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Research article

Engagement in the digital age: Understanding “what works” for participatory technologies in environmental decision-making

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ABSTRACT

Effective engagement is crucial for enhancing environmental decision-making processes, fostering more sustainable and equitable outcomes. However, the success of engagement is highly variable and context-dependent. While theoretical frameworks have been developed to explain outcome variance in engagement in environmental decision-making, they have not yet been tested in digital contexts, leaving their applicability to digital engagement processes unclear. More broadly, there are unanswered questions about the effectiveness of digital tools in achieving the goals of engagement, which have become increasingly pertinent amidst growing concerns about the potential of digital technologies for exacerbating exclusions, ethical issues, and systematically undermining democratic progress. This paper addresses this evidence gap by presenting findings from interviews with practitioners in UK public, private, and third sector organisations. Our results provide empirical insights into the technical, ethical, and inclusivity debates surrounding digital tools and their effectiveness in promoting accessible engagement, high-quality social interaction, place-based decision-making, and more trustworthy and credible outcomes. Our findings indicate that while current engagement theories are applicable to digital environments, the key explanatory factors acquire new dimensions in digital compared to in-person contexts. Drawing on the findings, this study contributes novel insights to expand current theory for explaining “what works” in engagement in environmental decisions, enhancing its relevance and applicability in the digital age. The paper concludes with evidence-led recommendations for environmental practitioners to improve engagement processes in digital and remote settings.

1. Introduction

Engagement is widely promoted to improve environmental decision-making and deliver sustainable, equitable, and resilient outcomes (Luyet et al., 2012; Newig et al., 2023; Reed, 2008). Engaging interested parties and those who may influence or be impacted by decisions is essential across various contexts such as natural resource management, governance, nature-based solutions, agriculture, protected areas, forestry, and planning (e.g., Ernst, 2019; Jankowski, 2009; Korpilo et al., 2018; Mease et al., 2018; Rollason et al., 2018; Ingram, 2008). Despite widespread promotion and claims of more inclusive and representative

decision-making for both digital and non-digital engagement, challenges persist, including the reinforcement of power imbalances and further marginalisation of minority perspectives (Cooke and Kothari, 2001; Few et al., 2007; Lane and Corbett, 2005).

To understand how and why engagement varies across different contexts, various models, theories, and frameworks have been developed (e.g., Arnstein, 1969; Bell and Reed, 2022; IAP2, 2018; OECD, 2022; Pretty, 1995; Reed et al., 2018). These frameworks explain different engagement forms, the roles of actors, and the impact on outcomes. Resources like Participedia (<https://participedia.net/>) and the OECD Observatory of Public Sector Innovation (<https://oecd-opsi.org>)

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org/case_type/opsi/) outline a breadth of approaches. Reed et al.'s (2018) "theory of participation", which was developed to be a holistic and context-sensitive approach, is widely cited within environmental management and decision-making contexts (e.g., Kahila-Tani et al., 2019; Holifield and Williams, 2019; Shackleton et al., 2019; Shrestha et al., 2019). This theory explains how different engagement approaches, methods, and tools are "fit for purpose", with four key factors explaining much of the variation in engagement outcomes: context, design, power, and scalar fit (see Fig. 1; also, de Vente et al., 2016). The theory of participation draws on these factors to help explain and predict positive and negative impacts on participants, society, and/or the environment.

Reed et al.'s (2018) theory arguably offers a more rigorous approach compared to previous models like Arnstein's ladder of citizen participation (Arnstein, 1969) and the International Association for Public Participation's spectrum of participation (IAP2, 2018), which conflated engagement types with explanatory factors and made normative assumptions that equated high engagement with positive outcomes and lower levels with "manipulation" and "tokenism" (see Bell and Reed, 2022; Hafferty, 2022). Numerous models, including the theory of participation, emphasise the role of context in explaining outcomes (e.g., Baker and Chapin, 2018; Bell and Reed, 2022; Chilvers and Kearnes, 2015), and some have suggested that context is the primary driver, making it difficult to posit more generalisable theories of engagement (e.g., Vella et al., 2021). However, Reed et al. (2018) argue that, independent of context, it is possible to predict engagement outcomes by

considering the systematic representation of relevant parties, effective management of power dynamics, and alignment with spatial and temporal scales. Although these theories have been widely applied and tested across environmental contexts in the UK and internationally (Hafferty, 2022; Newig et al., 2023), it remains unclear how the increasingly ubiquitous use of digital technology influences the effectiveness of engagement in delivering its widely claimed benefits.

Prominent models and theories for engagement in environmental decision-making have yet to consider how the factors determining "what works" take on new dimensions in the digital age. Reed et al. (2018) do not explicitly recognise how methodological choice - particularly digital (remote) and in-person engagement - can influence the process and outcomes of engagement. Additionally, the theory was based on empirical evidence (de Vente et al., 2016) which predominantly considered in-person methods for engagement such as interviews, workshops, focus groups, stakeholder meetings, and some low-tech virtual methods like digital newsletters and online surveys. Previous theoretical frameworks also do not consider their applicability in digital and remote contexts, including Arnstein's (1969) ladder of participation, Pops and Pavlak's (1991) model of fair decision-making processes, deliberative democracy frameworks (Dryzek, 1990; Cohen, 1989), participatory politics (Hahnel, 2005; Shalom, 2010), and Bell's (2014) procedural justice indicators (see Bell and Reed, 2022, for a review of these and other frameworks). No research to date has examined the extent to which Reed et al.'s (2018) theory of participation holds in digital and remote environments. This is important because engagement

