes as the mobility groups, tailored to their experiences with visual impairments. Nine caregivers as one group provided insights into the needs and challenges faced by those they care for, and how accessibility tools could be beneficial. ADA coordinators and urban planners, having two groups of 16 individuals in total, discussed the practical applications of accessibility data and tools in urban planning and compliance with ADA regulations. In the second series of workshops, participants from the first phase were invited to attend combined sessions. This included six people with mobility disabilities, five blind and low-vision individuals, four caregivers, and six ADA coordinators and urban planners. These workshops focused on themes identified in the first phase and allowed stakeholders to hear each other's perspectives and build on previous discussions. This research considered the beneficiaries of the study as various stakeholders, including people with disabilities (mobility and visual limitations), ADA coordinators, urban planners, and caregivers. People with disabilities saw the data to better plan accessible travel routes, while ADA coordinators and urban planners viewed it as a tool for developing barrier removal plans. The study highlighted the importance of accessibility data for planning, advocacy, and education of policy-makers. It also addressed concerns about the accuracy and trustworthiness of crowdsourced data. Labbé, *et al.* (2023) [PS13] recommended open data access to ensure data accuracy and to engage people with disabilities in the data collection process to improve sidewalk accessibility.

Mobasheri, *et al.* (2018) [PS14] studied data quality enrichment through awareness raising and collective action tools. They used sidewalk information for target users, such as wheelchair and/or pedestrian users. The participants involved in the study included city planners, activists, wheelchair users, policy-makers, and mappers. They were engaged through various methods such as mapping workshops, online and offline public awareness campaigns, the MyAccessible.EU website, the MapMyDay campaign, and social media platforms like X. These tools and events facilitated their involvement in raising awareness, collecting data, and advocating for improved sidewalk accessibility. The research described the beneficiaries of the study as the general public and local administrations. It provided these beneficiaries with an overview of the current accessibility situation in their municipality or region. This participation also increased public awareness about serious accessibility issues and ensured that data was continuously updated, contributing to the sustainability of tools and platforms hosting data. The study emphasized the importance of engaging citizens with different profiles and digital literacy levels to ensure inclusive participation. The beneficiaries were specified precisely as the general public, local administrations, and specific groups such as volunteers and citizens engaged in mapping activities.

In terms of **accessible housing**, the mechanisms used were forms of surveys. Slaug, *et al.* (2025) [PS18] examined accessibility problems in the Swedish housing stock. They used surveys, primarily through an app that posed descriptive questions about dwellings and residents, focusing on accessibility issues. The responses were automatically uploaded to a database, which was updated in real-time on a public project Web site. The participants were elderly people and people with reduced mobility. The recruitment involved in including 1,181 members of the public, with 70 percent aged 65 or older. Recruitment efforts were extensive, involving local and national news outlets, which resulted in significant media coverage. Public & Science Sweden (https://vetenskapallmanhet.se/eng/) informed its members through internal advertising, media coverage, and direct e-mail messages, while interest associations focusing on older adults, people with disabilities, and housing were also engaged. Partnering associations used social media to attract participants, and efforts were made to involve public school teachers and pupils, although interest from schools was limited. These diverse recruitment strategies ensured broad participation and engagement in the data collection process. The beneficiaries were specified precisely as older adults and the general public. It provided valuable insights into the current accessibility situation of housing, raising public awareness about serious issues. The study highlighted that older adults, who often face functional limitations, benefit significantly from identifying and addressing environmental barriers in their homes. It also emphasized the importance of user-friendly tools and clear instructions to engage older adults effectively.

In terms of **public transportation**, mechanisms include image labelling [PS10], interview [PS10], note-taking [PS19], surveys [PS19], and real-time data collection [PS20]. Hara, *et al.* (2015) [PS10] used formative interviews involving a diversity of visually impaired participants. They also photographed approaches to create an image dataset analogous to GSV, and to examine the image dataset multiple times without returning to a specific field site. Crowdsourcing labels were also used to find and label bus stop landmarks. The participants were blind people and crowd workers. The research identified visually impaired individuals, specifically low-vision and blind bus riders, as the primary beneficiaries. It elaborated on how landmarks like benches and shelters significantly assisted their navigation.

Steinfeld, *et al.* (2010) [PS19] examined the acceptance of citizen science to promote transit accessibility technology and disability. The study involved two groups of participants: wheeled mobility device users (WMD) and people without disabilities (control), each with 12 participants. Participants were recruited from local universities and the general public through various channels and were informed they would complete surveys and document items in a laboratory. All participants were paid volunteers who fully consented to the study. The researchers aimed to create a citizen science system that appealed to a broad spectrum of users, ensuring both groups could report relevant issues, thereby fostering a collaborative relationship with all users. The research identified public transit riders as the primary beneficiaries, particularly those who would use a citizen science system to report issues. It elaborated on the potential appeal of such a system by highlighting consistent, favorable results of text with photo reporting, which had been effective in previous accessibility efforts. The study also noted the importance of providing feedback to avoid the “black hole” problem, where complaints go unresolved, leading to low perceived benefit. The beneficiaries were specified as public transit riders, including those who encountered infrastructure problems and needed real-time information to stay engaged with the system.

