Master's thesis

NTNU
Norwegian University of Science and Technology
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Department of Computer Science

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E-Participation for the Net-Zero Transition: Designing for Youth Engagement in E-Participation Systems

Master's thesis in Computer Science
Supervisor: Ilias Pappas
Co-supervisor: John Krogstie
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Abstract

Climate change is having increasingly widespread impacts on a global scale, requiring immediate action to achieve the objectives outlined in the Paris Agreement. To limit global warming to 1.5°C, emissions must be reduced by 45% by 2030 and reach net-zero by 2050. The younger population, who will experience the greatest consequences of climate change, expresses frustration due to the perceived lack of action from politicians. The research field of Sustainable Human-Computer Interaction has called for the design of digital systems that can support transparent green policies and foster engaged democracies, to support the necessary societal system changes. Additionally, Digital Governance and E-Participation hold great promise for facilitating transparent decision-making processes and enhancing citizen engagement. Nonetheless, there is little research investigating the intersection of e-participation and environmental sustainability, despite the potential of digital technologies to address climate change. Furthermore, understanding the specific needs of young citizens with limited experience in societal participation remains a critical research gap. This thesis seeks to address these gaps and contribute to inclusive and informed decision-making processes necessary for addressing the urgency of climate change. The thesis aims to answer the following research questions:

RQ1 | How can an e-participation system for the net-zero transition facilitate participation and engagement among young citizens?

RQ2 | How can an e-participation system for the net-zero transition facilitate meaningful citizen input to government officials?

To answer the research questions, a design science research approach was employed, emphasizing the creation of an artifact and its iterative refinement and user testing. The artifact represented a prototype e-participation system specifically designed to engage young citizens. Feedback from young citizens and government officials was collected through several iterations using semi-structured interviews and artifact demonstrations. The transcribed interviews were analyzed using a thematic analysis approach. The findings resulted in five design principles and three design propositions for e-participation systems focused on climate policy, specifically targeting increased engagement and participation from young citizens while providing valuable content for policymakers.

The key contributions include offering guidelines through design principles and design propositions, for the development of e-participation platforms, as well as contributing to the larger discussion on the intersection of Sustainable Human-Computer Interaction and E-Participation.

Sammendrag

Klimaendringene har stadig mer omfattende globale konsekvenser, og det kreves umiddelbar handling for å oppnå målene fastsatt i Parisavtalen. For å begrense global oppvarming til 1,5 °C, må utslippene reduseres med 45% innen 2030 og nå netto null innen 2050. Den yngre befolkningen, som vil oppleve de største konsekvensene av klimaendringene, uttrykker frustrasjon over det de oppfatter som manglende handling fra politikere. Forskningsfeltet bærekraftig menneske-maskin-interaksjon (Sustainable HCI) har etterlyst design av digitale systemer som kan støtte transparent grønn politikk og fremme demokratier med engasjement for å støtte nødvendige systemendringer i samfunnet. I tillegg har digital styring og e-deltakelse stort potensial for å fremme transparente beslutningsprosesser og øke engasjement blant befolkningen. Likevel er det lite forskning på krysningen mellom e-deltakelse og bærekraftig menneske-maskin-interaksjon, til tross for potensialet digitale teknologier har til å bidra mot klimaendringene. Videre mangler det forskning på behovene til unge mennesker med begrenset erfaring innen samfunnsdeltakelse. Denne masteroppgaven adresserer disse manglene i forskningen og bidrar til inkluderende og informerte beslutningsprosesser som er nødvendige for å takle klimaendringene. For å gjøre dette, har masteroppgaven som mål å besvare følgende forskningsspørsmål:

RQ1 | Hvordan kan et e-deltakelsessystem for overgangen til netto null legge til rette for deltakelse og engasjement blant unge mennesker?

RQ2 | Hvordan kan et e-deltakelsessystem for overgangen til netto null bidra til meningsfulle innbyggerinnspill til statlige ansatte som utvikler klimapolitikk (government officials)?