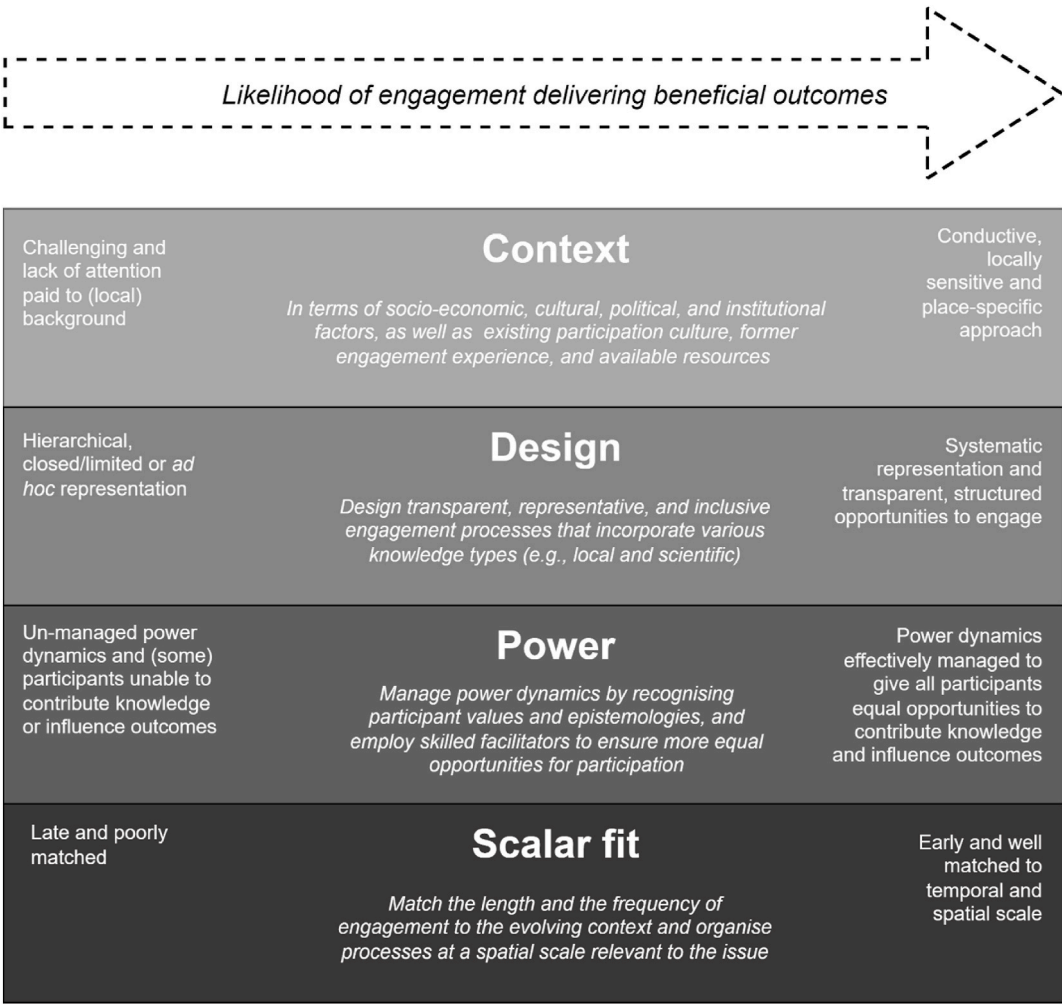


Fig. 1. The theory of participation: four factors which help explain outcomes in participatory environmental decision-making processes (diagram adapted from Reed et al., 2018).

processes may take on new dimensions in digital and remote environments compared to in-person processes.

Understanding the impact of digital technology on engagement is crucial as it continuously reshapes how it is understood and implemented in environmental research, policy, and practice (see Afzalan and Muller, 2018; Bojovic et al., 2015; Chivers et al., 2021; Ingram et al., 2022; McKinley et al., 2021; Hafferty, 2022; Hafferty et al., 2024; Salter et al., 2009; Sattler et al., 2022). Digital engagement tools encompass various platforms and technologies, including digital participatory platforms, participatory mapping, geo-visualisation, social media, gamification, and e-government tools (Falco and Kleinhans, 2018a). Table 1 provides a list of digital tools for engagement and examples demonstrating their use for environmental decision-making applications. These tools include synchronous (in real time) and asynchronous (remote) methods, as well as multimodal (including multiple different ways of doing digital engagement) and multimedia (using more than one expression of digital communication) approaches. They serve different purposes, from problem exploration to project evaluation, and include digital participatory platforms, participatory mapping, social media, collaboration tools, and open data platforms (Hafferty, 2022). Digital tools are also used in other domains like spatial and urban planning, development, healthcare, and technological innovation (see Falco and Kleinhans, 2018b).

Digital tools and technologies are often heralded for offering new avenues for engagement. Hafferty (2022) found that an array of digital platforms were promoted in UK-based environmental projects, with claimed benefits including increased efficiency, inclusion, and transparency. Similarly, Bojovic et al. (2015) found that internet-enabled tools improved the quality, efficiency, and legitimacy of participatory approaches to climate change adaptation with farmers in Northern Italy, and Salter et al. (2009) found that the development of a suite of new digital tools for landscape visualisation held advantages for participants' understanding of and engagement with sustainability issues facing small communities in North America. The claimed benefits of digital tools for engagement are reflected in international policies and frameworks for environment and sustainability issues, which frequently tout technological innovation as a "win-win" for both people and planet (Charlton et al., 2023; Hafferty, 2022; also see OECD, 2022). For example, the European Union's Digital Strategy (European Commission, 2023) and Digital Democracy Initiative (European Commission, 2023b) leverage Web 4.0 (the integration of digital and physical environments) and virtual worlds to create a more human-centred, sustainable future by enhancing citizen empowerment, democracy, and human rights through digital technology. The United Nations (UN) incorporates (digital) participation into two Sustainable Development Goals (SDGs), focusing on inclusive and sustainable planning and development, which promote peaceful, integrated societies (United Nations, 2023). In the UK, strategies for digital transformation prioritise the use of digital tools and platforms as the primary means of service delivery and public engagement (Charlton et al., 2023), with the Government's roadmap for digital and data transformation promising more efficient, accessible and inclusive public services with 'better outcomes for everyone' (Central Digital and Data Office, 2022, no page number). The UK's Department for the Environment, Food, and Rural Affairs (DEFRA) highlights the promises of digital transformation for delivering more efficient and effective services that make the best use of technology, digital, data, and automation (DEFRA, 2023). These "digital-by-default" or "digital-first" approaches, which are evident from national to local levels in the UK (Central Digital and Data Office, 2022; DLUHC, 2022; also see Charlton et al., 2023), underscore the perceived efficiency and 'limitless potential' of data and technology (see UK Digital Leader's Public Sector Innovation Conference, 2022) for meeting a wide range of relevant environment and sustainability priorities spanning net zero, decarbonisation, to socio-economic development and urban regeneration (Central Digital and Data Office, 2022).

However, critics argue that technology-centric narratives in

environmental and sustainability fields often overlook the broader societal implications of rapid, often poorly regulated digital transformation (Certomà and Corsini, 2021). Ethical, equity, and justice concerns have been raised about digital technologies exacerbating exclusions and biases, warning against blind faith in these tools, which may systematically undermine democratic progress. Digital transformation strategies have also been critiqued for focusing narrowly on digital divides and neglecting wider societal impacts (Charlton et al., 2023). As Stirling (2008) argues, decision-makers sometimes view technological innovation as inherently beneficial, downplaying or tacitly denying the influence of context, purpose, and power dynamics on process dynamics and outcomes, which risks reducing transparency, accountability, inclusion, and agency in participatory environmental decision-making. Persistent questions remain about the benefits and drawbacks of digital technologies in achieving engagement goals (Afzalan and Muller, 2018). For example, Salter et al. (2009) found that insufficient time and quality of interaction in digital engagement sessions necessitated a deeper examination of the optimal use of these tools in collaborative settings. Numerous studies also indicate substantive differences between digital and in-person engagement (Afzalan and Muller, 2018; Rowe and Gammack, 2004; Willis et al., 2021), which warrant further exploration in environmental decision-making contexts. The COVID-19 pandemic has further highlighted the urgency of these questions, exposing technology-related disparities (Hafferty, 2022; Robinson and Johnson, 2021). Despite the decades-long evolution of digital engagement (Wilson and Tewdwr-Jones, 2021), critical questions remain about its effectiveness in enabling democratic participation and promoting equitable, socially inclusive decision-making.