Traut and Steinfeld (2019) [PS20] utilized crowdsourced O-D transit rider trip data from the Tiramisu Transit app, combined with open and publicly available data such as GTFS, OpenStreetMap, and crime data, to identify and characterize poor bus transfers in Pittsburgh. Tiramisu app users contributed real-time bus arrival information and traced their trips, providing detailed data on their transit stops, routes, and bus fullness. The participants included Tiramisu Transit app users, who actively engaged by sharing their trip data, and researchers, who combined and analyzed the crowdsourced data with other datasets. This collaborative effort aimed to improve the understanding of bus transfer issues and enhance transit safety and efficiency in the Pittsburgh region. The research described the beneficiaries as transit agencies, which could use the data to enhance service, and transit riders, who benefited from improved transit experiences and more responsive service. It also provided valuable information to transit agencies, helping them understand and address issues related to bus transfers.

Application accessibility

Application accessibility includes subtopics related to UI accessibility [PS9], online citizen science apps [PS12], and usability of Web-based CS tools [PS21]. Table 4 summarizes mechanisms used, involved participants, and intended beneficiaries per each subtopic found in PSs.

Table 4: Summary of mechanisms, workers, and intended beneficiaries utilized in topics of application accessibility.

	Mechanisms used	Workers who	Intended beneficiaries

Topic	in study	participated in study	reported in study
UI accessibility [PS9]	• Interview • Observation • User study	• Blind people (set requirements for the solution) • Volunteers	• Blind people
Online citizen science apps [PS12]	• Contextual interview • Prototype trials • Co-design • Note-taking	• People with intellectual disabilities • Undergraduate students	• People with intellectual disabilities
Usability of Web-based CS tools [PS21]	• Questionnaire • Remote usability test	• Master's students in technical communication • Volunteers	• Elderly people • People with disabilities • Universal

Guo and Bigham (2018) [PS9] addressed **UI accessibility**, and the inaccessibility of physical interfaces like microwaves, toasters, and coffee machines for blind people, noting that tactile markings and static labels fail to make dynamic interfaces accessible. They conducted user studies to understand how blind individuals use and adapt to everyday appliances. To meet these needs, they developed an application which allowed users to take a picture of an interface, which was then interpreted by crowd workers and computer vision to provide real-time feedback and guidance. In their study 11 blind participants captured a photo of an inaccessible interface. The image was sent to crowd workers who rated its quality, segmented the interface area, and labeled individual buttons. Users could customize buttons' shapes and labels, and the application generates a 3D model for a tactile overlay that fit over the original controls. This overlay could be fabricated using a home 3D printer or through a mail-order service.

Howlett, *et al.* (2021) [PS12] investigated the accessibility of **online citizen science applications** for individuals with intellectual disabilities through a co-design process. This process involved participants with intellectual disabilities, researchers, and students. Their research aimed to benefit individuals with intellectual disabilities by improving their access to citizen science applications, promoting social inclusion, self-esteem, and community engagement. This study focused on the experiences of individuals with intellectual disabilities in developing an app prototype and its impact on their social inclusion and community engagement. Three participants with intellectual disabilities (co-designers) — who could communicate verbally and perform most daily tasks independently, but needed support for work and learning new technology — emphasized the need for simple language and visual representations in the app's questions. Data collection during the co-design phase was reflective and based on the research team's notes. In the next phase, trials of the prototype app were conducted with four participants with intellectual disabilities and support workers. All participants could speak, but varying levels of support were needed for reading and understanding complex words. Contextual interviews were conducted, and data was collected through observations, audio recordings, and pictures.

O'Keeffe and Walls (2020) [PS21] examined the **usability of Web-based CS tools** and reported a remote moderated usability test for the citizen science platform named SciStarter, conducted through a graduate course on usability for technical communicators. Five participants were selected, ranging in age from their late 20s to mid-60s, located in Maryland, Virginia, South Carolina, and Texas. The testing was conducted over Zoom.

Digital content accessibility

Digital content accessibility covered subtopics related to image captions [PS1], assistive technology [PS4], e-book accessibility [PS7], and image accessibility [PS15]. Table 5 summarizes mechanisms used, involved participants, and intended beneficiaries per each subtopic found in PSs.

Table 5: Mechanisms, workers, and intended beneficiaries utilized in topics of digital content accessibility.