For å besvare spørsmålene ble det benyttet en design science forskningsmetode, som legger vekt på utviklingen av en artefakt gjennom iterativ forbedring og brukertesting. Artefakten representerte en prototype av et e-deltakelsessystem spesifikt designet for å engasjere unge borgere. Tilbakemeldinger fra unge innbyggere og personer fra staten som jobber med klimapolitikk (government officials) ble samlet inn gjennom flere iterasjoner ved hjelp av semi-strukturerte intervjuer og demonstrasjoner av artefakten. De transkriberte intervjuene ble analysert ved hjelp av en tematisk analyse. Dette resulterte i fem designprinsipper og tre designforslag for e-deltakelsesystemer fokusert på klimapolitikk, med spesielt fokus på økt engasjement fra unge borgere samtidig som verdifullt innhold tilbys for beslutningstakere.

De viktigste bidragene inkluderer retningslinjer gjennom designprinsipper og designforslag for utvikling av e-deltakelsesystemer samt et bidrag til krysningen mellom forskningsfeltene for bærekraftig menneske-datamaskin-interaksjon og e-deltakelse.

Preface

This thesis was written at the Norwegian University of Science and Technology (NTNU) as part of the course TDT4900 - Computer Science, Master's Thesis. The project is conducted at the Department of Computer Science under the supervision of Professor Ilias Pappas.

We would like to thank our main supervisor, Ilias Pappas, for his guidance, feedback, and patience throughout this work. We would also like to thank our co-supervisor John Krogstie for providing valuable knowledge and guidance.

Thank you to everyone who has contributed to this thesis by taking the time to participate in interviews and user testing.

Finally, we would like to thank our friends and family for their support throughout this master's degree at NTNU.

Benedicte Kaltoft Hansen and Isabel Sørheim Slorer

Trondheim, 19th June 2023

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1. Introduction

This chapter elaborates on the motivation and background for the thesis, along with presenting the research questions and outlining the methods, and structure of the thesis.

The objective of this master's thesis is to investigate how an e-participation system for climate policy should be designed to promote participation and engagement from young citizens, while ensuring that the platform provides value to policymakers. This is performed by creating and evaluating a prototype artifact, resulting in five design principles and three design propositions.

The chapter proceeds as follows: Section 1.1 presents the background and motivation for the thesis. Section 1.2 describes the goal for the research project and presents the research questions. Section 1.3 describes the scope of the research. Section 1.4 describes the research methods used in the thesis. Section 1.5 presents the structure of the thesis.

1.1. Background and Motivation

The impacts of climate change are growing across the globe, and the UN environment program has stated that an urgent system-wide transformation of societies is necessary to stand a chance of achieving the Paris goals [2]. In order to keep global warming to no more than 1.5°C, emissions need to be reduced by 45% by 2030 and reach net-zero by 2050 [3]. In addition, many young citizens worldwide, which are the ones who will be impacted the most by the consequences [4], are increasingly frustrated by limited action from politicians in implementing effective climate policy. A UNICEF study shows that a majority of young Norwegians experience hopelessness regarding climate change, believing that those in power are not doing enough to mitigate it [5].

The research field of Sustainable Human-Computer Interaction (HCI) has been approaching climate change by impacting sustainable lifestyles through the design of technology and interactive systems [6]. However, the research field has been criticized for focusing on individual behavior change, and not addressing the complexity of sustainability. There has been a call to approach sustainability by designing for systems change of societies, in order to have a meaningful impact at scale [7], [8]. Suggested paths have been to ensure that digital systems bring the needed transparent accounting and accountability to green policy [8] or utilize Information and Communication Technologies (ICT) as a medium for communication to foster engaged and effective democracies [9].

Digital governance and e-participation have been seen as promising ways of facilitating transparent, balanced, and widely supported decision-making processes, as well as increasing engagement among citizens [10], [11], [12]. Given the urgency of climate change, research has pointed out that there is an obvious potential for digital technologies to contribute toward addressing the problem [13]. Despite this, there exists surprisingly little research on the intersection of digital governance, citizen participation, and environmental sustainability [14].