Empirical evidence on what works (and what does not) in digital engagement in environmental arenas is lacking. There is also a general over-emphasis on developing engagement methods and best practices, with less focus on the fundamental, context-dependent reasons for encountered difficulties (Wesselink et al., 2011). Existing participation theories, which provide a framework for understanding what works, have not been explicitly tested in digital contexts. As such, it is unknown to what extent they can guide digital engagement processes. For instance, while Luyet et al.'s (2012) framework for participation in environmental projects acknowledges that traditional models may integrate internet-enabled tools, it does not consider emerging technology-related issues or how such frameworks could be optimised to address them. Similarly, although many other authors have proposed conceptual and practical frameworks for engagement in various environmental and natural resource management contexts (e.g., Eaton et al., 2021; Talley et al., 2016; Watson et al., 2018), none have explicitly considered whether the core features of these frameworks change in digital engagement settings. Moreover, studies often explore factors like inclusion and trust (e.g., Panchyshyn and Corbett, 2022), digital divides (Bojovic et al., 2015), or the changing quality of deliberation (Nyerges and Aguirre, 2011) in isolation, rather than using comprehensive, empirically supported engagement theory to consider the interaction of diverse issues. There is a gap in understanding the benefits and drawbacks of digital tools for engagement and how factors known to share effective engagement might operate differently in digital and remote environments. This study addresses this gap by drawing from Reed et al.'s (2018) theory of participation, which synthesises relevant theoretical frameworks and is supported by empirical work on engagement in environmental management contexts, including de Vente et al. (2016), who evaluated engagement in dryland environmental projects, and Newig et al. (2023) who conducted a meta-analysis of over 200 OECD case studies. The theory of participation was chosen for its emphasis on contextual factors shaping engagement outcomes, aligning with various other theories (e.g., Baker and Chapin, 2018; Bell and Reed, 2022; Chilvers and Kearnes, 2015), and its prioritisation of significant explanatory factors (also see Newig et al., 2023), offering real-world relevance for practitioners and policymakers. The research centred on investigating practitioners' perspectives, offering unique insights about

the benefits and risks associated with digital engagement from the perspective of those delivering environmental decision-making processes. This also helped to meet an identified research gap on practitioners' insights into effective participation in environmental management (Holifield and Williams, 2019; Wesselink et al., 2011). Data collection during the COVID-19 pandemic provided a unique opportunity to examine perspectives on inclusive and effective engagement in digital remote settings, as an array of technical, ethical, and inclusion debates around technology were rapidly brought to the fore. This paper contributes to these gaps by addressing the following objectives.

1. To empirically investigate the technical, ethical, and inclusion dimensions of digital engagement with relevant parties in environmental decision-making processes.
2. To assess the relevance of existing engagement theory to processes that take place in digital and remote environments, identifying new factors that might explain engagement outcomes in these contexts.
3. To use these empirical and theoretical insights to produce evidence-led recommendations for environmental practitioners, practice-enablers, and decision-makers in order to improve engagement processes in digital contexts.

The following section outlines the qualitative methods and analytical approach, before highlighting the results and discussing their implications in the context of the literature. Opportunities to enhance existing theories, models, and frameworks for engagement in environmental decision-making are then explored in detail, offering new insights for researchers, practitioners, and decision-makers engaging in an increasingly digitised world. The paper concludes with both theoretical contributions and actionable recommendations for practitioners.

For clarity, *engagement* in this paper is defined as the active involvement of individuals, groups, and/or organisations in decisions affecting them (Hafferty, 2022; Reed, 2008). This definition embraces a variety of approaches, allowing exploration of the impact of digital technology across diverse environmental contexts. 'Digital' refers to processes using technologies that manipulate digital data (Salmons, 2016). These tools can operate online (connected to the internet), in real-time (synchronous), or remotely at various times (asynchronous). 'Remote' implies accessing, controlling, or interacting with digital technologies from a distance, often via the internet, without needing physical proximity to the source (e.g., videoconferencing).

2. Methods

Forty practitioners and practice-enablers from public, private, and third sector organisations in the UK were interviewed about digital engagement in environmental decision-making. This section details the qualitative study's methodology: interview protocol development, participant selection and recruitment, data analysis, and interpretation.

2.1. Interview protocol

A semi-structured interview protocol with open-ended questions was designed (Hopf, 2004; Qu and Dumay, 2011). All interviewees were asked a standardised set of questions which served as prompts to guide conversations and ensure all topics were covered, with flexibility for free-flowing discussion and follow-up questions. The interview protocol was informed by the literature review, ensuring relevance to practitioners priorities to help deliver relevant and useful outputs (Fazey et al., 2014). It included fourteen questions in three sections: (1) organisational background, (2) challenges and opportunities for digital engagement compared to in-person, and (3) future directions for engagement in the digital age. Participant voice was prioritised and the interviews encompassed various definitions, understandings, and practices of engagement. The interview question guide is included as supplementary

material.

2.2. Participant selection and data collection

A mixed selection process (Creswell and Poth, 2016) identified participants involved in the strategy, design, and/or delivery of engagement in environmental decision-making. This included a mixed selection process of purposeful (selection based on criteria of involvement in engagement, e.g., through professional groups), convenience (accessibility to the researcher, e.g., through the research team's network), and snowball sampling methods to reach additional participants, including those who were harder to reach (see Onwuegbuzie and Collins, 2007). This process involved multiple selection approaches to create a more comprehensive and diverse set of participants.

Participants were recruited until a broad range of perspectives were captured across different environmental organisations and areas of work (see Table 1). Environmental organisations were defined as an organised group of people working together in pursuit of common environmental goals, including for a profit, community service, and/or knowledge delivery (including research). Forty practitioners were interviewed, representing various environmental sectors like natural resource management, conservation, planning, agriculture, and sustainable development. Roles included executives, managers, consultants, scientists (including academic researchers), advisors, planners, and councillors across public, private, and third sectors). Interviews were conducted online or by phone between June–September 2020 during COVID-19 restrictions (also see Archibald et al., 2019), each lasting 45–100 minutes, and totalling 44 hours.

2.3. Analysis and interpretation

Interview recordings were transcribed using automated software (Otter.ai) and analysed with NVivo 12 (QSR International, 2018). A coding framework was developed using a combination of deductive and inductive approaches (Thornberg and Charmaz, 2014; Saldaña, 2021), following an iterative grounded theory approach (see Fereday and Muir-Cochrane, 2006; Maher et al., 2018). The *initial* coding framework, which contained 6 parent nodes and 23 child nodes (also see Siccama and Penna, 2008), was derived from the research questions and the literature review. Salient passages of text were coded against the initial coding framework. During this process, additional nodes (themes) were developed through an inductive (bottom-up) approach to coding, i.e., the process started with a set of nodes but then inductively added new nodes and iterated on them as the data was analysed (see Azungah, 2018; Fereday and Muir-Cochrane, 2006). Therefore, the framework evolved during the coding process with new nodes added when necessary, for example, where a new theme or idea was generated by the researcher (see Braun and Clarke, 2019, for critical reflections on the thematic coding process). This process of iterative coding was repeated until data saturation was reached, which is the point at which no new information or themes were observed in the data (see Guest et al., 2020). The initial and subsequent rounds of coding were completed by the lead author (Hafferty), and four members of the research team (Berry, Brockett, Orford, and Short) provided feedback to verify the coding choices and ensure comprehensive coverage of the data. The coding

Table 1
Research data.

Organisation	Number of interviews
Consultancy	12
Research institution	9
Local authority	3
Charity/not-for-profit	5
Non-departmental public body	8
Government department	3

process was underpinned by a continuous process of reflexivity (Pyett, 2003) involving ‘continual evaluation of subjective responses, inter-subjective dynamics, and the research process itself’ (Finlay, 2002, p. 532). Although the multi-stage approach to coding can be considered as a system of verification and is partly systematic, offering a rigorous and reproducible structure and process (De Wet and Erasmus, 2005), it is important to be clear that the qualitative nature of the coding approach remains subjective to the interpretation of the researcher, and therefore is ultimately subjective.

The final coding framework contained 4 parent nodes and 88 child and sub-child nodes. Each node represented themes in the data, and for each theme, key insights were compiled, and quotes were selected that were illustrative of these themes. The interviews revealed four broad themes, each involving nuanced and interlinked issues and dynamics. These themes are articulated in the next section. Themes are described qualitatively (i.e., not in terms of percentage or numerical responses) in order to capture the in-depth, contextually rich nature of the data, reflecting the nuances of participants’ experiences rather than generalising (also see Pyett, 2003). Participant voice was central to this research, and so quotations are included in the results below to illustrate themes and articulate practitioners’ perspectives in their own words. The discussion (section 4) involves a critical assessment and interpretation of the participants’ narratives and understanding of their lived experience, subjecting the data to a more detailed examination of the circumstances, structures, and constraints that have contributed to the formation of their views (ibid).