Topic	Mechanisms used in study	Workers who participated in study	Intended beneficiaries reported in study
Image captions [PS1]	• Image captions	• Volunteers • Undergraduate and graduate students	• Blind people • People with visual impairment • Universal
Assistive technology [PS4]	• Online study	• Volunteers (some of them are blind people or people with visual impairment)	• People with visual impairment • Universal
E-book accessibility [PS7]	• Questionnaire	• Volunteers (a group of library and disability professionals)	• People with print disabilities
Image accessibility [PS15]	• Image description	• Volunteers	• People with visual impairment • People with print disabilities

Aguirre, *et al.* (2023) [PS1] investigated **image captions**, important to those who are blind in order to access content. They explored how to effectively collect both thumbnail captions — succinct image descriptions meant to be consumed quickly — and comprehensive captions — which allow individuals to understand visual content in greater detail. They recruited 69 online workers to generate image descriptions and collected 768 captions in total. With the help of undergraduate and graduate students, they conducted evaluations to inspect correctness, fluency, amount of detail, and mentions of important concepts.

Bragg, *et al.* (2021) [PS4] studied **assistive technology**, more precisely, conversational agents and digital assistants and their synthetic speech. Their study focused on human listening rates, with attention to how people who were visually impaired compared with sighted people in their listening rates. Their volunteer-based online study included 1,409 participants. Participants listened to a series of clips read by synthetic speech and answered questions about what they heard.

Dobson and McNaught (2017) [PS7] probed the assessment of **e-book accessibility**. They selected a group of library and disability professionals from various parts of U.K. higher education to participate in an e-book accessibility audit. Key findings were reported through a follow-up questionnaire. Most of the volunteer auditors had little accessibility expertise, so a byproduct of the process was training on accessibility. The audit covered 275 e-books from 65 publishers across 44 different platforms. The results indicated increased awareness of e-book accessibility and empathy for disabled learners, as well as a desire for further training, particularly in using e-books with screen readers and text-to-speech software. They considered beneficiaries as those with print disabilities — those who are unable to access printed text, commonly due to a visual or physical impairment, or a specific learning difficulty such as dyslexia.

Morash, *et al.* (2015) [PS15] looked into **image descriptions**, involving novice Web workers to create descriptions of science, technology, engineering, and mathematics images to make them accessible to individuals with visual and print-reading disabilities. Their goal was to identify methods for creating descriptions that were inexpensive, effective, and followed existing accessibility guidelines. In the first test, guidelines were presented to workers, who then created a description in an empty text box and table. In the second test, a worker was asked for image information based on template-based descriptions according to standard accessibility guidelines.

Societal inclusiveness

Societal inclusiveness covered subtopics related to workplace inclusion and age friendliness [PS3], dignity as the acknowledgement of personhood [PS5], involvement of community-members [PS8], and universal design [PS11]. Table 6 summarizes mechanisms used, involved participants, and intended beneficiaries for each subtopic found in PSs.

Table 6: Mechanisms, workers, and intended beneficiaries utilized in topics of societal inclusiveness.

Topic	Mechanisms used in study	Workers who participated in study	Intended beneficiaries reported in study
Workplace inclusion and age friendliness [PS3]	• Survey	• Volunteers	• Elderly people • Universal
Dignity as the acknowledgement of personhood	• Focus group • Qualitative survey	• People who self-identified as a person with disability or	• People with disabilities • People with impairments

[PS5]		impairment	
Involvement of community members [PS8]	Questionnaire Usability test User test	Elderly people Volunteers (researchers, specialists, developers, university students, adults, children)	Elderly people Universal
Universal design [PS11]	Group discussion Photographing	Volunteers (people from disability organizations, and museum staff)	People with disabilities Universal accessibility

Baker and Finkelstein (2024) [PS3] explored **inclusion and age friendliness** in workplaces. This study delved into age metastereotypes, defined as beliefs that a person has regarding the age stereotypes held by others about their age group. Baker and Finkelstein evaluated the results of two surveys related to individual differences in the following variables: a) age metastereotype consciousness (degree of being self-conscious of age stereotypes); b) age metastereotype activation (implicit cognitive cues of age metastereotypes); and, c) age metastereotype accessibility (explicit knowledge of age metastereotype content). The first survey was conducted with young university students and showed that public self-consciousness and external locus of control were related to the likelihood that a person worries about being age stereotyped (consciousness). The second survey, where participants were recruited through Amazon's Mechanical Turk, had a broader age spectrum: 171 older workers with a median age of 57 years and 186 younger workers with a median age of 26 years. The sample consisted of 48 percent women, 65 percent white, and 77 percent employed full-time in the U.S. Participants reported working 37 hours per week and having been in their roles for approximately 5.5 years. The results highlighted that older worker appeared more likely than younger workers to activate negative age metastereotypes and be age metastereotype conscious, whereas younger workers were more likely than older workers to both activate and have accessible positive age metastereotypes.

