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Process first, tools second: A conceptual framework to embed digital participation in planning processes for citizen empowerment

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ABSTRACT

Digital participation tools hold the promise to empower citizens and local communities to address urban development challenges. However, although many scholars have experimented with digital tools for citizen engagement, their efforts remain largely disconnected from planning practice. To address this disconnection, this paper analyses digital participation in planning from three perspectives: participatory planning, citizen engagement level, and human–computer interaction (HCI). We considered a wide range of digital participation tools, from tools designed for research projects to commercial and open-source tools. Our results show that there are two levels of "power mediation" and their "mediating actors" in digital participatory planning: (1) the digital tool and the HCI designer who creates the tool, and (2) the planning cycle and the planner who defines the participatory process. We furthermore highlight the importance of embedding participation tools in *complementarity* with each other to empower citizens at different levels. Taking these two insights into account, we developed an integrated framework – the EmpowerCycle – to embed digital participation tools in planning processes for citizen empowerment. The framework addresses the disconnection between digital tools and planning practice, supporting both researchers and practitioners in the design and implementation of digital participation tools in planning practice and decision-making processes.

1. Introduction

The origins of participatory planning can be linked to the community development movements of the 1960s and 1970s. These decades witnessed the emergence of neighbourhood planning as a response to top-down urban renewal projects that often disregarded the needs and desires of local communities (Arnstein, 1969; Jacobs, 1961). During this period, there was a growing recognition of the importance of involving communities and other local stakeholders in planning and decision-making processes that affected their lives. The interest in participatory planning accelerated in the mid-1990s, accompanied by developments in Information and Communications Technology (ICT) and digital tools such as public participation geographic information systems (PPGIS) and participatory GIS (PGIS) (Geertman & Witte, 2024). Nowadays, public participation is an integral part of planning processes in many countries worldwide (Gonçalves et al., 2024; Kahila-Tani et al., 2016, 2019), and its importance is broadly recognised (Wilson et al., 2019).

With recent advancements in technologies such as eXtended Realities and artificial intelligence, new digital tools and their applications in planning practice are emerging (Akkers et al., 2025; Dane et al., 2024). Despite the increasing interest in digital tools, the link between these tools and planning practice is still weak, with only a few digital participation tools in the academic literature intending to or succeeding in influencing policy-making (Denwood et al., 2022; Ramirez Aranda et al., 2023). This issue is related to social, cultural, and political challenges of adopting such technologies rather than in technological limitations, largely because of the complex nature of public participation (Ballatore et al., 2020; Falco & Kleinhans, 2018). Overlooking the complexity inherent in participatory planning is problematic because each step of the planning process requires a dedicated participation approach for addressing (i) the needs of the citizens who will use these digital tools and (ii) the specific conditions of use cases, including temporal, spatial, and place-based dimensions, which makes every planning process unique (Ataman et al., 2025). In the absence of a deliberate emphasis on planning processes, many opportunities for meaningful and empowering engagement are lost, and the potential of digital participation tools remains underutilised.

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Scholars have also criticised the top-down, technocratic approach to the development and implementation of digital participation tools (Biedermann et al., 2023; Gonçalves et al., 2024; Gooch et al., 2015; Pfeffer et al., 2013) and more generally of digital planning and the related smart city concept (Cardullo & Kitchin, 2019, 2025; Kitchin, 2015; Vanolo, 2016). Technology is usually designed by developers and implemented by planning authorities and/or private companies, with citizens becoming mere recipients or consumers of technology (Cardullo & Kitchin, 2019; Gonçalves et al., 2024; Vanolo, 2016). Such an approach does not consider how people interact with technology, reinforcing technology-related barriers to digital engagement, such as digital literacy, and hindering the potential of digital participation to empower citizens in planning and decision-making processes. Although there are many studies where digital participatory tools are developed together with citizens and according to their preferences (e.g., Dane et al. (2024), Pettit et al. (2014), Van Cauwenbergh et al. (2018)), these studies do not engage with questions of empowerment nor adopt a Human-Computer Interaction (HCI) lens explicitly, which is crucial for understanding how people interact with technology.

This paper provides a multidisciplinary framework to embed digital participation tools in planning processes for citizen empowerment. We provide a comprehensive analysis of 14 digital participation tools, ranging from tools designed for research projects to commercial and open-source tools. We follow a three-step analysis: first, mapping the tools to a typical planning cycle, then defining the level of citizen empowerment that they support and unpacking how digital empowerment occurs through an HCI design lens. The results reveal gaps in the planning cycle for which few tools exist as well as limitations of digital participation tools in empowering citizens in planning. To address these, we argue for a shift towards participation *processes* that cultivate participatory mindsets across all stages of the planning cycle. In short, starting with the planning process before jumping into digital participation tools. To this end, we present the EmpowerCycle framework, the Participatory Planning Cycle for Digital Empowerment. EmpowerCycle supports the shift towards process-based participation by offering a comprehensive analytical tool to guide the selection and design of digital participation tools, while also enabling improved documentation and evaluation of their use in planning contexts.

The paper is organised as follows. Section 2 provides background literature, drawing from the fields of planning theory, citizen engagement, and empowerment through human–computer interaction. Section 3 presents the methodology used in the paper, Section 4 describes the results, and Section 5 introduces the EmpowerCycle framework. Next, Section 6 discusses the findings in perspective to the broader literature, also highlighting limitations and future work opportunities, while Section 7 concludes the paper.

2. Literature background

2.1. Digital technologies in participatory planning

The introduction of digital tools in planning practice is aimed at enhancing efficiency, effectiveness, and inclusivity in planning processes (Geertman & Witte, 2024; Kahila-Tani et al., 2016). Some of these digital technologies, such as social media and crowdsourcing apps, enable data-driven approaches, meaning that they allow the collection of data for analysis and simulation to support informed decision-making, whereas other digital tools, such as PPGIS, online games, virtual or augmented reality applications are instruments to support planning decisions (Geertman & Stillwell, 2020; Geertman & Witte, 2024). Digital technologies also create opportunities for citizens to participate in decision-making, with great potential to reach larger numbers of participants, enable remote participation and promote two-way interaction between stakeholders (Afzalan & Muller, 2018; Herzog et al., 2024; Jankowski et al., 2019; Kahila-Tani et al., 2019).

As digital participation tools become increasingly integrated into planning processes, a range of new challenges has emerged. These include issues of data ownership, privacy, and consent in data collection; questions of digital citizenship; inequalities in digital literacy; the loss of visual cues, human interaction, and opportunities for socialisation; diminished attention spans in online environments; and the disingenuous application of such tools in mapwashing practices (Afzalan & Muller, 2018; Cardullo & Kitchin, 2019; Ellul et al., 2011; Gonçalves et al., 2024; Jankowski et al., 2019; Kahila-Tani et al., 2019; Mattern, 2020; Mualam et al., 2024; Nold & Francis, 2017). These technology-specific concerns intersect with persistent challenges in participatory practice, including power imbalances in decision-making, tokenistic forms of engagement, limited representation, and lack of trust and perceived legitimacy (Einstein et al., 2022; Fernández-Martínez et al., 2020; Leal, 2007; Monno & Khakee, 2012; Mualam et al., 2024). Some of these issues are further exacerbated by the increasing outsourcing of public functions and services, including participation, to private consultants and global platforms (Mattern, 2020; Sadowski, 2020). These new and persistent challenges indicate that, despite the development of advanced methods and tools for citizen and stakeholder engagement, participatory practices are yet to be meaningfully embedded in planning practice and decision-making processes. In particular, a systematic approach to using digital participation tools in planning practice is still missing, hindering their uptake and meaningful application.

The first step to address this gap is to clarify what constitutes planning. Although establishing a generic or universal planning process is challenging – if even possible – there have been several attempts to delineate what activities constitute planning. Starting in the 1950s, rational planning focused on selecting and implementing the most optimal plan from various alternatives, leading to practices like master planning. This structured process starts from understanding the problem in the given context and setting goals to the generation and evaluation of alternatives, with explicit links to implementation (Lawrence, 2000). With the communicative turn in planning, a more relational understanding of planning emerged, revealing the complex and interactive nature of planning (Healey, 2006). Following this, various scholars have synthesised this process into multiple-step models. For instance, Berke et al. (2006) delineate an eight-stage planning process, including issue identification, goal formulation, data analysis, alternative consideration, plan selection, implementation, and outcome monitoring. Teriman (2012) introduced an ecosystem approach, emphasising sustainability in the urban development process by including the stage of sustainability evaluation. More recently, Rocco et al. (2024) proposed a model that goes beyond analysis, design, and implementation to incorporate public participation and stakeholder engagement also as core planning activities in planning through an iterative series of steps.