3. Results

The following sections present the qualitative results, which explore how the core contextual factors and socio-economic dynamics that explain what works in engagement processes (e.g., Baker and Chapin, 2018; Reed et al., 2018) take on new dimensions in digital and remote environments. Given this, unique considerations are identified for engagement processes which solely use digital and remote technologies, compared to in-person or hybrid processes.

3.1. Access and inclusion

Across all of the interviews, practitioners discussed how digital technology both benefits and constrains inclusive engagement, exploring how digital skills enhanced accessibility for some but create issues for others by amplifying digital divides and skill gaps. Practitioners highlighted the connection between accessibility and inclusion, noting that digital engagement improves efficiency, overcomes geographical limitations, time constraints, and enables non-verbal interactions, potentially making engagement more inclusive. However, digital tools exacerbate challenges related to the UK’s digital divide, particularly in areas lacking infrastructure and services. Digital literacy and comfort levels were often attributed as crucial for effective digital engagement. The interviewees’ confidence in using these tools varied, with many describing how they had faced challenges adapting to facilitating engagement via digital technologies: *‘I’m having to rethink everything that was just my natural talent, if you like, of facilitating and engaging with people’* (PR#24, research institution).

Despite these challenges, digital engagement offers opportunities to enhance digital literacy and confidence. The interviewees emphasised trialling digital tools with participants and providing training to build skills and trust. The COVID-19 pandemic spurred creative digital engagement, altering pre-pandemic norms, which had *‘changed the paradigm of communication’* (PR#15, consultancy) and *‘broadened our armoury of engagement tools’* (PR#23, local authority), including the use of more engagement platforms, participatory mapping, 3D visualisation, and video conferencing. Interviewees frequently described how experimenting with various digital tools through a hybrid approach expanded engagement options and improves accessibility, with several

practitioners highlighting the benefits of *‘having as many {digital and in-person} options as possible, so as many people can be involved as possible, at all times’* (PR#26, consultancy).

However, using multiple digital tools also introduced issues with interoperability, data integration, tool selection, and digital fatigue. One participant struggled with integrating information from multiple platforms: *‘I’m using about six different {digital} platform suites. [...] And so, I’ve got all this information. [...] But it’s piecing the information together {which is the issue}. It’s putting it into a coherent form.’* (PR#02, consultancy). Interviewees cautioned against choosing technology for novelty, stressing practical usability and context appropriateness: *‘the real danger with technology of seeing it as the {main} thing, that you put the technology first and foremost, rather than looking at what you’re trying to achieve. [...] There’s a real problem; {people} think, “Oh, this is really cool!” rather than saying, “Why are we using it?”’* (PR#02, consultancy). Some digital tools were seen as overly complex, potentially diverting focus from deeper engagement goals, reflecting broader concerns among the interviewees that digital technology may be used as an add-on “gimmick” rather than to meaningfully enhance accessibility and inclusion for marginalised participants.

3.2. Social interaction

The data revealed that digital engagement restricts social contextual cues compared to in-person interactions, posing new and different challenges for trust-building and addressing power imbalances. The interviewees highlighted specific limitations in digital engagement including data quality, informal conversations, interpretation of non-verbal cues, and supporting collaborative efforts. For example, practitioners felt that digital methods limited opportunities for deeper two-way deliberation and more open discussions, compared to in-person interactions: *‘Digital tools are useful when you’ve got a specific element of a scheme, [...] however, it is more challenging to capture people’s in-depth values, opinions, and aspirations about an area’* (PR#22, consultancy). Specifically, the interviewees raised concerns about digital engagement’s effectiveness in capturing qualitative data (e.g., about public perceptions towards local environmental issues), and often implied that digital tools were more appropriate for gathering quantitative information. The interviewees also expressed concerns about the increased absence of informal and spontaneous conversations in digital contexts, and highlighted the value of in-person methods in uncovering nuanced insights into complex, place-based environmental issues. The results indicate how digital and remote environments can make it more difficult to navigate tensions related to lack of (or poor quality) social interactions and the impact on high quality engagement. Interviewees explained that the efficiency and precision of digital methods often came at the expense of rich social interaction and nuanced data, which introduced new challenges for capturing detailed information about public perceptions towards environmental challenges (e.g., local community knowledge) which relied on fostering informal and free-flowing conversations. The interviewees also described how they missed “off-the-agenda” and spontaneous conversations in entirely digital and remote interactions: *‘that kind of informal contact is what is lost. Electronic communication tends to be only for a specific purpose, rather than for a general chat.’* (PR#04, charity/not-for-profit). Interviewees encountered issues such as assessing the room’s dynamics, participant presence and attentiveness, understanding emotional states, and fostering trust and camaraderie, which concurrently impacted practitioners’ ability to build trusting relationships with participants and foster more empowering forms of engagement.

Despite the limitations in digital interactions, the interviewees also proposed solutions. Skilled facilitation and deliberative efforts were shown to enhance informality in online interactions, promoting opportunities for sharing personal experiences and playfulness. Examples included encouraging informal interactions during breaks, post-meeting chats, and gamified online approaches. Employing multimodal methods,

smaller groups, and camera usage were described by many interviewees as beneficial, although requiring the use of webcams was also recognised as contributing to digital fatigue. Interviewees made specific efforts to replicate what they perceived as more “natural” human-to-human interactions online, such as active listening, empathy, open dialogue, and storytelling to share experiences and promote mutual learning. While digital tools offer innovative ways to enhance social interaction, the findings ultimately suggest that they cannot fully replicate the depth and nuance of physical human-to-human interaction. Many interviewees expressed a strong desire for meaningful human contact with participants and being physically together in the same space. Moreover, digital engagement was challenging for collaborative, co-produced, and co-designed approaches. For example, one practitioner found it *‘difficult to do the real collaborative design work’* online, commenting that collaboration was *‘a little bit easier {in-person} because anyone can talk at any moment, and you can read the signals in the room’* (PR#20, consultancy). Many interviewees perceived that digital engagement constrained bottom-up engagement: *‘it {digital engagement} just feels a lot more top-down as well. There’s not really a chance for it to be kind of more community driven.’* (PR#07, research institution).

3.3. Place-based knowledge

The interviewees reported that exclusively digital and remote engagement methods limited the capture and interpretation of place-based knowledge, as access to physical environments was restricted to what can be viewed through a screen. Practitioners highlighted challenges in conducting place-based engagement digitally, describing how digital tools restricted understanding the on-the-ground realities of decision-making: *‘there’s still a great benefit with people getting together and talking, naturally, in the field, and talking through issues ... Which you can’t necessarily achieve through digital engagement. [...] We actually need to be outside and get in the environment and see things for real’* (PR#28, non-departmental public body). The interviews emphasised that in-person and in-situ methods were more effective at capturing and incorporating local knowledge and experiences into decision-making. This approach was crucial for producing a holistic and integrated understanding of environmental management decisions based on both local knowledge and scientific data: *‘{site visits} just makes the work feel more real and more worthwhile. It’s not just reports or numbers in a spreadsheet. It gives you a real insight. And you come away feeling a lot more informed’* (PR#21, government department). Integrating local knowledge through in-person methods was described as essential for understanding the on-the-ground realities of environmental issues, including the complexities and trade-offs between different priorities: *‘a huge part of {decision-making} is going and walking and being shown what it is that’s going on. [...] It works really well when describing challenges and blockers and things’* (PR#18, government department). The interviewees noted that lack of physical access to landscapes limited their own understanding and presented a barrier to including the perspectives of local groups who might be impacted or interested in the decision-making process.