In a topic on **dignity as the acknowledgment of personhood**, *Chapman, et al.* (2024) [PS5] examined the complex relationship between individual and collective experiences from the perspective of people with disabilities. Using the so-called extreme citizen science approach, people with disabilities participated as active partners in data collection through qualitative surveys and focus groups. The research team included researchers without disabilities, a researcher with long-term experience of disability personally and as a carer, and a citizen scientist with lived experience of disability who has research and advocacy experience, to direct and lead all aspects of the research. They established four key principles to guide inclusive research: (1) using a human rights concept of disability; (2) eliminating barriers to participation; (3) diversity in engagement through accessibility and inclusion; and, (4) working transparently. Framework analysis was employed to ensure the validity of the findings while prioritizing the voices of people with disabilities. Although the research team included people with disabilities and was led by a person with a permanent disability, the participants — citizen scientists — were still engaged as informants without an active role in the research process. Additionally, disabilities or impairments of participants were confirmed only through self-identification.

In a topic on **involvement of community members**, Granbom, *et al.* (2023) [PS8], looked into the citizen science approach as a tool for developing an application that was easy to use for older adults to report potential environmental barriers. The development process consisted of six iterative phases. The team included three university researchers, two citizen science specialists, and two representatives from a technical development company. Team members participated in various phases, while members of the public were involved in providing input, testing, and giving feedback throughout the development process. Participants (*n*=22) were recruited through senior organizations and participants needed to be at least 65 years old.

In the first phase, the content of the application was fine-tuned by researchers and citizen scientists. The final content included yes/no questions about the presence of environmental barriers at entrances and indoors. The questions were short and free of technical jargon. In addition to questions about barriers, descriptive questions were asked. In the second phase, a printed mock-up was produced, which was used as a starting point for developing the prototype in the third phase. In the fourth phase, the application was tested to improve the usability of the prototype. Usability was tested by five older adults (65 years or older). They were asked to respond to a study-specific questionnaire about the application, inspired by the system usability scale. Responses were further complemented with open-ended questions. To improve usability, changes were made, and the usability test was repeated by inviting another group of public members, namely students in the undergraduate occupational therapy program (*n*=26). In the fifth phase, the updated version was tested for reliability, with 18 older adults (65 years or older). They were invited to use the application to measure and record data on environmental barriers in a two-room apartment made available by one of the team members. Participants were instructed to use their own smartphones. Two researchers assisted during the testing, provided instructions, and monitored the test situations to ensure compliance. In phase 6, the final tests of the application and finishing touches were made to include other potential members of the public who might also be interested in participating. Accordingly, 12 participants, including children (10–15 years old, *n*=5), working-age adults (*n*=3), and older adults (*n*=4), carried out the final test. They were instructed to use the application in their own dwellings and then respond to the usability survey.

Hedvall, *et al.* (2018) [PS11] treated **universal design** (UD) in museum exhibitions instead of traditionally applying accessibility principles. They aimed to improve overall accessibility, specifically mentioning the beneficiaries as people with disabilities. The research was led by researchers, but participants included staff members and 31 visitors representing various disability organizations.

The research consisted of a series of workshops at two museums using a citizen science approach. Each workshop format encompassed three steps where one of the researchers introduced universal design. Participants were divided into mixed groups with both visitors and staff, assigned to take photos of museum features that were in line with or in conflict with universal design. At the end of the workshop, all groups gathered to discuss their findings by comparing and discussing their examples. Participants not only collected information but also actively produced new information collaboratively.

In the workshops, participants were free to use any camera app that they wanted, and after returning from the photo exercises, they connected their smartphones directly to the projector and presented the photos that they had taken and the reasons for taking them in the order that they had taken them. All presentations and discussions were recorded on video and with a digital sound recorder, and transcribed. The transcriptions were then anonymized, imported into NVivo, and analyzed using conventional content analysis, supported by the videos for recollection of different photographs.

Discussion

This study conducted a review of existing literature to examine the application of community-driven research within the context of accessibility-related studies. A diverse array of mechanisms were identified, commonly employed in citizen science and crowdsourcing initiatives, to address accessibility challenges. Data were extracted regarding participant involvement to determine who participated in the research and who was identified as a beneficiary. Taking the findings together, this study made four key contributions.

First, the current study presents how community-driven research is utilized in accessibility-related studies and identifies the accessibility-related issues that have been addressed. Figure 2 illustrates the conceptual framework of community-driven research in accessibility. To articulate the components and their interrelationships within this framework, we developed the following schema:

Researchers establish an *aim* that helps *beneficiaries* and orchestrates *mechanisms* to involve *community members*, who are *volunteers* and/or *beneficiaries*, to use these *mechanisms* to address the initial *goal*.