In parallel, there have been contributions explicitly focusing on the use of digital tools in the planning stages. Yeh and Batty (1990) outline various planning stages to which Geographic Information Systems (GIS) can contribute, from formulation of objectives and alternatives to implementation and post-implementation monitoring. Within the context of planning support systems and software, Vonk et al. (2005) classify the use of GIS within planning into four functional categories: information provision (provide access to input data), communication support (assist planners to convey information to non-technical stakeholders), supporting analysis functions (enable knowledge synthesis and converting data to intelligible understanding), and supporting design and planning functions (allow exploration of design alternatives and "what-if" scenarios). Similarly, Daniel (2020) examined the application of digital tools to support various stages of the planning process: contextual and site analysis, evaluation of planning scenarios, visualisation and public participation, and monitoring and evaluation.

From the literature review above, six general steps of the planning cycle are synthesised: (1) context and problem analysis, (2) visioning and goal setting, (3) design of alternatives (which can be a spatial

plan, a public policy, or an urban design), (4) evaluating and selecting, (5) testing and prototyping, and (6) implementation and monitoring. Each planning stage demands a tailored approach to the use of digital participation tools, as the participation form varies at each planning stage due to the level of decision-making authority granted to the citizens and the required interactivity of communication (whether one-way or two-way) between the citizens and authorities. This has also been recognised theoretically for the evaluation of digital participation tools (Poplin, 2014).

Yet, the academic community working on digital participation tools tends to focus more on the technology and method rather than the role of these tools in empowering participation and engagement, especially at the different stages of the planning cycle. Failure to account for the specific planning stage in which digital participation technologies are deployed can result in a misalignment between the form of input such technologies facilitate and the form of input required at that stage. For instance, one cannot expect citizens to articulate long-term visions for the future through a platform designed primarily for quick, transient contributions (Wilson et al., 2019). This risks making the developed digital tools a singular by-product of a public participation activity or a research project, rather than a foundation for enabling iterative public participation embedded in existing planning processes (Brown & Kyttä, 2014). Therefore, there is still a need to understand the use of digital tools at the different stages of a complete planning cycle. This approach requires an expanded public participation framework linked to planning stages as well as to the role of citizens in participation (elaborated next).

2.2. The role of citizens in planning

Various academic efforts attempted to conceptualise public participation and citizen engagement in planning literature. One of the first was Arnstein (1969), who sees public participation as a categorical term for power, through which the "have-nots" or marginalised citizens and communities can be deliberately included in decision-making processes. Arnstein conceptualises participation in a ladder typology with eight levels, in which the first steps of the ladder represent non-participation, tokenism, and manipulation, while the higher levels represent partnerships, delegated power, and citizen control. Through similar critical lenses, Pretty (1995) derived a typology of participation that considers how resources interact with power dynamics. Pretty has identified seven types of citizen engagement, from manipulative participation to self-mobilisation. Pretty's typology stands out because of the emphasis on self-mobilisation instead of citizen control. Here, self-mobilisation means that people and communities take the initiative independently of external institutions and make decisions about the use of resources, which may or may not challenge existing distributions of wealth and power. While the one-dimensional models above have been criticised for being too simple to account for the diversity of participatory processes and their goals (Tritter & McCallum, 2006), their simplicity helps to illustrate that significant gradations of participation exist and, as such, can be applied in any case in which the silent actors are trying to be heard.

In addition to the "level" of participation, scholars have looked at other dimensions of public participation. By considering the diversity of interests within participatory processes, White (1996) identified four major forms of public participation: nominal, instrumental, representative, and transformative. In this typology, the interests of facilitators (top-down) and participants (bottom-up) are distinguished. The Democracy Cube by Fung (2006) represents public participation using three dimensions, namely Authority & Power, Communication & Decision Mode, and Participants. The Authority & Power dimension is similar to that employed by Arnstein, whereas the other two highlight the degree of inclusivity and the intensity of communicative exchange among participants. Gaventa (2006) developed the PowerCube Framework to explore power dynamics within participation processes across the three axes of levels, spaces, and forms of power. A recent contribution to the conceptualisation of public participation is the 3A³ framework of participation (Hofer & Kaufmann, 2023), composed of three dimensions (actors, arenas, and aims), each consisting of three interacting elements. This multi-dimensional framework presents participation as an emergent phenomenon embedded in planning processes and the wider social, cultural, political, spatial, and temporal context.

With the digitalisation of planning and the emergence of the smart city as a city concept, critiques to the role of citizens in emerged (e.g., Cardullo and Kitchin (2019, 2025), Kitchin et al. (2019), Vanolo (2016)). In particular, Vanolo (2016) outlines four imaginaries of the smart city: the city "without citizens", which erases human presence, devoiding citizens from any agency; the dystopian city, marked by surveillance and control; the smart city with active citizens, where individuals act as data-generating "sensors"; and the citizen of the future, burdened with ensuring sustainability for future generations. In each, citizens are, respectively, absent, controlled, instrumentalised, or burdened, rather than genuinely empowered. Cardullo and Kitchin (2019) also engaged with the various citizen roles enacted across smart city initiatives. By reworking Arnstein (1969) ladder of citizen participation into four main levels (non-participation, consumerism, tokenism, and citizen control), they demonstrate that participation within smart cities is mostly limited to "tokenism" and "consumerism". Rooted in stewardship, civic paternalism, and a neoliberal conception of citizenship, smart cities treat citizens as consumers or testers, people to be steered, controlled, and nudged to act in certain ways, or as sources of data which can be turned into products.

To link the frameworks described above to digital participation technologies, we discuss the following five levels of participation: non-participation, nominal, instrumental, representative, and transformative. The first level – non-participation – is recurrent in ladder-like frameworks (e.g., Arnstein (1969), Carden and Fell (2021), Fung (2006)) and refers to forms of participation related to therapy and manipulation, where participation is used to steer, nudge, and control citizens. Citizen input is created through algorithmically-mediated services (such as public transport chip cards and mobile apps), which can then be mined for planning and operational insights but also for the purposes of social sorting, predictive profiling, and micro-marketing, as well as for trading with and between data brokers (Cardullo & Kitchin, 2019; Kandt & Batty, 2021; Kitchin, 2014). Technologies such as chip cards and mobile tracing apps, however, are not digital *participation* technologies as there is no intention to involve citizens in planning decisions. Instead, citizens are treated as '**sensors**', becoming data-points in a (big) data-set (Gabrys, 2014; Kandt & Batty, 2021; Thatcher et al., 2016; Vanolo, 2016).

The second level – nominal participation – refers to situations where more powerful actors such as urban planning authorities provide top-down information about the justification of urban development plans and projects (Anttiroiko, 2016; White, 1996). In this regard, digital technologies can be pivotal in disseminating information and raising awareness. Social media platforms, municipal websites, and tailored mobile applications serve as channels for sharing updates, news, and policies, ensuring that citizens stay informed about relevant issues affecting their communities and environments. Additionally, the use of open data platforms to inform citizens about the current situation in the city through open data and analytics has surged (Kapoor et al., 2015). At this level of participation, engagement is passive, and citizens become '**receivers**', being informed or aware of issues (Ertiö, 2015; Hasler et al., 2017), which configures degrees of tokenism for Arnstein (1969) and Cardullo and Kitchin (2019).

The third level of participation is instrumental participation, through which citizens can indicate their needs and preferences for their current living environment and also provide feedback and suggestions on pre-decided policies or projects by urban planning authorities. A variety of digital tools can empower citizens to become assessors. For instance,

online surveys (mobile survey/data collection applications), and interactive forums are tailored solutions to collect citizens' needs and preferences, thereby supporting citizens in expressing their viewpoints and sharing feedback (Gün et al., 2020; Kahila-Tani et al., 2016). Moreover, cutting-edge digital tools, such as Digital Twins, Virtual Reality (VR), and Augmented Reality (AR) applications, also support these lower-level participation forms (both nominal and instrumental) by offering engaging and visual avenues for information dissemination and awareness-raising, thereby enabling individuals to explore and experience future pre-decided urban development scenarios and provide their feedback (Dembski et al., 2020; Hämäläinen, 2021). Here, planners are interested in the knowledge of the local citizens (Ertiö, 2015), citizens become more active compared to nominal participation, and their role can be considered that of **'assessors'** (Hasler et al., 2017).