Practitioners emphasised the value of the unrestricted, flowing nature of in-person and in-situ conversations compared to online interactions: *‘It’s also the “outdoor-ness” and the fact that you can have robust discussions. Outside, people don’t feel constrained’* (PR#08, consultancy). Being outdoors was associated with more informal, relaxed, and dynamic conversations that better connected people with their physical surroundings. Practitioners described how talking with people outside was beneficial for using places as prompts for discussion, enriching engagement processes with more in-depth, nuanced, and place-based knowledge. This ensured that decisions were based on more accurate and context-specific information about a particular area or environmental problem. Digital engagement was critiqued for constraining people’s sensory experiences of landscapes, which were important for producing a rich place-based understanding of environmental issues: *‘I certainly don’t think you can ever recreate the physical elements of speaking*

to {local partners} in the field, touching things, collecting things yourself ...’ (PR#11, research institution). Interviewees also emphasised the importance of in-person, in-situ engagement for building trust and promoting knowledge sharing: *‘if you want to show you’re engaging, then you do need to get out and about. [...] I think it would help us build a lot more trust {compared to engaging online}.’* (PR#18, government department). Practitioners noted that physical site visits helped break down power hierarchies with participants, and integrate important bottom-up perspectives.

Despite these challenges, the data also highlighted the potential of hybrid engagement techniques for gathering location-specific information remotely, such as participatory mapping, mobile apps, 3D visualisation, and virtual tours/exhibitions. However, the interviewees stressed that hybrid methods, combining in-person and remote approaches, were essential, as virtual technology could not fully replicate the benefits of in-person, place-based engagement.

3.4. Credibility and trust

Building on the other findings presented in this section, the interviewees described situations where it was more challenging to establish and maintain trusting relationships in digital settings, compared to in-person interactions. They stressed that in-person engagement was crucial for practitioners and organisations to appear trustworthy and accountable: *‘{in-person approaches} demonstrate presence, and a commitment [...] You’re not hiding behind a digital tool - you’re out there, and you’re willing to be spoken with, and spoken at. [...] There needs to be a perception of politicians and decision-makers being willing to be held to account’* (PR#12, consultancy). Specifically, practitioners believed that in-person approaches were essential right at the start of the engagement process, before any digital tools were used, to build trust and rapport in a more informal and relaxed setting. Meeting people face-to-face was frequently described as essential for *‘making things a bit more human’* (PR#21, government department), which was essential for establishing and maintaining the trusting relationships needed to improve the perceived legitimacy of the organisations and practitioners tasked with delivering the process: *‘I think that physical presence is key, just showing that you’re not just a bunch of faceless bureaucrats sitting in an office in London’* (PR#21, government department).

Across the interviews, practitioners raised concerns about the impact of using entirely digital and remote techniques on the perceived credibility of information conveyed digitally. Practitioners reflected that this risked increasing the likelihood of miscommunication, misinterpretation, and bias, which could lead to (further) confusion and conflicts. In-person, human-to-human interactions were described as essential for mitigating these risks: *‘the way to establish trust and rapport is to meet people {in-person} and have a conversation with them, and see what their mannerisms are’* (PR#24, research institution). Several practitioners did, however, highlight the benefits of using digital tools and platforms for increasing the transparency of information and how it was being used in the decision-making process: *‘{online tools} aim to help people understand more about the life cycle of the project. [...] {It} really encourages the transparency, building a lot of trust between our clients’* (PR#26, consultancy). Despite the claimed benefits, the interviewees described how privacy and security risks, including participant anonymity and data ownership, could become more prominent when using digital tools to engage, compared to in-person techniques, and it was important to have strategies in place to mitigate these risks. Overall, practitioners believed that in-person engagement must remain a central instrument for conveying complex information effectively and building trust with diverse participants. Incorporating both digital and in-person tools was seen as the most effective way to build the relationships needed to establish and maintain trust throughout the decision-making process.

4. Discussion

This section explores the findings in the context of the literature on digital engagement in environmental decision-making. It then assesses the applicability of existing engagement theories, drawing on Reed et al.'s (2018) theory of participation (Fig. 1). Building on this, recommendations are made to enhance digital engagement approaches in environmental research, policy, and practice.

4.1. Engagement acquires new dimensions in digital environments

The interviews revealed technical, ethical, and inclusivity considerations for digital engagement in environmental decision-making. Four interlinked themes emerged relating to the implications of digital tools and technologies on access and inclusion, social interaction, place-based knowledge, credibility and trust. These themes demonstrate how the factors shaping engagement acquire new dimensions in digital and remote environments, compared to in-person situations.

Digital technology offers benefits for inclusive engagement, such as increased efficiency and overcoming geographical limitations. These tools can make engagement more representative and inclusive, aligning with studies highlighting the potential of online tools to improve the quality of engagement processes and the representation of marginalised or “harder to reach” groups (e.g., Bojovic et al., 2015; Chivers et al., 2021). Practitioners promoted using multimodal and multimedia tools to enhance inclusivity, reflecting research advocating for combining digital and in-person methods for more effective engagement (e.g., Charlton et al., 2023; Chivers et al., 2021; Sattler et al., 2022). Effective public involvement, as also suggested by Seltzer and Mahmoudi (2013), needs to involve a multiplicity of techniques and opportunities, across different contexts and timescales, to enable people to participate in ways that suit them best. However, as Bojovic et al. (2015) argue, digital technologies should not be viewed as a “silver bullet” for inclusive engagement. While the introduction of more creative and innovative digital tools can increase accessibility, it ultimately does not overcome all of the barriers that are inherent to engagement (also see Afzalan and Muller, 2018; McKinley et al., 2021; Salter et al., 2009). Digital tools can be seen as a “quick fix” rather than a “visible and meaningful endeavour that creates proactive possibilities for and through an enhanced democratic process” (Wilson and Tewdwr-Jones, 2021 p. 248), which distracts from deeper issues of exclusion and marginalisation.

Digital divides remain a significant barrier to digital engagement in environmental solutions (Bojovic et al., 2015; Chivers et al., 2021; McKinley et al., 2021), exacerbating accessibility and skills gaps, especially in regions with insufficient infrastructure or slower technological adoption (Ingram et al., 2022; Panganiban, 2019). Notably, while existing studies tend to focus on digital skills gaps as a barrier for participants (e.g., Bojovic et al., 2015), the results highlighted the impact of digital tools on the confidence of those coordinating and facilitating the engagement process (this aligns with other studies which argue for more explicit consideration of practitioners' perspectives of engagement, see Hafferty, 2022; Hafferty et al., 2024; Wesselink et al., 2011). However, the results of this research go beyond considerations of access and digital divides, revealing new insights about the intricate relationship between digital tools and the social contextual cues that shape engagement processes. The interviews highlighted how digital engagement changed specific social dynamics that were key for building trust and addressing power dynamics, which are crucial for incorporating diverse knowledge types and managing competing interests in environmental decision-making (Reed, 2008). Unlike existing research that only very broadly considers the impact of technology on emotional and social connections (e.g., Afzalan and Muller, 2018; Willis et al., 2021), the findings uncover specific, interconnected impacts on key factors that are known to shape effective and inclusive outcomes (see Newig et al., 2023; Reed et al., 2018; de Vente et al., 2016). Digital and remote engagement constrains the capture and representation of in-depth, nuanced,

place-based information about environmental issues. Tremblay et al. (2021) highlight concerns about methodological rigour, including reduced opportunities for probing and picking up non-verbal cues, in addition to a lack of contextual understanding arising from the absence of an immersive physical setting. This limitation risks undermining efforts to integrate local knowledge into decision-making about landscapes and ecosystems, which is crucial for effective environmental management across various domains (Raymond et al., 2010).