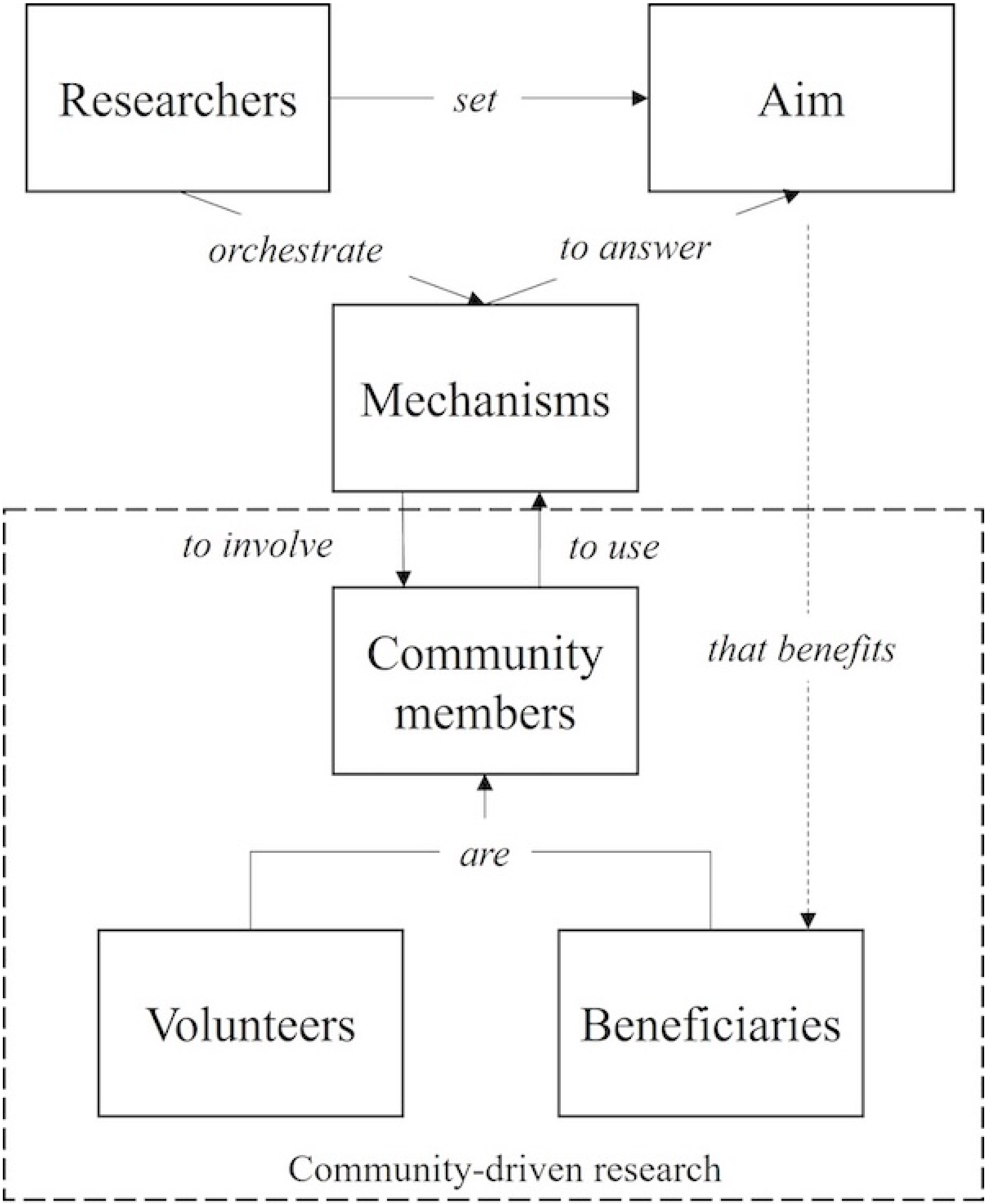

Figure 2: Context of community-driven accessibility-related research.

This framework aims to elucidate the formation of the community-driven research context as derived from the primary studies. The research context of the selected primary studies encompasses a diverse range of topics, including urban accessibility [PS2; PS6; PS16; PS17; PS22], sidewalk accessibility [PS13; PS14], accessible housing [PS18], public transportation accessibility [PS10; PS19; PS20], user interface (UI) accessibility [PS9], online citizen science applications [PS12], usability of Web-based citizen science tools [PS21], image captions [PS1], assistive technologies [PS4], e-book accessibility [PS7], image accessibility

[PS15], workplace inclusion and age-friendliness [PS3], dignity as the acknowledgment of personhood [PS5], community member involvement [PS8], and universal design [PS11].