The fourth level of participation – representative participation – gives citizens a voice in the planning process to share their opinions about potential policies and/or interventions that can affect them, while engaging with the decision-makers *before* a decision is made for future interventions. Therefore, at this level of participation, citizens are more empowered and their role becomes that of **'contributors'**, contributing to the ideation and decision-making of future interventions (Hasler et al., 2017). Through online town halls, digital forums and virtual meetings, online voting and polls, and participatory budgeting systems, citizens are represented at *decisive* moments, share their opinions, and exert influence over decisions regarding resource allocation and policy priorities for urban intervention proposals.

The final form of participation is transformative participation and entails the independent engagement of citizens in shaping societal values and structures. Through co-design, gamification, and scenario modelling ("what-if" scenarios) approaches and interactive affordances such as online interactive platforms and interactive eXtended reality applications (i.e., VR, AR apps), digital technologies enable citizens to voice themselves as well as create their own independent designs and proposal ideas (Gün et al., 2020). In this case, the use of such digital tools is especially necessary for citizens to (i) gain skills such as critical thinking and collaborative problem-solving and also (ii) grasp the complex decision-making processes and (iii) understand the consequences of their policy/intervention decisions (what it would mean for society, ecology, economy) through experiencing the scenario simulations (Ghodsvali et al., 2022). In bringing in their own ideas and submitting their own propositions (and vote on them) for new policies and/or interventions, citizens take the role of **'stakeholders'** (Hasler et al., 2017).

Besides the level of non-participation, which has no intend to engage citizens democratically in the planning process, the other four levels of participation can support different forms of participation at various planning stages. Instrumental and nominal participation are mostly utilised in early planning stages (analysis of the current context and local knowledge and values) and later stages (assessment and evaluation of the practicality and viability of proposed strategies, policies, and interventions) (Gaete Cruz et al., 2023). High-level forms of participation, namely representative and transformative participation, are usually utilised mostly in visioning, designing, and implementation phases but also might exist in all stages of the planning cycle (Gaete Cruz et al., 2023).

Despite the potential to support planning, when it comes to effectively applying digital tools for empowering citizens, six practical challenges have to be addressed (Ataman et al., 2025; Ataman & Tuncer, 2022; Dane et al., 2024; Gonçalves et al., 2024; Kleinhans et al., 2022; Pfeffer et al., 2013; Van Cauwenbergh et al., 2018): (1) access to digital tools and the awareness regarding their existence and the functionalities; (2) ability of citizens to effectively use such tools as such user generated content is reliable and the digital outputs are interpretable for citizens to initiate discussions; (3) sustaining intrinsic or extrinsic motivation to remain engaged; (4) managing expectation regarding the abilities of the digital tools for

sustaining two-way dialogues between citizens and decision makers; (5) re-establishing routines and practices regarding data protection and privacy, changes in the governance structure to better situate citizens' input, providing guidelines on how to stimulate digital participation, having trained personnel capable of managing the digital tools, and avoiding the participation process from turning into a shallow process for data collection; and (6) addressing the time lag between the digital participation and the actual implementation of strategies. These issues mostly relate to the design and implementation of these tools and the interaction of citizens with the functionalities and capabilities of these tools.

2.3. Empowering citizens through digital tools: Human-computer interaction perspective

As highlighted in the previous section, digital tools can support different forms of participation. Another aspect to consider is whether participation is initiated by institutions (top-down) or by residents (bottom-up) (Van Meerkerk, 2019). Although citizen participation within the planning cycle is inherently institutionalised (Andersen & Medaglia, 2009), bottom-up participation is possible in various steps of the planning cycle. For example, citizens can self-organise to identify local problems, develop visions and goals for change, and propose solutions. Digital tools supporting top-down or bottom-up participation may need to be designed in a different way but need, in both cases, to empower citizens in some way to partake in urban planning.

The Human-Computer Interaction (HCI) design literature has provided a framework that specifically considers how digital tools may empower technology users (Schneider et al., 2018). In a literature review on the use of empowerment in HCI, Schneider et al. (2018) characterised empowerment through four categories: the 'concept of power', the 'psychological component', the 'persistence of empowerment', and the 'design mindset'. They furthermore distinguished eight lines of research, ranging from 'empowering experiences' to 'community empowerment', and mapped how the notions of empowerment manifest in the existing HCI literature.

In the context of this paper, it is valuable to consider how the various categories of empowerment are taken into account when designing digital tools and technologies for citizen participation in planning. Drawing from social and political theory, Schneider et al. (2018) employ the notions of *power-to* and *power-over* to distinguish, respectively, whether the technology provides the user with the ability to do something they were not able to do before, or whether the technology influences the power relationship between two actors, enabling the one to exercise power over the other (in this paper, the relationship between citizens and decision-makers). While, for example, technologies to create digital arts can empower teenagers to voice to understand, share and critique their own and other experiences (power-to) (Murray et al., 2024), the low-cost technology-supported PosterVote prototype increases the democratic power of residents over local government (power-over) (Vlachokyriakos et al., 2014).

Following Schneider et al. (2018), empowerment manifests itself through three psychological components: *feeling, knowing,* or *doing.* This distinction helps designers of digital tools to decide what type of psychological effect they aim to achieve with their technology. The City Commons approach of Balestrini et al. (2017), for example, showcases that different digital tools play a role in fostering a sense of awareness and increased knowledge with local residents and in collaboratively designing actions to address the identified issue. Similarly, DiSalvo et al. (2009) utilised accessible sensing robots aiming to increase the self-confidence of residents with sensing technologies, which are then further developed to support the knowledge manifestation of empowerment.

Another differentiating element in digital technology for empowerment is whether the technology supports *transient* or *persistent* empowerment. Transient empowerment means that the empowering experience is only present while using the technology. This can often be

observed in pop-up urbanism technologies (Biedermann et al., 2023; Fredericks et al., 2018), where technologies pop up in the urban space and ask residents to provide their input without connection to broader decision-making structures. In contrast, persistent empowerment continues after the technology was used either because citizens gain political power which unfolds and persists after usage (such as in a voting system) or thanks to the development of skills and practices that last after the empowering experience (Schneider et al., 2018).

Finally, digital technologies for empowerment are crafted through either an *expert* or *participatory* design mindset Schneider et al. (2018). Technologies developed with an *expert* mindset view citizens as subjects in the design phase of the digital tool, whereas those employing a *participatory* mindset treat citizens as co-creators. Citizens are then not only users of the technology but have also been actively involved in the design of the digital tool.

3. Methodology

3.1. Analytical framework

In this paper, we analyse digital technologies through the three notions of the planning cycle, the role of citizens in planning, and the four dimensions of HCI empowerment (Fig. 1). First, we define a generic iterative planning cycle based on key activities typical of planning processes (as described in Section 2.2). Aligned with these perspectives, we adopt the following key planning stages: (1) Context and Problem analysis, (2) Visioning & Goal setting, (3) Design (of a space, policy, infrastructure, etc.), (4) Evaluation & Selection, (5) Testing & Experimentation (of what has been designed), and (6) Implementation & monitoring. We note that, while we adopt these six generic planning stages for analytical purposes, it is necessary to map planning stages relevant to the local context; literature shows the six stages are generally valid but not always readily identifiable, particularly in less formalised processes (Hofer & Kaufmann, 2023).

Next, building on the typology of citizen roles in urban planning based on Hasler et al. (2017) (see Section 2.2), we examine how digital technologies can facilitate *active* public participation in the planning process. The most passive forms of public participation are citizens *sensors* and *receivers* are, therefore, not considered. Excluding these two levels from our analysis, we focus on the three highest levels of public participation that each digital tool can support: citizens as *assessors*, providing their preferences or input on pre-decided topics; citizens as *contributors*, contributing to ideation and future decisions; and citizens as *stakeholders*, participating more independently in decision-making.