Moreover, researchers have stated that young people's interest in politics can be increased if online communication channels are offered [11], and that young people become more passive if they do not see themselves as being heard [15]. However, there exists a notable research gap in understanding the specific needs of young citizens who have limited experience in societal participation, as highlighted in a recent study on youth participation [16].

1.2. Goals and Research Questions

The aim of this research study is to address the research gaps and wicked problem [17] mentioned in the previous section, bridging Sustainable HCI with E-Participation. The study will investigate how to design effective e-participation systems that make climate policy more accessible, transparent, and appealing for young people to engage and participate in. Additionally, we aim to ensure that the system is designed to make it easier for government officials to reach out and gather citizens' opinions through meaningful input that can be utilized for informed decision-making. By developing user-centered design principles we aim to contribute to the development of future e-participation initiatives, as well as inspire future research on e-participation, addressing the transition to net-zero.

Based on this goal the following research questions are formulated:

RQ1 | How can an e-participation system for the net-zero transition facilitate participation and engagement among young citizens?

RQ2 | How can an e-participation system for the net-zero transition facilitate meaningful citizen input to government officials?

1.3. Research Scope

The stakeholders included in the scope of this research study are young citizens and government officials. There exist no formal definitions of the term "young people". The

United Nations defines "youth" as people between 15 and 24 years [18], and the Finnish Youth Act defines it as people under 29 years [16]. In this study, young citizens are defined as citizens between the ages of 18 and 29.

The stakeholder group of government officials in this study is defined as elected politicians or employees in official administration offices that work on the creation and approval of policies. This includes all three levels of governance in Norway, which are the state, the county municipality, and the municipality. The participants from this stakeholder group included in the study are two employees at the Ministry of Climate and Environment, one employee at the Climate and Environment Department at Trondheim Municipality, and one local politician engaged in climate politics.

Additionally, all included participants from both stakeholder groups are Norwegian.

1.4. Research Method

A design science approach has been used to develop this master's thesis, following the design science research methodology process proposed by Peffers et al. [19]. They describe six activities for a design science research project: *problem identification and motivation*, *define the objectives of a solution*, *design and development*, *demonstration*, *evaluation*, and *communication*.

Semi-structured interviews were performed as the data collection method following the guidelines for planning and conducting interviews proposed by Oates et al. [20]. These interviews were performed to identify the root causes of the problem and gain deeper insight. Both young citizens and government officials, representing the two stakeholder groups, were included in the interview process. All interviews were analyzed to identify patterns and recurring issues using a thematic analysis approach proposed by Braun and Clarke [21]. Then, the requirements and specifications of a possible artifact to address the problems were defined.

A partially functional prototype of the proposed artifact was developed using a no-code tool to enable user testing of the concept. The user testing involved both stakeholder groups and was conducted using a combination of artifact demonstration and semi-structured interviews, and analyzed using thematic analysis. The user testing was performed in two iterations. First, testing with government officials was conducted, and the results were evaluated. Then, adjustments were made to the artifact requirements and functionality based on the received feedback, before a new iteration of user testing was performed with young citizens. The data collected from this second iteration was analyzed, resulting in six initial design principles. The artifact was then updated to incorporate all the design principles and address the findings from the second iteration. A final demonstration was conducted to validate and further refine the principles. As a result, five final design principles were established. Additionally, findings that did not meet the threshold for inclusion as design principles due to insufficient validation were

formulated as design propositions.

1.5. Thesis Structure

The rest of this thesis proceeds as follows.

Chapter 2 presents the background theory and relevant work necessary to put the work in the context of what is done in previous research and how it builds upon this, and identifies the research gap addressed through this thesis.

Chapter 3 introduces the research methodology used, the data collection methods, the thematic analysis used to analyze the data collected, the approach used to formulate the design principles, and the ethical considerations taken during the thesis work.