Secondly, this study illustrated how participants — other than professional researchers — have been involved in the research process and the roles that they have assumed. By comparing the mechanisms employed in citizen science projects with broader user participation practices, such as user-centered design approaches (Mack, *et al.*, 2021; Mäkipää, *et al.*, 2022; Paiva, *et al.*, 2021), we identified distinctive features in the roles of participants within citizen science. Several mechanisms of involvement were observed across the reviewed studies, and three levels of participation were distinguished, each corresponding to the nature of the task assigned.

The first degree of participation characterized participants as monitors, observers, or data collectors. This level of involvement typically included tasks such as conducting observations [PS9], annotating obstacles [PS16; PS22], labeling obstacles [PS17], mapping obstacles [PS17], mapping sidewalk data [PS14], taking photographs [PS6; PS11], and collecting real-time data [PS20]. These activities were generally structured and predefined, requiring participants to contribute data without necessarily influencing the research design or interpretation.

The second degree of participation categorized participants as data sources or self-reporting data generators. At this level, participants primarily contributed information about their own experiences, behaviors, or perceptions. This included activities such as participating in contextual interviews [PS12], focus groups [PS5], group discussions [PS11; PS13], individual interviews [PS9; PS10], and note-taking exercises [PS12; PS19]. Additional methods included surveys [PS3; PS18; PS19], qualitative surveys [PS5], on-site field surveys [PS2], questionnaires [PS7; PS8; PS21; PS22], remote usability tests [PS21], usability tests [PS8], user reports [PS16], user studies [PS9], user tests [PS8], workshops [PS2; PS6], prototype trials [PS12], online forums [PS2], and online studies [PS4]. These methods emphasize participants' subjective input.

The third degree of participation defined participants as task executors, meaning they performed specific tasks assigned by researchers. The complexity and demands of these tasks could vary considerably. Examples included participating in co-design activities [PS12], making audio notes [PS6], validating data as experienced moderator volunteers [PS17], generating image captions [PS1], providing image descriptions [PS15], labeling images [PS10], conducting virtual accessibility audits [PS2], and contributing to the dissemination of results through presentations [PS6]. This level of participation reflected a more active and often skill-based engagement, where participants contributed directly to the execution and, in some cases, the communication of research outcomes.

Contrasting these participant roles with Arnstein's (1969) ladder of participation — as adapted by Krüger, *et al.* (2023) in their methodological framework for involving people with disabilities — revealed notable contradictions in prior citizen science studies. For instance, the notion of "Nothing about us without us" (Charlton, 1998) — where individuals directly affected by accessibility issues must be included in the research process — was not consistently upheld. This inconsistency arose because citizen science often relied on general volunteers, rather than specifically engaging members of the target population.

Several studies — by Sato, *et al.* (2010), Shinohara, *et al.* (2018a, 2018b), and Takagi, *et al.* (2013, 2008) — explored the role of community in enhancing accessibility, a concept they referred to as *social accessibility*. These works integrated user-centered design methodologies with a focus on the social dimensions of accessibility, examining how professional designers could leverage community input to embed accessibility into design practices. Notably, Takagi, *et al.* (2013, 2008) developed a crowdsourcing platform that enabled users experiencing accessibility barriers to report issues, which were then addressed by volunteers who were notified and invited to contribute solutions. Although these actions were carried out for the general and collective good, according to "Nothing about us without us," the contributions made by volunteer participants raised ethical concerns that warranted further investigation. On the other hand, it must also be acknowledged that taking no action without the contribution of the target population may, in some cases, constrain the development of accessibility solutions.

Previous systematic literature reviews examined the needs and requirements of volunteers regarding the usability of citizen science applications (Skarlatidou, *et al.*, 2019), as well as the applicability of citizen science within the field of information systems research (Mäkipää, *et al.*, 2020). According to Mäkipää, *et al.* (2020), voluntary participants could be involved in various stages of the research process, including resource gathering, defining research questions or problems, data collection and analysis, dissemination of results, and evaluation of findings. We recommend that accessibility-related studies, which may be highly user-sensitive, include beneficiaries in the research design phase before the actual study begins. Early involvement is essential to ensure that mechanisms employed are accessible and inclusive for all community members.

As a third contribution, we noticed the importance of explicitly articulating how the beneficiaries were involved in community-driven research. Selected studies addressed a wide range of accessibility issues targeting the following populations (named in the same way as in the original study): people with disabilities [PS5; PS11; PS13; PS16; PS20; PS21], people with impairments [PS5], blind people [PS1; PS9; PS10; PS17], people with visual impairment [PS1; PS4; PS10; PS15; PS17; PS22], people with intellectual disabilities [PS12], people with print disability [PS7; PS15], people with mobility impairment [PS2; PS14; PS17; PS22], people with reduced mobility [PS2; PS14; PS16; PS18; PS22], elderly people [PS3; PS6; PS8; PS18; PS21; PS22], universal [PS1-PS4; PS8; PS11; PS13; PS19; PS21; PS22]. Notably, in many studies, the role of the target population was not explicitly described, making it unclear whether the intended beneficiaries were actively involved in the research process.