Finally, we use the empowerment framework from Schneider et al. (2018) (see Section 2.3) to understand how digital tools empower citizens through four dimensions: the concept of power, the psychological component, the persistence of empowerment, and the design mindset. The first dimension is the concept of power, which is categorised as *power-to* or *power-over*. The second dimension is the psychological component, which manifests through *feeling*, *knowing*, or *doing*. The third dimension considers the persistence of empowerment, which can be either *transient* or *persistent*. The fourth dimension is the design mindset, which distinguishes two perspectives: an *expert* mindset and a *participatory* mindset.

3.2. Tool selection and analysis process

In order to select digital tools for analysis, we reviewed the tools identified in a previous study by Gonçalves et al. (2024), in which over 150 digital tools developed for use in the context of urban governance were identified. These tools were divided among the four authors, who screened them based on a set of criteria to select the ones most relevant to the context of this study. These criteria are: (1) The tool must be digital, (2) There must be available documentation(s) associated with the tool and its application, (3) The tool must be accessible, (4) The tool must be tailored to an application in the urban environment, (5) The tool must be linked to at least one of the steps of the planning cycle, and (6) The tool must at least support the role of citizens as assessors. After the screening, 11 tools were considered suitable for this study. Based on the past experiences of authors, three additional tools (Bio-Civo, Redistrict and CoHeSIVE) were considered, leading to the selection of 14 tools for analysis. An overview and the main functionalities of the tools selected are presented in Table 1. The geographical context in which each tool has been applied is also included and reveals that most tools have been developed and implemented in Global North countries.

For each tool in Table 1, the content of relevant reports, publications, and websites was analysed using the three notions in Fig. 1. This also included analysing the tool itself or demo versions. Case studies where the tools have been applied were also considered for a more realistic overview of the functionalities of the selected tools. The tools were analysed independently by the authors and in two rounds, with each tool evaluated by two different authors. The four authors then shared and discussed the results of their analysis in collective sessions, where mismatches between authors were discussed. These mismatches happened due to misinterpretations of the framework presented above, particularly the HCI dimensions. In other cases, we found it difficult to infer the role of citizens, particularly the difference between contributor and stakeholder (as we discuss later in Section 6). To solve the mismatches, we then went back to the literature to first come to an understanding of specific dimensions of the framework and then reinterpret and consolidate the findings as presented in Section 4. Finally, this analysis revealed the need for an integrated conceptual framework to bridge the gap between the design of digital participation tools and their application in planning for citizen empowerment, which is presented in Section 5.

4. Results

4.1. Coverage of the planning cycle

Fig. 2 shows how the digital tools are mapped on the planning cycle. The stage of Evaluation & Selection is the most supported one, with eight out of the fourteen tools, while Visioning & Goal Setting and Testing & Experimentation have just a few tools, with two and one, respectively. The gap in the later stages is somewhat expected given the nature of urban planning, where testing and experimenting are usually limited to urban living labs or acupuncture urbanism, and it may be challenging to involve citizens in the implementation of urban projects, particularly large-scale or infrastructure projects (Bryson et al., 2023; Sarabi et al., 2021). A strong overlap between tools that support the stage of Context and Problem Analysis and the stage of Implementation & Monitoring is also observed.

Fix my Street, Commonplace, Maptionnaire, and I Change my City support both the first and the last stage of the planning cycle. These tools offer (spatial) surveys and/or maps on which residents can indicate issues or address concerns about the urban space. Features such as tracking the number of complaints or sending follow-up messages support the Implementation & Monitoring stage. This is, however, only a passive way of engaging citizens; they are not actively involved in monitoring or implementing spatial interventions. Pol.is stands out as a tool applicable only in the Context and Problem analysis. It creates clusters of people with similar views (called "clusters of consensus and division") around specific issues, based on citizen responses to specific statements. Through collecting and clustering input from citizens, digital tools in the Context and Problem analysis stage thus inform planners about which topics residents care about and where controversies lie, helping them make decisions at an early stage of the planning process.

Crowdgauge and Commonplace are the only tools with features related to the Visioning & Goal Setting stage. Crowdgauge asks citizens to define priorities for a specific area while Commonplace analyses sentiments in citizen comments. This way, these tools provide insights
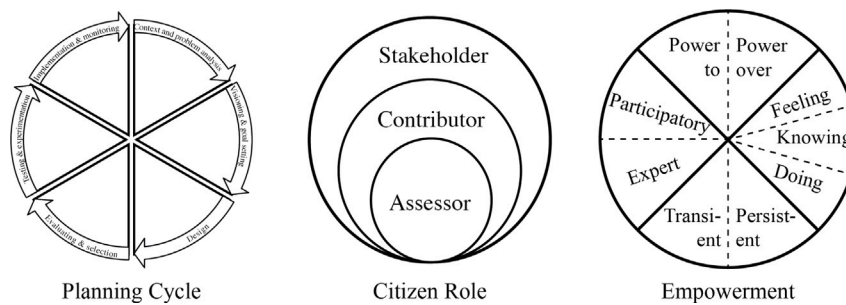
Fig. 1. Three-part analytical framework, combining the notions of the planning cycle, the role of citizens, and HCI empowerment.

Table 1
List of digital participation tools analysed in the paper, including a short description, main functionalities, and geographic context where the tool has been applied.

Tool	Short description	Main functionalities	Context
Fix my Street	Platform to report, view, or discuss local problems	Citizens report a local problem,s and the platform sends it to the local council	UK
Block by Block	Methodology that uses Minecraft for community engagement	Citizens design scenarios using a Minecraft environment	Various (Global)
Quick Urban Analysis Toolkit	Platform for viewing and manipulating simple urban geometry	Citizens design urban scenarios using a 3D environment	South Africa (ongoing)
Maptionnaire	Platform to design and manage community engagement, with a focus on map-based surveys	Provides various functionalities, with a focus on map-based surveys and participatory budgeting	Various (mostly EU)
Commonplace	Platform to design and manage community engagement	Provides various functionalities for outreach, engagement and collaboration	UK
Bio-CiVo	Platform to engage citizens in urban biodiversity	Citizen evaluate existing biodiversity scenarios and design their own scenarios	The Netherlands
CrowdGauge	An open-source framework for creating educational online games	Users to rank a set of priorities, then demonstrates how a series of actions and policies might impact those priorities	US
DIPAS	Digital system for citizen participation online and on site	Citizens are informed about ongoing local projects and provide comments	Hamburg, Germany
Redistrict	Platform for online public deliberation on rezoning	Citizens manipulate parcels of land and visualise the impact of the plan configurations	US
PlaceSpeak	Privacy-protected civic network	Citizens sign in to the platform, providing proof of residency. Citizens are informed about developments in their surroundings, provide feedback, discuss ideas, and reach decision-makers.	Canada
I Change my City	Platform to report and prioritise local problems	Citizens post a complaint, visualise and vote on the complaints from others, and interact with civic authorities to ensure the complaint is resolved	India
betri reykjavík	Platform to crowdsource of solutions to urban challenges	Citizens submit, debate, and prioritise policy proposals and ideas	Iceland
Polis	Platform to gather and analyse citizen comments at a large scale	Citizens respond and add statements about specific topics. An algorithm then identifies consensus and divisive statements, which are shown to participants. The statements are meant to generate dialogue between participants	Various (Global)
CoHeSIVE	A participatory co-design method and Virtual Reality application	Participants design scenarios using the CoHeSIVE VR app, based on given attributes and their levels	The Netherlands

into the values and priorities of citizens, in line with recent research that shows the importance of understanding public values in urban development (Herzog et al., 2024). Such an understanding goes beyond the identification of specific issues typical of the previous stage of Context and Problem Analysis but falls short of involving citizens in vision-making exercises. This gap at such an early stage may explain why participation remains tokenistic (Monno & Khakee, 2012), as citizens are not involved in defining city visions and strategic goals,

which are key planning outputs that influence all other decisions in the planning process.