The interview findings highlighted several issues with digital engagement affecting knowledge integration, trust-building, and managing power imbalances. These include a lack of sustained two-way deliberation, barriers to spontaneous “spin-off” conversations, and impacts on social interactions like shared meals (also see Tremblay et al., 2021). Digital engagement limits the capture and interpretation of place-based knowledge, as access to physical environments is restricted to what can be viewed through a screen (Tremblay et al., 2021). Relying solely on digital approaches risks undermining place-based, community-led decision-making, including strategies to challenge the dominance of “expert” knowledge in environmental solutions (Jankowski, 2009). In-person and in-situ methods, which use the physical geographical location as prompts for stimulating conversations about the environment, are widely promoted for their potential to enhance place-based environmental decision-making. For example, Thomas et al. (2019) discuss the methodological significance of on-farm interviews for encouraging in-depth, flowing narratives about the environment and natural resource management.

Interpreting non-verbal cues, such as body language and tone of voice, is crucial for building trust and camaraderie during engagement. These cues convey emotions and shared understandings about environmental issues (Rowe and Gammack, 2004). The interviews revealed that digital-only situations pose unique challenges for establishing trust early in the engagement process, supporting Sattler et al. (2022) who noted that ‘in this online setting, it is difficult to build trust with stakeholders who are meeting for the first time, and the interaction among them is limited’ (p.68). This exacerbates existing challenges in environmental decision-making at the science-policy interface, where trust is frequently identified as a central precondition for knowledge exchange and fostering multi-stakeholder collaboration (Newig et al., 2023; Reed, 2008). Limited opportunities for interpreting social cues in digital environments may also hinder collective action to address collective action to address environmental challenges. For example, the digitalisation of engagement processes can complicate efforts to implement co-designed solutions at the landscape scale (e.g., Environmental Land Management in England; Hurley et al., 2020). Contrary to Willis et al. (2021), who ‘did not find different or more unhealthy power dynamics compared to in-person processes’ (p.14), the interview findings suggest that addressing power imbalances is less effective digitally. This is particularly concerning as power delegation is a key factor for determining improved environmental governance outcomes (Newig et al., 2023).

In common with Reed et al. (2018), the interviewees highlighted the importance of socio economic, cultural, and institutional contexts on the outcomes of engagement, and the need to tailor engagement strategies to these contextual factors. Both studies stress the importance of integrating local, place-based knowledge into decision-making processes, and our findings suggest that digital tools should not replace the richness of in-person, place-based engagement. Although Reed et al. (2018) did not consider digital engagement specifically, the need to consider context, including place-based considerations, supports their emphasis on spatial and temporal fit. Our findings also echo Reed et al.'s emphasis on managing power dynamics, trust and ensuring effective representation in decision-making processes. While Reed et al. (2018) focus on systematic representation of interests, our findings emphasised access to the process, equality, diversity and inclusion more strongly. This includes addressing digital divides and promoting the use of multiple engagement methods to include diverse participants. Our findings also

emphasise the importance of interpreting non-verbal cues and fostering relationships through direct communication more strongly, issues taken for granted by Reed et al., (2018) due to their sole focus on in-person engagement.

4.2. We need more effective theories for understanding “what works” for engagement in the digital age

The previous section explored the technical, ethical, and inclusion issues surrounding digital engagement in environmental decision-making. This section leverages the empirical findings to assess how established theories for understanding “what works” in engagement apply to digital and remote contexts. Reed et al. (2018) theory of participation serves as a lens to interpret these findings, highlighting distinct and novel factors that may explain engagement outcomes in digital settings. This theory suggests that a range of socio-economic, cultural, and political contextual factors shape engagement processes and outcomes, alongside objectives and engagement history, process design considerations, power dynamics, spatial and temporal fit (Fig. 1; also see Bell and Reed, 2022; de Vente et al., 2016). Other frameworks for engagement confirm that engagement is dynamic, highly context-dependent, and ultimately depends on goals and rationales, organisational capacity and capability, and wider socio-political factors (Baker and Chapin, 2018; Eaton et al., 2021; Luyet et al., 2012; Talley et al., 2016; Watson et al., 2018). Although existing frameworks provide conceptual insights into how a range of features influence outcomes, they often overlook their applicability in digital and remote settings.

Reed et al.’s (2018) theory offers a valuable lens for interpreting the findings because it is comprehensive and empirically-informed, explicit to environmental decision-making contexts, and focuses on key factors explaining engagement outcomes in a way that is context-sensitive, relevant and accessible for practitioners. However, it does not consider whether these factors change in digital and remote environments, nor do preceding frameworks (e.g., Arnstein, 1969; IAP2, 2018; see Bell and Reed, 2022, for a review). Although many theories account for transparency, trust, power, and representation as outcome-shaping factors, they do not consider how these factors (and their interrelationships) change when selecting digital methods and approaches. While digital environments are arguably just one of the many contexts that engagement must adapt to, the unique mechanisms of digital engagement and its inherent exclusions, which often mirror and exacerbate wider socio-economic inequalities, warrant a critical evaluation of this assumption.

This study has shown that the factors affecting engagement outcomes, such as inclusivity, power, trust, and social dynamics, acquire new dimensions in digital environments. Engagement theory may need re-imagining for digital settings to ensure effective and inclusive participation. To maintain contemporary relevance, theories and frameworks emphasising context (e.g., Baker and Chapin, 2018; Bell and Reed, 2022; Eaton et al. (2021); Luyet et al., 2012; Talley et al., 2016; Watson et al., 2018) must consider the role and impact of digital tools on engagement processes and outcomes, as well as those coordinating the process and their participants. The influence of methodological choices, including differences between digital and in-person engagement, should receive greater attention in future frameworks for engagement in environmental decision-making.

The research identified unique issues in digital and remote engagement, compared to in-person interactions (see Table 2 for a summary). These factors should be central elements in engagement theories and frameworks, intertwined with considerations of process design, power relations, context, and spatio-temporal factors. While some issues have in-person equivalents, the findings indicate that important differences exist. For example, systemic digital exclusion challenges like digital literacy cannot be fully resolved by process design adaptations typical of in-person engagement (e.g., adjusting to suit participants’ schedules or locations, tailoring workshops for marginalised groups, etc.). Moreover,

Table 2
Summary of key findings: the unique technical and ethical challenges for digital and remote engagement (source: the authors).