Participants in the primary studies, whom we classified as workers, comprised four distinct participant groups:

(1) Individuals involved in the study due to their professional expertise. This group included ADA coordinators and urban planners [PS13], caregivers [PS13], volunteer experts such as representatives from local administrations, disability rights organizations, and hotel associations [PS16], volunteers affiliated with disability organizations and museum staff [PS11], as well as a group of library and disability professionals serving as volunteers [PS7].

(2) Individuals involved in the study due to their personal characteristics. These studies included blind people (interviewees) [PS10]; (set requirements for the solution) [PS9], people who self-identified as a person with a disability or impairment [PS5], people with disabilities [PS18], people with intellectual disabilities [PS12], people with mobility limitations [PS2; PS13], people with visual limitations [PS13], persons with visual impairments [PS22], people without disabilities (control group) [PS19], wheelchair users [PS22], wheeled mobility device (WMD) users [PS19], elderly people [PS2; PS6; PS8; PS18; PS22], volunteers, some of whom are blind people or people with visual impairments [PS4], and volunteers, some of whom are people with reduced mobility or mobility impairments [PS14].

(3) Individuals involved in the study for other specific reasons. This research included parents with pushchairs [PS2], volunteers (people without disabilities as a control group) [PS22], Master’s students in technical communication [PS21], undergraduate and graduate students [PS1], and undergraduate students [PS12].

(4) Volunteers in general. This category included individuals who participated on a voluntary basis without a clearly defined professional or personal characteristic relevant to the study. The primary studies included crowd workers [PS10], volunteers [PS1; PS3; PS9; PS15- PS18; PS20; PS21], and volunteers (researchers, specialists, developers, university students, adults, children) [PS8].

The findings indicate that intended beneficiaries were not always included in the research process, potentially excluding key perspectives. To ensure the relevance and significance of the research problem, it is essential to engage target groups in defining and validating the issues under investigation. In several primary studies, volunteers who did not belong to the target population were involved, raising concerns about the alignment between participant demographics and intended beneficiaries. In such cases, it is crucial that the identification of the problem is also substantiated by the target group.

As a final contribution, we propose research directions for future community-driven studies that address accessibility issues. While this study has certain limitations, it is important to acknowledge that studies not indexed in *Web of Science* and *Scopus* were excluded. Despite this, we conducted a comprehensive screening of 787 research papers, ultimately identifying 22 studies that aligned with our research objectives. We thus had a set of appropriate studies that enabled us to answer the research question. The findings of this study highlighted the potential of citizen science to contribute meaningfully to accessibility research. Citizen science can be effective using different methods to collect, analyze, or produce information. However, among the accessibility studies using citizen science, there was less research on how the solutions found could affect the rest of the population or how non-target groups perceive the development of accessibility. It is evident that citizen science projects have the potential to address accessibility issues by involving a wide range of users. However, it is necessary to ensure that the techniques and methods used in the study are accessible to participants. Additionally, as noted by Chapman, *et al.* (2024), disabilities or impairments of participants should be confirmed only through self-identification to avoid misinterpretations and ethical questions.

Future research should seek empirical information on the effects of accessibility solutions among populations by involving volunteers who have a particular disability and wish to share information about it. This study provides a foundation in the mechanisms that could be applied to accessibility studies benefiting community-driven research. These foundations could be used to create a research project that effectively and ethically engages people with disabilities to solve accessibility problems. We propose that the relationship between researchers and volunteers should be examined from the perspectives of ethical principles, trust, and role expectations.

Research on accessibility is sensitive. Therefore, in addition to general research principles (informed consent, anonymity, confidentiality, and voluntariness), the effects of power dynamics and interactions between researchers and participants should be further examined. It appears that in community-driven research on accessibility topics, researchers often assume the role of managers, while volunteers are seen as data collectors, data sources, or task executors. This setup could create a power dynamic where participants may feel pressured to act or respond in certain ways. Hence, it is important that the power dynamics are not top-down but strive for a more equitable relationship. According to Mäkipää, *et al.* (2020], participants in citizen science research could also take on project management roles. The suitability of different roles and tasks in accessibility-related research requires further examination. It is also noteworthy that participation in accessibility research could affect participants' identity, self-understanding, and their communities. Therefore, researchers must be aware of how their actions can affect the lives of participants.