Bio-CiVo and Redistrict combine the Design stage with the Evaluation & selection: Users first create a design (in these two cases, to improve biodiversity or re-zoning of schools, respectively) and evaluate their proposal and potentially the designs that were created by others. Block by Block, CoHeSIVE, and Quick Urban Analysis Toolkit also support the design stage. These tools operate within a three-dimensional
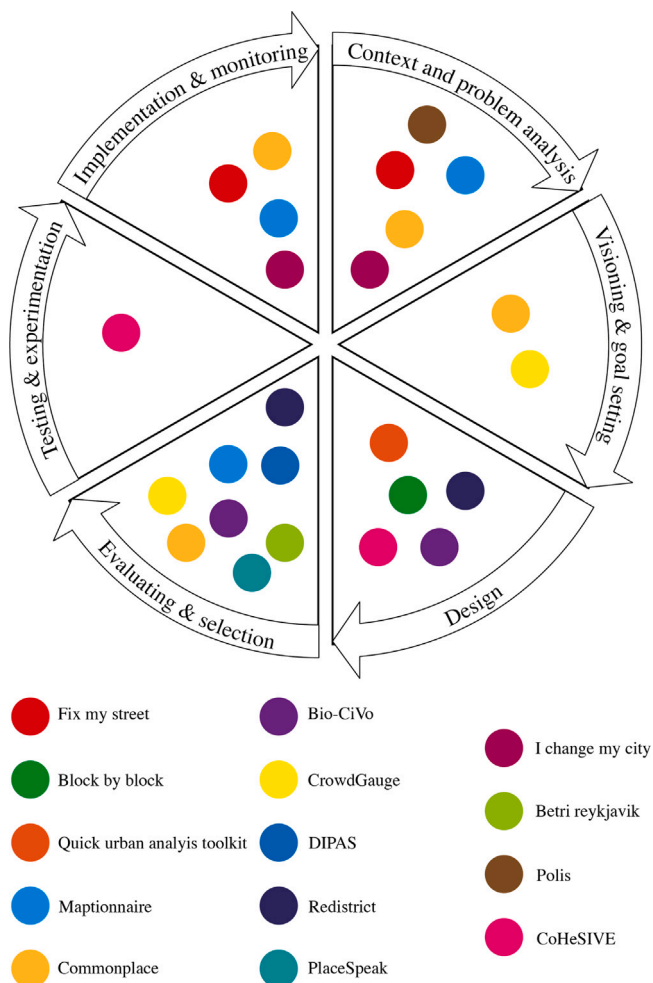
Fig. 2. Digital tools mapped on the planning cycle.

(3D) environment, where citizens design their own scenarios for urban spaces by manipulating the given 3D elements. Redistrict particularly differs from the other design-supporting tools because it supports the design of spatial plans, while the others focus on the design of spaces (such as public or semi-public spaces). In the design step of the planning cycle, we observe a varied number of interfaces that allow citizens to propose scenarios or designs for the city, which planners can then use as input to "official" scenarios and designs.

Most of the digital tools support the Evaluation & selection stage of the planning cycle. These tools request feedback from citizens on ongoing projects in the city through voting, liking, and/or commenting features. Although they support the same planning stage, their interface differs significantly: DIPAS is a map-based tool, CrowdGauge has a gamified interface, and betri reykjavík and PlaceSpeak use a portfolio-looking interface. These tools enable citizens to evaluate proposed designs on specific aspects and, through that, support planners in making decisions.

CoHeSIVE was the only tool to support the Testing & Experimentation stage, providing the opportunity for experiential learning through immersive VR technology, which is central to testing and experimenting with urban innovations. This tool enables creating, experiencing, and comparing future scenarios (what-if scenarios), while providing embodied and experiential experiences to the consequences that a user's decision-making has on the environment, as well as the emotional responses to environmental change. Immersive tools are still in their early phases, and further research is needed to evaluate their functionality in the real-world context (Dane et al., 2024), which may

eventually also lead to more tools that enable citizen involvement in the Testing & experimentation stage.

4.2. The role of citizens

Fig. 3 presents the roles that citizens can take with each digital tool: assessor, contributor, and stakeholder. The assessor role is supported by eleven tools, through either a closed, semi-closed or open feedback model. Closed or semi-closed models restrict what citizens can assess, merely providing feedback or voting on specific projects or proposing ideas to address specific issues within those projects. Examples are DIPAS, CrowdGauge, and betri reykjavík. Pol.is also operates in a semi-closed approach, since citizens can add new statements to a pre-defined topic of discussion. While this expands their involvement slightly, citizens remain largely limited to questions asked on specific issues, which reduces their capacity to influence broader decision-making.

Open-ended assessor systems allow citizens to report issues in the city without being constrained by project-specific boundaries, exemplified by I Change my City and Fix My Street. These tools invite citizens to report on urban issues independently of predefined projects. By removing these constraints, they encourage broader and potentially more meaningful participation. Open-ended systems have the potential to position citizens as contributors rather than as mere assessors. However, for citizens to truly act as contributors, it is necessary to determine whether they are present and involved in decision-making processes.

Seven tools support citizens to play the contributor role, usually in two ways. The first way is through participatory budgeting (Maptionnaire and Commonplace), which allows citizens to decide how to allocate public budget with features dedicated to collecting ideas, allocating budget, moderating, and voting on the ideas to decide on the budget. The second way is through engaging citizens in urban design and land-use planning. Here, tools like Block by Block, Quick Urban Analysis Toolkit, Bio-CiVo, CoHeSIVE, and Re-district enable citizens to contribute to the ideation and selection of future urban interventions.

While none of the tools truly support citizens to act as stakeholders, four tools have the potential to do so. This is indicated by the semi-transparent colouring in Fig. 3. The main difference between the roles of contributors and stakeholders is the level of independence citizens have in the process. For example, tools like Block by Block, Quick Urban Analysis Toolkit, and CoHeSIVE use a digital 3D environment mirroring the urban space to be designed or planned. Bio-CiVo offers a generic 3 × 3 grid that can represent any urban environment, enabling a higher level of citizen independence. While 3D and immersive environments depict the urban space less abstractly, closer to how citizens experience the city, these environments need to be created by experts, which prevents citizens from independently creating new designs for different areas beyond the environment they have been given. A more general environment like the one offered in Bio-CiVo allows more freedom, yet can also be less engaging since it is not place-specific.

4.3. Empowerment through digital tools

Fig. 4 shows how empowerment is manifested in each of the tools, using the framework of Schneider et al. (2018). Considering the concept of power, nine tools focus on the relationship between actor A and B, enabling citizens to have power over urban planners and decision-makers. *Power-over* tools enable citizens to raise issues or make complaints (Fix my Street; I Change my City), to react to ongoing projects in the city (DIPAS; PlaceSpeak; betri reykjavík), or to propose initiatives and vote through participatory budgeting (Commonplace; Maptionnaire). The other five tools enable citizens with a *power-to* perspective: Block by Block, Quick Urban Analysis Toolkit, Bio-CiVo, Redistrict, and CoHeSIVE empower citizens to create, test, and refine their own urban interventions, enabling them to step into the shoes of the designers and planners. Citizens can thus either influence urban decisions by confronting urban planners with their wishes and needs
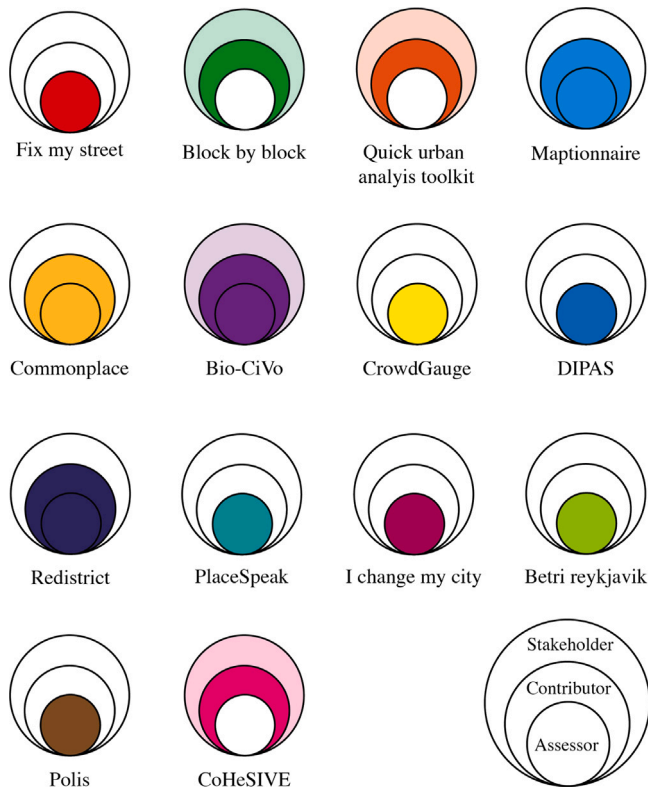
Fig. 3. The role of citizens supported by each tool: assessor, contributor, and stakeholder. The semi-transparent colouring indicates that four tools have the *potential* to enable higher levels of engagement, placing citizens as stakeholders in the planning process.