Challenge	Description
Access and inclusion	<ul style="list-style-type: none">• Digital technology presents both benefits and challenges for inclusive engagement, as it can enhance accessibility for some, but also exacerbates digital divides and skills gaps for others.• Digital literacy and level of comfort using digital technology are key for more effective and inclusive engagement, which is an important issue for both participants and coordinators.• Despite the widely claimed benefits of using a multiplicity of digital tools to enhance inclusivity, there are drawbacks associated with using multiple digital tools and techniques including interoperability and data integration issues.
Social interaction	<ul style="list-style-type: none">• Digital engagement falls short in capturing the richness of in-person interactions, particularly regarding social contextual cues. Informal, spontaneous conversations, which provide nuanced insights into complex issues, may also be absent in digital contexts.• Interpreting non-verbal cues, such as body language and tone of voice, is challenging in digital interactions, increasing barriers for building trust and addressing power imbalances.• Additional specific constraints can be placed on more co-designed, collaborative, and empowering forms of engagement.
Place-based knowledge	<ul style="list-style-type: none">• Exclusively digital and remote engagement methods limit the capture and interpretation of place-based knowledge.• These approaches constrain access to physical environments to what can be seen through a screen, restricting understandings of complex place-based issues and knowledges.• In-person and in-situ engagement methods are valued for their effectiveness in engaging people in in-depth discussions about places.
Credibility and trust	<ul style="list-style-type: none">• It can be more challenging to establish and maintain trust in digital settings compared to in-person interactions.• There are specific concerns about the perceived credibility of information conveyed digitally, leading to increased risk of miscommunication, misinterpretation, and bias. Privacy and security are also prominent issues.• In-person engagement can be valuable for practitioners and organisations to be viewed as trustworthy and accountable.

digital methods create fundamental barriers that often require in-person solutions, including building trust and rapport with participants. Institutionalised engagement processes will always exclude segments of society (Cooke and Kothari, 2001; Stirling, 2008), but digital processes likely exclude groups differently than in-person engagement, particularly those already marginalised by digital transitions (Certomà and Corsini, 2021) and whose voices are typically overlooked in environmental decision-making processes (Few et al., 2007). If these important substantive differences between in-person and digital approaches are overlooked in engagement frameworks, then this risks users being naive to the quality and effectiveness of the process, and may exacerbate (rather than challenge and dismantle) exclusions and power imbalances.

Digital literacy issues were found to hinder both facilitators and participants, potentially worsening when facilitators lack skills or confidence to effectively include a diversity of voices. This underscores the importance of process design, which is prominent in prevailing theories and frameworks, but going beyond this to highlight that merely adjusting the process does not sufficiently address digital inaccessibility and exclusion. The findings indicate that extensive preparatory work may be needed to enhance inclusivity in digital processes. Rather than focusing solely on process (re)design, fundamental barriers to digital engagement, such as digital literacy, should be integrated into the pre-engagement phase, requiring more extensive and long-term efforts than typically seen in engagement processes. Moreover, while it may be tempting to opt for multiple digital tools to optimise the inclusion of diverse participants, the findings indicated that this may distract from the more fundamental reasons as to why people might be excluded in

environmental decisions (for example, see [Few et al., 2007](#)). Instead of a digital-first approach, practitioners should carefully select digital and non-digital approaches to align with participants' needs and accessibility requirements. More broadly, the research emphasised the critical role of inclusion in digital engagement, which is linked with process design and power dynamics, and has a significant bearing on the outcomes of engagement and the extent to which marginalised groups are given agency and voice. This builds on evidence from [de Vente et al. \(2016\)](#), [Fritsch and Newig \(2012\)](#), and [Newig et al. \(2023\)](#) that the representation of different interests in engagement processes can significantly affect decision-making outcomes. This led [Reed and Rudman \(2023 p.973\)](#) to suggest that attention to voice, 'as the embodiment of empowered and equitable representation', is one of the key factors influencing the outcomes of engagement processes. However, to enable all relevant parties to engage in an engagement process as equals requires consideration of the specific barriers to engagement that are presented by digital-first strategies.

Current engagement theory (e.g., [Reed et al., 2018](#); [Bell and Reed, 2022](#)), the research underpinning it ([de Vente et al., 2016](#)), and recent studies which draw from such theory (e.g., [Newig et al., 2023](#)), overlook the impact of digital engagement on social cues and informal interactions that are critical to high-quality communication. They also overlook how digital engagement may restrict power delegation, the prioritisation of participant voice, and trust building, which as this study suggests may be (at least partly) linked to impacts on high quality social interaction. While it is often assumed that face-to-face dialogue typically produces higher quality engagement outcomes (e.g., [Rowe and Gammack, 2004](#)), studies on engagement in environmental decision-making do not consider how these factors change in digital environments where non-verbal cues are harder to interpret, and informal interaction is more challenging to facilitate digitally. While the interviewees in this study used creative digital methods to encourage social interaction, it remains unclear if these methods can fully replicate the value of in-person interaction. The research suggests that digital tools cannot completely replicate the depth and nuance of face-to-face interaction and meaningful human contact. Digital technology affects people's ability to express intrinsic values like compassion, cooperation, community, and human connection, shaping both the relationships and the knowledge that is developed through engagement. These values are often more deeply and powerfully experienced in sensory, in-person situations compared to digital environments which can stifle them (also see [Afzalan and Muller, 2018](#); [Rowe and Gammack, 2004](#); [Willis et al., 2021](#)). The changing nature of online communication may explain why the research participants faced difficulties establishing trust without in-person events, managing power imbalances, and expressed concerns about the quality of information collected via digital engagement.

Existing engagement theories do not consider the limitations of digital approaches on collecting and interpreting place-based knowledge. The absence of in-person social cues and informal conversations in digital settings might explain why the research participants valued the unrestricted nature of face-to-face engagement (also see [Thomas et al., 2019](#)). Research drawing on engagement theory must consider the adverse impact of digital technology on understanding local contextual factors and appropriate spatial fit, especially when integrating diverse actors and local knowledge for place-based environmental decision-making ([Raymond et al., 2010](#)). This emphasises the need for research that theorises about integrating in-person and digital tools for capturing, representing, and analysing local knowledge alongside scientific data, combining qualitative and quantitative approaches through public participatory and community-based environmental decision-making (e.g., [Jankowski, 2009](#)).

The current literature on engagement focuses on theory and empirical work involving participants, but lacks insights from practitioners coordinating these processes (see [Hafferty, 2022](#); [Wesselink et al., 2011](#)). This research highlights practitioners' essential role in improving digital engagement and challenging the institutionalised norm of

digital-first approaches. Participants stressed the significance of in-person methods for conveying information transparently and building trust, enhancing the credibility of decision-makers and organisations. Issues related to trust in digital settings, and the solutions needed to address them, likely stem from governance factors and institutional cultures, including practitioners' capacity to deliver on engagement goals in environmental decision-making (also see [Hafferty et al., 2024](#)).

Overall, this research confirms the core elements of engagement theory but argues that important distinctions are currently overlooked. These distinctions must be emphasised when theorising about engagement for future research and practice. Recommendations and final reflections are outlined below.

5. Conclusion and implications for practice

This paper provides key insights into what works (and what does not work) for engagement in the digital age. Responding to the first objective of the study, the findings uncover in-depth and nuanced insights from practitioners on the technical, ethical, and inclusivity issues surrounding digital tools in environmental decision-making processes. The analysis focuses on issues that are widely experienced by environmental practitioners and decision-makers - such as connecting with "harder to reach" participants across remote rural areas, navigating complex multi-partner collaborations at landscape scale, and efforts to integrate local and scientific knowledge - while arguably also maintaining broader relevance to digital engagement in other sectors. The results reveal unique issues for digital engagement that extend beyond the consideration of digital divides (e.g., [Bojovic et al., 2015](#)) to empirically explore the benefits and pitfalls of digital engagement for meaningful inclusion, fostering social interaction, place-based decision-making, and building trust and rapport. The study challenges prevailing digital-by-default and digital-first narratives ([Central Digital and Data Office, 2022](#); [DLUHC, 2022](#)), demonstrating that no single approach - digital, in-person, or hybrid - guarantees success in every situation. Although the findings confirm the relevance of existing engagement theory that prioritises contextual factors in explaining outcomes, there are important distinctions and additional factors that need to be considered in entirely digital and remote contexts.