Conclusion

This study contributes to the synthesis of community-driven research addressing accessibility issues. A key finding is that, given the inherently sensitive nature of accessibility research, it is essential to carefully consider who is regarded as the beneficiary of the research outcomes and who is engaged in the research process to work toward achieving those outcomes. We examined how community-driven research on accessibility has been conducted and synthesized insights from 22 primary studies identified through a systematic review. A wide range of methods used to engage participants was identified, along with specific roles that participants assumed within these studies. We observed three degrees of participation: participants acting as monitors, observers, or data collectors; those serving as data sources or self-reporting data generators; and those functioning as task executors, performing specific tasks assigned by researchers. Our analysis also revealed that researchers involve volunteers for various reasons, including individuals engaged due to their professional expertise, those involved based on personal characteristics, others included for specific contextual reasons, and general volunteers. As a concluding contribution, we propose future research directions for community-driven studies that address accessibility-related issues. In particular, we suggest that the relationship between researchers and volunteers should be examined through the lenses of ethical principles, trust, and role expectations.

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Notes

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Appendix

Table 7: Selected primary studies.

ID	Reference	Title	Publication venue
PS1	Aguirre, *et al.*, 2023	Crowdsourcing thumbnail captions: Data collection and validation	*ACM Transactions on Interactive Intelligent Systems*

PS2	Allahbakhshi, 2023	Towards an inclusive urban environment: A participatory approach for collecting spatial accessibility data in Zurich	*Leibniz International Proceedings in Informatics (LIPIcs)*
PS3	Baker and Finkelstein, 2024	Age metastereotypes at work: The influence of individual differences on age metastereotype consciousness, accessibility, and activation	*Personality and Individual Differences*
PS4	Bragg, *et al.*, 2021	Expanding a large inclusive study of human listening rates	*ACM Transactions on Accessible Computing (TACCESS)*
PS5	Chapman, *et al.*, 2024	Dignity and the importance of acknowledgement of personhood for people with disability	*Qualitative Health Research*
PS6	Chesser, *et al.*, 2020	Exploring university age-friendliness using collaborative citizen science	*The Gerontologist*
PS7	Dobson and McNaught, 2017	Crowdsourcing e-book accessibility information and the impact on staff development	*Insights: The UKSG Journal*
PS8	Granbom, *et al.*, 2023	Involving members of the public to develop a data collection app for a citizen science project on housing accessibility targeting older adults	*Citizen Science: Theory and Practice*
PS9	Guo and Bigham, 2018	Making everyday interfaces accessible: Tactile overlays by and for blind people	*IEEE Pervasive Computing*
		Improving public transit accessibility	*ACM*

PS10	Hara, *et al.*, 2015	for blind riders by crowdsourcing bus stop landmark locations with Google Street View: An extended analysis	*Transactions on Accessible Computing (TACCESS)*
PS11	Hedvall, *et al.*, 2018	Co-constructing universal design in citizen science workshops	*Studies in Health Technology and Informatics*
PS12	Howlett, *et al.*, 2021	Accessible citizen science, by people with intellectual disability	*ASSETS '21: Proceedings of the 23rd International ACM SIGACCESS Conference on Computers and Accessibility*
PS13	Labbé, *et al.*, 2023	Multiple-stakeholder perspectives on accessibility data and the use of socio-technical tools to improve sidewalk accessibility	*Disabilities*
PS14	Mobasheri, *et al.*, 2018	OpenStreetMap data quality enrichment through awareness raising and collective action tools — experiences from a European project	*Geo-spatial Information Science*
PS15	Morash, *et al.*, 2015	Guiding novice Web workers in making image descriptions using templates	*ACM Transactions on Accessible Computing (TACCESS)*
PS16	Prandi, *et al.*, 2017	On the need of trustworthy sensing and crowdsourcing for urban accessibility in smart city	*ACM Transactions on Internet Technology*
PS17	Qin, *et al.*, 2016	Geocrowdsourcing and accessibility for dynamic environments	*GeoJournal*
		Estimating accessibility	

PS18	Slaug, *et al.*, 2025	problems in the Swedish housing stock using citizen science: The Housing Experiment 2021	*Journal of Applied Gerontology*
PS19	Steinfeld, *et al.*, 2010	The value and acceptance of citizen science to promote transit accessibility	*Technology and Disability*
PS20	Traut and Steinfeld, 2019	Identifying commonly used and potentially unsafe transit transfers with crowdsourcing	*Transportation Research Part A: Policy and Practice*
PS21	O'Keeffe and Walls, 2020	Usability testing and experience design in citizen science: A case study	*SIGDOC '20: Proceedings of the 38th ACM International Conference on Design of Communication*
PS22	Zeng, *et al.*, 2017	Improvement in environmental accessibility via volunteered geographic information: A case study	*Universal Access in the Information Society*

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