Fig. 4. How empowerment is manifested in each of the tools.

using *power-over* tools or have the power to step into the shoes of the experts to create urban spaces and land-use plans using *power-to* tools.

Empowerment has three psychological components: feeling, knowing, and doing. Twelve tools, of which seven primarily, focus on *feeling* empowered. This includes tools such as Maptionnaire and DIPAS, among others, which facilitate such empowerment by enabling citizens to provide input to influence planning, so they *feel* they are part of decisions. CrowdGauge combines *feeling* with *knowing* to further empower citizens through gamification, where citizens acquired knowledge about how specific planning decisions impact their own values/priorities. The tools that aim for *doing* as a form of empowerment are all taking place within the power-to dimension. Bio-CiVo, CoHeSIVE and Redistrict, for example, operate through all three psychological components: *feeling, knowing* and *doing*. By inviting citizens to design, they tap into the component of *doing*, similar to Block by Block and the Quick Urban Analysis Toolkit. By combining design and evaluation, they enable citizens to analyse the impact of their designs, fostering understanding and learning, and the development of problem-solving skills and thus operating through *knowing*. The combination of the three components thus enables citizens to create and evaluate urban designs (doing and knowing), tap into the *power-to* dimension, potentially developing a sense of efficacy, while having the feeling of influencing decisions.

All digital tools aim for *persistent* empowerment. There is an expectation that citizen input will be used by the platform owner where the tool is deployed, who may or may not be a planning authority/expert. For example, Fix My Street is not connected to a public authority but sends the citizen reports directly to the local council or other authority responsible for dealing with the reported problem. The tool also publishes the report so the community can see what has already been reported and subscribe to any reports they are interested in. Other
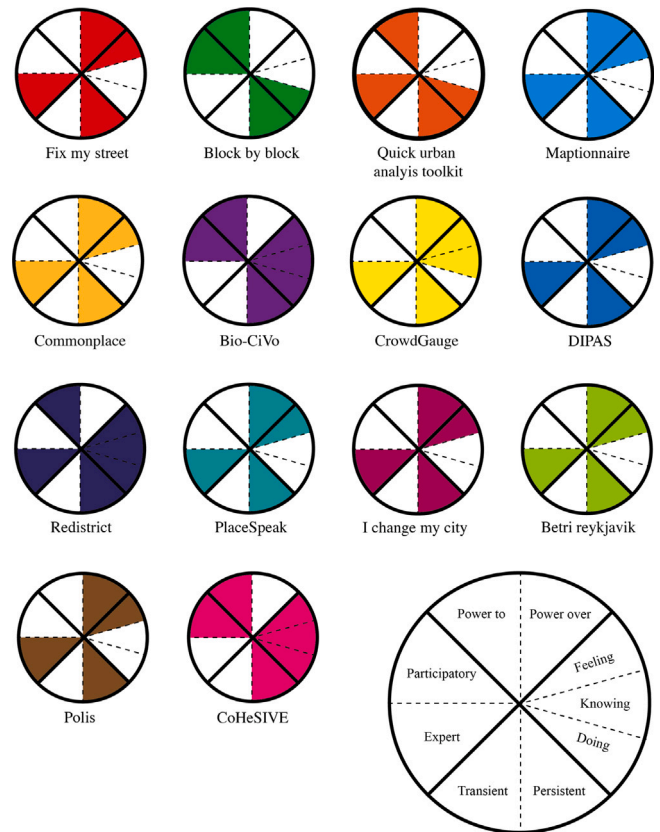
tools, such as I Change my City and Maptionnaire, also offer mechanisms/features to help track this temporal dimension of empowerment. However, whether the empowerment is really persistent depends on how citizen input is embedded into the planning/design process, as well as how citizens perceive this themselves, which is, in many cases, unclear from an analysis that focuses solely on HCI design dimensions. A good counter-example is Block by Block, where a Minecraft-like environment is used in a co-creative process for urban design and has been successfully applied in many cases already.

Eleven of the tools are primarily developed with an *expert* mindset, meaning that citizens are not involved in the design of the digital tool itself. In these cases, digital participation tools function primarily as data collection instruments, gathering citizen input for decision-making. Although some tools make use of citizen-centric features, such as gamification in CrowdGauge and others, we did not find evidence that citizens were included in the design process of these tools. This may also be a result of limited information on how the tools were created. Block by Block, CoHeSIVE, and Bio-CiVo represent exceptions, as these tools are developed with primarily a *participatory* mindset. They were designed with the active participation of individuals who are regarded as collaborators and contributors throughout the tool design process.

5. EmpowerCycle: The participatory planning cycle for digital empowerment

The results presented in this paper lead to two central insights. First, citizen empowerment in planning depends on two levels of "power mediation" and corresponding "mediating actors": the digital tool and the HCI designer who creates the tool, and the planning cycle and the planner who defines the participatory process, with the role citizens can play in planning defined at the intersection of the two levels. This

helps us to understand why a good coverage of the planning cycle does not necessarily mean that citizens are empowered (as digital tools may be poorly designed) or why even tools that are well-designed in terms of HCI fail to influence planning decisions (as digital tools may not be meaningfully embedded in the planning process). Second, citizen empowerment in planning cannot be achieved through a single "holy grail" digital tool. In other words, there is no one-size-fits-all tool for participatory planning (Gonçalves et al., 2024). Instead, it is necessary to *embed* existing (or to be developed) tools in *complementarity* to each other to cover the planning cycle and achieve the HCI requirements, empowering citizens at different levels. This also means using digital tools in complementarity with in-person on-site participation (Gonçalves et al., 2024).

From these two insights, we developed EmpowerCycle, the Participatory Planning Cycle for Digital Empowerment (Fig. 5a). The EmpowerCycle framework integrates the three notions of participatory planning, role of citizens, and HCI empowerment, which are necessary to understand how digital tools empower citizens to take certain roles in planning processes. As such, the framework supports a shift in how digital tools are designed and implemented, away from top-down one-size-fits-all approaches and towards situated *processes* that cultivate participatory mindsets across all stages of the planning cycle; paraphrasing (Jiang et al., 2022): process first, tools second. Furthermore, the framework brings together two practices that currently operate on opposite sides of the same coin. By understanding how planning operates, digital tool designers can better define the roles of the citizens they seek to empower. Likewise, by recognising how empowerment is embedded in digital tools, planners can appreciate the value of situated tools that enable distinct citizen roles across planning stages. Given that planners rarely drive innovations in digital participation tools (Milz et al., 2024) and designers cannot ensure their implementation (Gonçalves et al., 2024), collaboration between the two can foster participatory processes in which citizens have clearly defined roles, contributing not only to improved planning outcomes but also to more democratic practices.

The framework application is illustrated through an example that embeds Maptionnaire and CoHeSIVE in a complementary way into a participatory planning cycle (Fig. 5b). In this example, Maptionnaire supports citizens to act as *assessors* in the Context and Problem Analysis stage by providing contextual input through spatial surveys. Since these surveys are designed by the expert planner beforehand, the scope of influence of citizens is limited to the topics included in the survey questions. The data collected through the survey is used to formulate a vision and define the goals of a particular area. Our results show a gap in this phase of the planning cycle (Section 4.1), as none of the digital tools considered in the paper support the involvement of citizens directly in vision-making exercises. This gap is thus also present in the illustrative example but offers the opportunity for innovative tool design. The vision and associated strategic goals then set the requirements for the design options. Here, citizens are included as *contributors* in the Design phase through CoHeSIVE, a virtual reality tool that supports citizens to contribute their own design options.