To explore these issues and to respond to the second research objective, this study has assessed the applicability of existing engagement theory in digital environments. Drawing on [Reed et al.'s \(2018\)](#) theory of participation, the findings underscore the importance of contextual factors, managing power imbalances, developing trust, integrating place-based knowledge, ensuring inclusive processes, and effective process design. Arguably, the findings are also broadly relevant in relation to other theories and frameworks that prioritise the role of context in explaining the outcomes of engagement (e.g., [Baker and Chapin, 2018](#); [Eaton et al. \(2021\)](#); [Luyet et al., 2012](#); [Talley et al., 2016](#); [Watson et al., 2018](#)). There were a number of important parallels between our findings and [Reed et al. \(2018\)](#) theory, including.

- An emphasis on the role of contextual factors in shaping engagement outcomes, highlighting the need for tailored engagement strategies;
- The need to explicitly and sensitively manage power imbalances to ensure equitable and inclusive decision-making processes;
- The development and maintenance of trust, retaining a need for in-person engagement for building the trust needed to underpin and legitimise decision-making;
- The importance of spatial fit, integrating local, place-based knowledge into decision-making processes to enhance the relevance and effectiveness of decisions made;
- The need for inclusive engagement processes that ensure diverse and equitable participation, to underpin the credibility, legitimacy and utility of decisions made; and
- The role of process design and effective facilitation, whether online or in person, in enabling each of the above considerations.

This study extends [Reed et al. \(2018\)](#) theory to digital contexts, revealing the need for theoretical frameworks to emphasise the implications of digital engagement on.

- The need to consider digital inclusions and exclusions for diverse groups and individuals, ensuring diverse voices are heard in digital settings;
- The significance of social contextual cues, addressing the loss of intrinsic human expressions in digital interactions and how this shapes both knowledge and relationships;
- The incorporation of place-based interactions, recognising the limitations of digital tools in capturing on-the-ground realities including local knowledge and experiences, and;
- Understanding how the above factors interact to shape the dynamics of trust and credibility shift in virtual environments, with implications for transparent knowledge sharing, building rapport with participants, and the perceived credibility of decisions and organisations.

These issues need to be explicitly considered when designing and delivering participatory environmental decision-making processes; digital tools should not be selected by default or a blind-faith optimism in their benefits, but underpinned by a conscious, critical, and ethical evaluation of their promises and pitfalls. In particular, the findings suggest that digital engagement restricts opportunities for meaningful human connection and the expression of intrinsic values such as compassion, empathy, cooperation, and community, while also limiting in-depth and nuanced understandings of place. This is a significant consideration given rapid advances towards more immersive digital technologies which enable people to feel increasingly part of artificial, simulated environments, including virtual and augmented reality, haptics, and future computing paradigms like the “metaverse” which seek to integrate and blur the boundaries between digital and physical experiences ([Hafferty, 2022](#)). As the boundaries between physical and digital worlds become increasingly enmeshed, future research and practice must be equipped to understand and account for the impacts of digital technologies on human-human and human-environment interactions.

This study has limitations that suggest areas for future research. While it demonstrates the impact of methodological choice on engagement outcomes, method selection alone does not fully explain the differences between expectations and realities. Broader socio-economic, cultural, institutional, and governance factors play significant roles (e.

g., see [Baker and Chapin, 2018](#)), along with varying values, expectations, norms, assumptions, and attitudes about participation ([Wessellink et al., 2011](#)), as well as institutional capacity and capability to engage ([Hafferty, 2022](#)). Future research should explore how the goals of engagement can be at variance with the institutional structures within which they are carried out. Moreover, the focus of the research on top-down governance may overlook bottom-up perspectives, potentially limiting opportunities for meaningful empowerment ([Stirling, 2008](#)). Research should examine the dynamics of whose voices are heard, who decides, and who benefits from digitally-enabled engagement processes, especially from community-led initiatives. The study’s UK and environmental decision-making context also warrants exploring its applicability across different sectors and international contexts. Future research could assess how findings vary across time and spatial scales, and the scalability of specific digital methods for inclusive decision-making. Finally, although the findings are arguably relevant to other theories and frameworks for engagement, future research could explicitly test this by applying alternative theories in digital contexts.

To operationalise the conceptual insights and respond to the paper’s final objective, a series of ‘thinking points’ are presented (see [Table 3](#) and [Fig. 2](#)). These points encourage engagement coordinators and facilitators to critically evaluate the opportunities and challenges of digital tools and reflect on the merits of digital versus in-person methods. They challenge digital-first strategies and advocate for a responsible engagement culture that considers the technical, ethical, and inclusivity implications of digital tools. These thinking points, while focused on environmental decision-making, are arguably relevant to a wide range of decision-making contexts across different sectors and can be used to complement existing practices, guidelines, and toolkits.

In summary, this research fills a crucial gap as the first study to apply theoretical frameworks to digital and remote engagement in environmental decision-making. By providing empirically-driven insights and recommendations, it offers additional points for consideration to researchers, decision-makers, and other relevant parties on identifying and overcoming the challenges of digital engagement. These findings address a range of technical, ethical, and inclusivity issues with the potential to enhance participatory processes in various environmental domains. Moreover, the insights are broadly applicable to any participatory approach that emphasises the role of context in shaping and explaining outcomes across different levels and types of engagement, offering significant scope for impact in transforming decision-making for more sustainable and equitable futures.

Table 3
Recommendations for environmental practitioners and decision-makers: Key thinking points for engagement in the digital age (source: the authors).

1. Access and inclusion
<ul style="list-style-type: none">• To promote inclusivity and representation in engagement, practitioners should adopt a balanced approach that combines digital and non-digital methods, recognising that while digital tools can enhance accessibility for some, it may also exacerbate digital divides and skills gaps for others.• Emphasise the importance of digital literacy and confidence, proactively plan to mitigate challenges, and invest in enhancing digital skills among both participants and coordinators for more inclusive engagement, e.g., by experimenting with tools in the pre-engagement phase.
2. Social interaction
<ul style="list-style-type: none">• To compensate for the limitations of digital tools in replicating the depth and richness of in-person interactions, practitioners should mindfully create opportunities for informal and spontaneous conversations, which can be more effective via in-person techniques.• Foster trust, address power imbalances, and enable collaboration in digital engagement by developing skills like communication, empathy, and active listening while adapting digital strategies to ensure equal participation opportunities.
3. Place-based knowledge
<ul style="list-style-type: none">• Balance digital engagement with in-person and in-situ methods to fully capture place-based issues, recognising that digital-only approaches may limit the expression and understanding of the local context as experienced by relevant parties.• Highlight the importance of in-person interactions for in-depth, unrestricted discussions on place-based issues, as they can facilitate more comprehensive conversations compared to digital tools.
4. Credibility and trust.
<ul style="list-style-type: none">• Prioritise in-person interactions at the stage of engagement processes to establish trust, rapport and credibility, as building and maintaining trust in digital settings can be more challenging.• Acknowledge and tackle concerns regarding the credibility of digital information, as well as the heightened risk of miscommunication, misinterpretation, and bias, and other privacy and security issues like participant anonymity and data ownership.



Fig. 2. Recommendations for environmental practitioners: Key thinking points for navigating engagement in the digital age.

CRedit authorship contribution statement

Caitlin Hafferty: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. **Mark S. Reed:** Writing – original draft, Writing – review & editing. **Beth F.T. Brockett:** Supervision, Writing – review & editing, Validation. **Scott Orford:** Supervision, Writing – review & editing, Validation. **Robert Berry:** Supervision, Writing – review & editing, Validation. **Chris Short:** Supervision, Validation, Writing – review & editing. **Joshua Davis:** Writing – review & editing.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGBT in order to improve the readability of the article. This tool was used in the review and editing stages of drafts only. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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Appendix A. Supplementary data

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