Chapter 4 defines the problem addressed in the thesis and presents the work conducted to identify the root causes of the problem. Additionally, the requirements for an artifact to address the defined problem are proposed.

Chapter 5 elaborates on the design and development process of the artifact.

Chapter 6 presents the results from the two iterations of user testing of the artifact, and the updates made to the artifact to address the findings. Finally, the resulting design principles and design propositions are presented, and the process of validating and refining them.

Chapter 7 answers the research questions, discusses the results from the testing of the artifact, and presents the implications and limitations of the research.

Chapter 8 presents a conclusion for the research and suggestions for future work.

2. Background and Related Work

This chapter summarizes the relevant background theory and related work needed to comprehend the work and how it relates to the different disciplines it crosses. It also identifies the gap in the existing research this thesis attempts to address. Section 2.1 explains the concepts of climate change and net-zero. Section 2.2 elaborates on the research fields related to ICT and Sustainability, specifically Sustainable HCI, and how it shaped the study. Section 2.3 provides an overview of digital governance and e-participation with definitions of the terms and related work. Section 2.4 summarizes work related to youth needs in e-participation systems.

2.1. Climate Change and Net-Zero

Climate change involves long-term shifts in temperatures and weather patterns. Such shifts can occur naturally, but since the industrial revolution in the 1800s, humans have been the main driver of climate change, primarily by burning fossil fuels like coal, oil, and gas, which are causing greenhouse gases warming the world [3].

The global average temperature is now about 1.1°C warmer than before the industrial revolution, with each of the last decades being warmer than the previous decade since 1850 [3], [22]. As the earth is a system where everything is connected, changes in one area can influence changes in others, and consequences include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity [3].

Thousands of scientists and reviewers have agreed that limiting the global temperature rise to no more than 1.5°C will help to maintain a livable climate and avoid the worst impact of climate change. However, with the current policies in place, it is predicted that the temperature will rise by 2.8°C by 2100 [3]. The Paris Agreement is a legally binding international treaty that includes commitments from all countries, today 193 states plus the European Union, to reduce their emissions [23]. Emissions need to be reduced by 45% by 2030 and reach net-zero by 2050 to keep global warming to no more than 1.5°C [3]. Net-zero is defined as cutting greenhouse emissions to as close to zero as possible, and any remaining emissions are re-absorbed from the atmosphere, for instance, by oceans and forests [24].

Currently, commitments made by governments are falling short of what is required to reach net-zero by 2050, as they will lead to an increase of almost 11% in greenhouse

emissions by 2030, compared to 2010 levels. The UN environment program has stated that an urgent system-wide transformation of societies is necessary to stand a chance of achieving the Paris goals [2]. *The Climate Change 2023: Synthesis Report* outlines that the 1.5°C limit is still achievable and that by sharing best practices, technology, effective policy measures, and mobilizing sufficient finance, any community can decrease or prevent the usage of carbon-intensive consumption methods [25]. This research study focuses on supporting the development of climate policies to help accelerate the transition to net-zero.

2.2. ICT and Sustainability

Sustainability can be defined in various ways. A well-known definition is the Brundtland definition, defining it as; "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [26]. The sustainable development goals serve as a global framework to guide progress toward sustainability and involve 17 goals that call for action from all countries to promote prosperity while protecting the planet [27]. Goal number 13 calls for urgent action to combat climate change, but all 17 goals are interconnected and influence climate change and its impacts [27]. Another widely used framework to describe sustainability is the three-pillar model, which includes environmental, social, and economic sustainability. Within this framework, the pillar of environmental sustainability is particularly relevant to climate change as it focuses on protecting the planet for future generations by limiting pollution, preserving biodiversity, and reducing our carbon footprint [28].

Information and Communication Technology (ICT) in relation to Sustainability encompass various research areas, including ICT for Sustainability (ICT4S), Environmental Informatics, and Sustainable Human-Computer Interaction (HCI) [1].