The design options (co-)created by citizens subsequently feed into the Evaluation & Selection phase, where a broader pool of citizens *assess* the designs made with CoHeSIVE and choose their preferred designs through a voting scheme in Maptionnaire. After this phase, the expert planner can make decisions based on the most voted options to create a final design that considers the diversity in citizen opinions as well as the voices not included in this process. This is important because a planning intervention (be it a policy or a spatial intervention) cannot be decided based on a majority vote, but must be created taking other factors into account. Besides ensuring that planning interventions are inclusive, the expert also needs to comply with various planning and design regulations/restrictions that citizens may not be aware of. The expert thus has the difficult task of integrating different perspectives and knowledges into the final spatial design. When a final design is
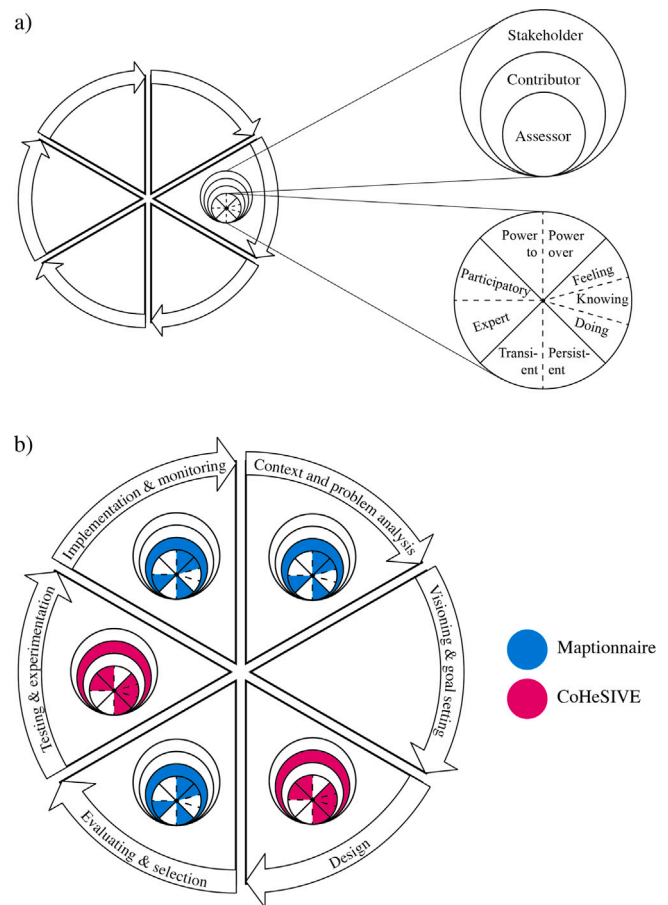

Fig. 5. (a) EmpowerCycle framework: The Participatory Planning Cycle for Digital Empowerment, showing that citizen empowerment is linked to both a specific tool and a planning stage. (b) Illustrative example of the framework application embedding Maptionnaire and CoHeSIVE in the planning cycle.

available, CoHeSIVE is used again in the Testing & Experimenting phase so citizens can experience the proposed environment, which then goes into implementation. Finally, the details of the entire process, including the results of the voting process, are made available in Maptionnaire for transparency in the Implementation & Monitoring phase.

6. Discussion

While our results and framework help to understand the dimensions through which digital participation tools empower citizens in planning processes, they do not prescribe particular combinations of these dimensions as inherently more or less empowering. We therefore refrain from normatively suggesting how participatory planning should be organised or which tools should be used where, as such processes are inherently context-dependent and thus shaped by institutional and legal frameworks, community dynamics, the capacities and resources of stakeholders, the planning issue at hand, among other factors. Nonetheless, we offer reflections on key topics by situating our findings within the broader literature.

First, we invite a deeper reflection on what constitutes a 'participation gap' in the planning cycle. As we have seen, fewer digital tools exist to support the stages of visioning and implementation. In implementation, participation is often constrained by the nature of the stage itself; for instance, the technical expertise or safety requirements of construction can limit citizen involvement. This does not mean participation at this stage is either impossible or undesirable, nor that

digital tools are necessarily the most suitable means to enable it. In visioning, by contrast, a stronger case exists for citizen engagement given the significance of vision documents and strategic agendas. This does not mean participation at this stage is either straightforward or feasible, nor always best facilitated through digital tools. Normatively, this requires designing for democratic capacity and citizen empowerment (Helbing et al., 2023). Pragmatically, it requires assessing whether proposed participatory activities address concrete needs, whether new tools enhance existing practices, and what capacities and resources must be developed or allocated to introduce and sustain new (digital) tools.

Second, regarding the dimension of 'concept of power', most tools analysed in this study operate on the relationship between citizens and decision-makers (*power-over*), seeking to "flip" this relationship by highlighting everyday issues that may escape official attention (e.g., submitting complaints) or by influencing decisions (e.g., providing suggestions, voting). In this way, they enforce accountability over the authorities and decision-makers, who otherwise exercise *power-over* citizens. A few tools empower citizens to act independently; when they do it is by enabling citizens to "step into the shoes of planners and designers", as we describe. Both forms of empowerment can be considered legitimate and valuable. However, in the first case, the inversion of the power relationship occurs only if decision-makers take citizen input seriously. This connects to the 'persistence of empowerment' dimension: while we classify all tools as aiming for persistent empowerment, as they seek to influence spatial decisions in some capacity, evidence of such persistence was found only in a limited number of cases.

Here, the concepts of *potestas* and *potentia* as articulated by Foucault (drawing on Spinoza) are instructive. *Potestas* denotes the traditional, top-down form of power exercised by authorities and institutions, whereas *potentia* refers to a bottom-up, productive force grounded in people's capacity to act, create, and resist. While *potestas* operates through control, *potentia* is immanent and collective. As shown, *power-over* digital participation tools can challenge *potestas* by inverting the power dynamic and enabling citizens to hold decision-makers accountable, for example, through complaint platforms, though only to a limited extent. By contrast, *power-to* tools build *potentia* by enabling citizens to undertake tasks beyond their existing skills. We note that, in our study, the only tools that enable higher citizen roles are the ones with *power-to* characteristics. However, as Nunes (2021) observes, *potentia* depends on quantity; its strength lies in collective action. For digital tools to genuinely empower citizens in a Foucauldian sense, they must therefore build not only individual capacity but also connections among citizens, fostering networks that enable collective action. This aligns with notions of collective participation within the "Democracy by Design" framework proposed by Helbing et al. (2023), although grounded in a different theoretical tradition.

Third, regarding the HCI dimension of 'psychological component', we emphasise that all three components – feeling, knowing, doing – are essential for empowerment, without implying a hierarchy among them. However, not all three need to be activated by a single digital tool. Psychological empowerment may be achieved through combinations of digital tools, integration with in-person formats, or other social processes. In these cases, understanding the 'soft infrastructure' (Star, 1999; Tonkiss, 2015) surrounding digital tools becomes relevant, encompassing "both the network of people with their informal relational practices of learning and working together, and the more institutionalised agreements and documentation leading to its unique internal governance" (Cardullo & Kitchin, 2025). Differences in such infrastructures help explain why the same tool can lead to different empowerment dynamics (Cardullo & Kitchin, 2025).

Moreover, while certain digital features may be strongly associated with a specific psychological component, for instance, educational materials fostering empowerment through *knowing*, we stress that such associations should ultimately be assessed by citizens themselves.

Citizen-led evaluations not only capture lived experiences but can also uncover dynamics that extend beyond the digital environment, including both anticipated and unforeseen behaviours. For example, engagement with a tool might prompt citizens to seek further knowledge on the topic or motivate them to take action outside the digital space. The psychological component should therefore be approached in an integral way, in relation to the broader set of participatory tools in use, and the activities that occur within soft infrastructures or outside formal participatory settings. This integrated perspective recognises that empowerment emerges from the interplay of multiple tools, contexts, and social processes, rather than from isolated digital features alone.

Fourth, and extending from the point above on participatory evaluation, we turn to the role citizens can take in planning processes. Although the citizen role model differentiates strictly between contributors, assessors, and stakeholders, we found the distinction to be not so clear-cut. Conceptually, being a stakeholder requires a certain level of independence from public authorities, enabling citizens to engage in parity – and agonistically (Mouffe, 1999) – with other stakeholders in formal participatory processes or despite formal processes (going towards even higher levels of participation, such as citizen control or self-management). However, in practice, whether citizens are contributors or stakeholders depends on how they are regarded by the planners and other stakeholders and how they see themselves in the process. Here, too, participatory evaluation of planning processes can help to understand lived experiences in participatory practices.