ICT for Sustainability (ICT4S) explores ways to leverage the transformational power of ICT to foster sustainable patterns of production and consumption. According to Hilty and Aebischer [1], two things are essential to achieve this objective: 1. to stop the growth of ICT's own footprint, and 2. to find ways to apply ICT as an enabler in order to reduce the footprint of production and consumption by society [1]. The impacts of ICT for Sustainability are categorized by the LES model in the book *ICT for Sustainability: An Emerging Research Field* by Hilty and Aebischer [1]. Figure 2.1 shows the LES model, which comprises three levels:

- **Level 1: Life-cycle impacts** refers to the direct impact of ICT on the environment.
- **Level 2: Enabling impact** includes the indirect impact at the micro-level, such as changes in behavior or organizational practices.
- **Level 3: Structural impact** pertains to the broader, macro-level impact of ICT on the economy and institutional practices.

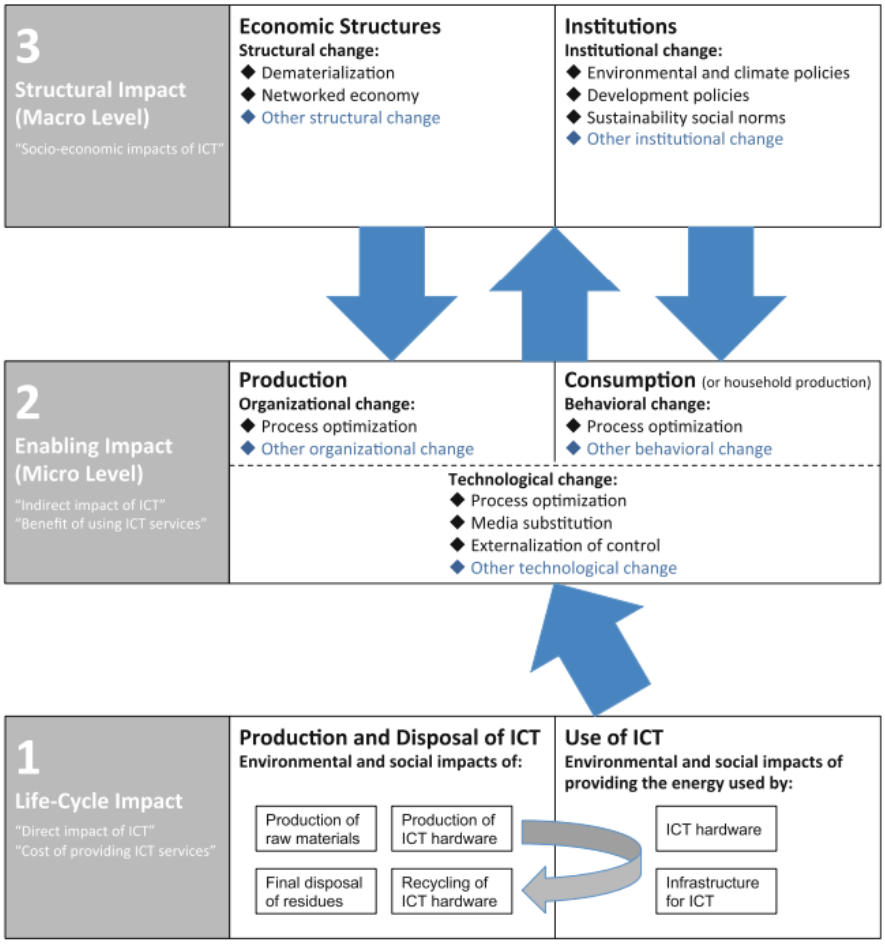


Figure 2.1.: The LES Model [1]

Level 3: Structural Impact refers to the impacts of ICT leading to persistent changes that are observable at the macro level. The aggregated actions on a micro level gradually evolve into structures at a macro level that, in turn, influence actions at the micro level. It is divided into two categories: *Economic Structures* and *Institutions*. Institutions refer to immaterial structures shaping action, such as laws, policies, and social norms. This type of impact is the focus throughout the study.

Environmental Informatics combines information systems with advanced simulation modeling techniques and spatial data processing to address environmental challenges. The potential for shared data and understanding can help create consensus on environmental strategies and policies [1]. Avouris and Page [29] identifies six relevant methods for this field: modeling and simulation, knowledge-based systems, user interface design, computer graphics and visualization, artificial neural networks, and data integration. While this thesis has drawn inspiration from certain ideas in this field, this has remained primarily high-level, and we have not delved deeper into this specific area of research.

2.2.1. Sustainable HCI

Sustainable Human-Computer Interaction (SHCI) is a sub-field of Human-Computer Interaction (HCI) that emerged in 2007 with the concept of Sustainable Interaction Design [30], which focuses on the relationship between humans and technology in the context of sustainability. Design can be defined as an act of choosing among or informing choices of future ways of being [30]. Mankoff et al. [6] categorize SHCI into two categories: *Sustainability in design*, which involves reducing the material impact of software and hardware, and *Sustainability through design*, which involves influencing sustainable lifestyles and behavior through the design of technology and interactive systems. DiSalvo et al. [31] categorize the work into five genres: *persuasive technology*, *ambient awareness*, *sustainable interaction design*, *formative user studies*, and *pervasive and participatory sensing*.

In 2010 *persuasive technology* constituted roughly 45% of the research in the field of Sustainable HCI [31]. These technologies are designed to change attitudes or behaviors, and aim to encourage sustainable behavior by convincing or nudging users. Examples of such technologies include gamification, interactive visual displays, sensors, and apps that track carbon or energy use and offer challenges, competition, and rewards for sustainable behavior. However, this approach has been criticized for simplifying the problem of sustainability and ignoring larger structural issues by solely focusing on individual behavioral change [7]. Consequently, through the years, several authors have called for Sustainable HCI to move toward a more holistic approach that uses systems thinking to address structural change [8], [32]. In addition, there have also been calls for Sustainable HCI to build bridges with other fields, such as environmental data science, environmental psychology, and politics, with the argument that HCI could not solve the problem of sustainability alone [33].

Previous SHCI literature has also emphasized the role of digital networks and interactive

technologies. E. Blevis and S. Blevis [34] encouraged SHCI researchers in 2010 to contribute toward "the design of digital networking and interactive technologies that can help people at various levels—as individuals, small groups, governments, and global bodies—plan and prepare for the orderly adaptation to these effects". Knowles et al. [9] suggest using ICT as a medium for communication to generate a critical mass and develop a vision of technology's role in fostering invigorated, engaged, and effective democracies. In other words, "giving people the tools for responding to the crisis in meaningful ways, in contrast to taking actions such as emailing a congressperson, posting comments on social media, or signing an e-petition" [9]. In addition, they call for challenging established values and moving beyond online forums to develop "the kind of platforms that support real debate" [9].

A decade after the first critiques were raised, researchers in SHCI have responded to the critiques by moving towards designing with and for communities and thinking contextually rather than solely focusing on individual behavioral change. Still, questions are being raised about whether this is enough [8]. One paper that has responded to the criticism is the article *HCI and Environmental Public Policy: Opportunities for Engagement* [35], which notes that although there is a considerable body of work on how social practices and digital technologies impact energy consumption, there is no evidence that the HCI community has attempted to influence climate change politics or has been successful in doing so. The authors suggest that increasing direct communication with environmental public policymakers could be a wise step to take.

Bremer et al. [8] suggest a new pathway which they call *Green Policy Informatics*. This pathway involves ensuring that "digital systems bring needed transparent accounting and accountability, support complex decision-making under uncertainty, and enable the deconstruction of popular myths about the energy and carbon impacts on everyday life" [8]. The authors also suggest that data visualization can be applied to track compliance with emissions targets at various scales, for instance, by adding clarity to the complex dynamics of multiple emission sources. Additionally, the authors point out that an essential role of SHCI can be to make sure that the systems developed to support a radical transition are user-centered.