Lastly, we discuss the dimension of 'design mindset'. We noted a predominance of expert-based tools, which is in line with previous research that criticises the top-down approach to the development and implementation of digital participation tools (Biedermann et al., 2023; Gonçalves et al., 2024; Gooch et al., 2015; Pfeffer et al., 2013). An expert mindset reveals that there is little effort to understand and improve how citizens, in their diversity, interact with technology and, consequently, little effort in creating technologies that value non-expert knowledge. In other words, citizens are asked to provide input that fits expert frameworks, thus restricting the full expression of lived experience. Our analysis somewhat corroborates this perspective, as it shows that the only time citizens have the role of stakeholders is when the tools are designed with a participatory mindset. Otherwise, the role of citizens in planning is usually limited to assessors, rather than the higher levels of contributors or stakeholders. If most digital participation tools are designed with an expert mindset, we have to ask who exactly the digital tool empowers: Does it empower experts by restricting citizen input to expert frameworks? Or does it empower citizens to meaningfully participate in urban planning?

6.1. Limitations and future work

One limitation of our framework is that it applies specifically to *digital* participation tools, owing to the integration of the HCI dimensions. Echoing Jankowski et al. (2019), we emphasise that digital technologies are not "a panacea for scaling and improving the quality of public participation processes and outcomes". They might create an unequal playground by excluding people with less access to the technologies or digital literacy (Boland et al., 2022). Digital participation can even limit the opportunity for interaction with individuals with different life experiences who may not be the target audience of such tools (Robinson & Johnson, 2023). A well-designed participatory *process* needs to consider the exclusionary consequences of digital engagement (Bronsvoort & Uitermark, 2022; Heeks & Shekhar, 2019; Witteborn, 2021). It is necessary to ask (and answer) additional questions, such as: Who is excluded from digital participation? How can digital tools be designed to ensure inclusivity across population groups? To what extent can we enable the integration of digital tools in the planning processes while increasing the agency of citizens? How to combine digital tools

with in-person participation? And, ultimately, are digital tools the most appropriate medium for empowering citizens?

All these questions are emerging in recent debates about the use of technology in urban decision-making (Boland et al., 2022; Gonçalves et al., 2024; Jankowski et al., 2019; Yang et al., 2024). While we believe our process-based approach implicitly requires these reflections, there remains a need for a more robust framework to account for place-based dynamics, including the diverse backgrounds and contexts of citizens involved. A recent contribution in this direction is the alignment of the Urban Digital Twins concept with participatory forms of governance involving the 'commoning' of city information, as conceptually proposed by Dawkins and Kitchin (2025). Incorporating justice concerns throughout the lifecycle of digital participation tools – spanning their design, application, and the handling of collected data – also emerges as a critical area for improvement in our framework.

Moreover, while we acknowledge that planning processes are shaped by broader socio-political dynamics, our framework is not explicit about the contextual arrangements under which the selected digital tools have been applied. This dimension is important for two reasons. The first is that there are barriers to digital participation also on the implementation side – meaning the planning or, more broadly, governance side. We note that, among the tools analysed, many emerged as pilot projects or research-driven experiments, often driven by academic institutions or NGOs, rather than embedded within municipal decision-making frameworks. Without political buy-in, these tools fail to become standard practice in the planning processes. This may also be due to the resistance of governmental institutions to shifting power towards citizens (Gonçalves et al., 2024). Other barriers to (digital) participation include a lack of institutional frameworks, missing data management and ethics frameworks, a lack of concrete policies and procedures, intra-organisational culture delays, and the availability of human and material resources (Ataman et al., 2025; Ballatore et al., 2020; Falco & Kleinhans, 2018; Gonçalves et al., 2024). Scholars have also noted the implementation gap, varying levels of preparedness, and resistance regarding the adoption of technology within the planning profession in general (Boland et al., 2025; Daniel et al., 2024; Devlin & Coaffee, 2023; Wilson & Tewdwr-Jones, 2022). Exploring governance arrangements and challenges, and the role they play in enabling citizen empowerment through these tools, is necessary for their effective adoption in planning practice.

The second reason is that the broader socio-cultural-political context has an important influence on both planning processes and technology use and adoption. Within planning processes, participation touches down at various moments. In formalised processes, this may refer to visioning, the design, or implementation, as used in this paper. As pointed out earlier, even in formalised processes, it may not be straightforward to identify planning stages; this is even less so in less formalised processes, typical of non-western contexts (Frediani & Cociña, 2019). Less formalised processes have more opportunities for insurgency, where citizens do not constrain themselves to participation processes sanctioned by the authorities (Miraftab, 2009). Contextual differences are also seen in how new technologies are articulated from the "top" (Arora, 2025; Ricaurte et al., 2024) and the "bottom" (Dutta & Mazumdar, 2025), as well as in the way people perceive technology in relation to their lived experiences (Arora, 2025). While insurgency and bottom-up participation can arise in any context, in post-colonial settings, participation mechanisms have often been used to depoliticise struggles, extend state control, and maintain the status quo by stabilising state–society relations (Miraftab, 2009; Vanolo, 2016). Planning practices also vary widely, with western paradigms increasingly subject to contestation (Kamana et al., 2024; Miraftab, 2009). Beyond empirical discussions, it is important to highlight the importance of non-western theoretical scholarship and how it can be productive to take plural epistemologies seriously in digital planning and related fields (Medrado & Verdegem, 2024; Milan & Treré, 2024; Valente & Grohmann, 2024). Further research is needed to validate

whether and how the EmpowerCycle framework can be adapted to other planning contexts or informal practices.

Finally, this study relied on existing documentation about digital tools and their use, which introduced certain limitations. In particular, it was often difficult to determine the precise role of citizens or to assess whether, and how, their contributions influenced planning decisions. As Boland et al. (2022) notes, this requires examining not only levels of involvement but also the quality of engagement and its genuine impact on planning. Future research should therefore investigate how citizens perceive their own role and influence in planning, alongside how other stakeholders view citizens' contributions. This is critical, as a tool deemed empowering by external analysts may not be perceived as such by citizens themselves. Importantly, prior research shows that such perceptions vary across socio-demographic groups and other factors (Gonçalves et al., 2024; Li et al., 2020; Zheng, 2017). A similar limitation emerged regarding the design mindset behind the tools: for many, this information was unavailable, and while some appeared citizen-friendly, we found little evidence of citizen involvement in their creation. These limitations, however, also present an opportunity: Our framework can support better documentation and evaluation of participatory practices by encouraging more holistic reflection on both the design and application of digital participation tools in planning.

7. Conclusion

This paper addresses the gap between the design and application of digital participation tools in planning practice. It does so by integrating three key notions: a planning cycle with six typical stages, a typology of citizen roles in planning, and four dimensions of empowerment through a human–computer interaction (HCI) design lens. The paper first provides a comprehensive analysis of fourteen digital participation tools, ranging from tools designed for research projects to commercial and open-source tools. The analysis shows that various digital tools exist to support planners in collecting input from citizens and making decisions based on the collected data. There is, however, a lack of tools that support planners and citizens in collective visioning and joint experimentation, implementation, and monitoring of planning interventions. Furthermore, the majority of tools analysed enable citizens to contribute to planning as assessors, thus with limited influence. Fewer tools empower citizens to take roles as contributors or stakeholders, engaging in planning with greater independence and parity with formal stakeholders. Many tools operate within a top-down "expert mindset", limiting digital participation to data collection with no clear influence on decision-making. These findings raise concerns about tokenistic digital participation and, more broadly, about the exclusion of those without digital access or literacy and the potential for digital tools to perpetuate exclusion and inequalities.

Our results ultimately show that there are two levels of power that mediate the use of digital participation tools in planning processes: the digital tool and the HCI designer, and the planning process and the planner. Such an understanding explains that a well-integrated planning process does not guarantee empowerment if the tool is poorly designed, and that even well-designed tools can fall short in empowerment if not meaningfully embedded in planning practice. Overlooking this dual mediation of power creates a disconnect between digital participation and real-world planning. We furthermore show that empowering citizens in planning requires the complementary use of diverse tools to achieve different levels of engagement and empowerment. Based on these insights, we argue for a shift towards situated participation *processes* that cultivate participatory mindsets across all stages of the planning cycle: process first, tools second. To support this shift, we offer the EmpowerCycle framework, a comprehensive framework that integrates perspectives of different disciplines (planning, citizen engagement, and HCI design) to inform the selection and design of digital participation tools. The framework can also help in better documentation and assessment of digital tools and their application in planning.

CRediT authorship contribution statement

J.E. Goncalves: Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **G. Slingerland:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **S. Sarabi:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization. **G. Dane:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis, Conceptualization.

Data availability

No data was used for the research described in the article.

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