2.3. Digital Governance and E-Participation

Based on the calls from SCHI literature, we wanted to explore ways in which information technologies can be leveraged to impact climate policy. We considered the fields of digital governance and e-participation to be highly relevant in this context. However, from entering the search string ("sustainable HCI" AND "digital governance") and ("sustainable HCI" AND "e-participation") in Scopus we were not able to identify any literature on the intersection of Sustainable HCI and E-participation or Digital governance.

2.3.1. Digital Governance

E-government has been defined in different ways by different sources [10]. The world bank refers to e-government as "the use by government agencies of information technologies that have the ability to transform relations with citizens, businesses, and other arms of government" [36]. Utilizing e-government services can lead to advantages such as improved government efficiency, improved services to citizens, and enhanced democratic processes [14]. **E-governance** tends to be used interchangeably with e-government but can be seen as a broader concept that involves multiple actors beyond the government. While e-government is primarily focused on the digitization of public administration, e-governance transforms relations between government, citizens, businesses, and other governments [12].

Digital governance and has emerged from the concept of e-governance and e-government, and tends to be conflated with e-governance as there are no clear conceptual distinctions between the two terms. Governance can be defined as "the process of steering society and the economy through collective action and in accordance with common goals" [37], while Digital governance research investigates the utilization of digital technologies in governance structures and processes [38]. According to Engvall and Flak [12], digital governance can be seen as a development of e-governance, with a slightly greater focus on computational capabilities, such as data analysis, modeling, and visualization. They define digital governance as the use of digital technology in governance structures and processes to achieve governance objectives and normative values. Digital governance is argued to have the potential to bring about several benefits, including enhanced efficiency, increased citizen-government engagement, bridging of fragmentation and silos, and facilitating collaboration [12]. A key to digital governance are decentralized processes, collaborative decision-making, and the active involvement of multiple stakeholders with transparency and accountability for both stakeholders and algorithms [39].

Given the urgency of the climate crisis, scholars have highlighted that there is an "obvious potential in digital technologies to contribute toward addressing the problem" [13]. Engvall and Flak [13] emphasize the significant scope for improvement in analytical capabilities, communication services for diverse stakeholders, support for data-driven decision-making, and more effective assessments of progress towards established goals. *Governing Environmental Sustainability: A Literature Review* [14] highlights that research exploring the interrelationships between e-government, citizen participation, and environmental sustainability is surprisingly rare, despite governments being recommended to utilize digital technologies to address this challenge. It suggests that more research is needed to explore how e-government services can be improved and designed to cope with different environmental issues through collective action with citizens [14].

2.3.2. E-Participation

The concept of citizen participation in environmental policy is not new. The UN Conference on Environmental and Development (UNCED) in 1992, resulted in the

"Rio Declaration", which stated that "environmental issues are best handled with the participation of all concerned citizens, at all relevant levels" [40]. This prepared the ground for the term "environmental democracy". Later the Aarhus Convention was launched in 1998 by the United Nations Economic Commission for Europe (UNECE) to strengthen environmental rights by establishing standards for public participation for citizens based on three principles; "access to information," "participation in decision-making," and "access to justices" in environmental matters [41]. Overall, **Citizen Participation** involves the active involvement of citizens in public decision-making, enabling collaborative efforts to tackle general issues. This can include both individuals and organized communities, with "participation" encompassing both observation and the ability to exert influence depending on interpretation [42]. The aim of citizen participation is to improve the quality and legitimacy of policy decisions and address the challenges of representative democracy, particularly in addressing complex and fragmented policy environments, and wicked problems [43]. Benefits of citizen participation include increased knowledge, authority, power, and problem-solving ability for individuals, communities, organizations, and society as a whole [42]. Some expect that citizen participation can help overcome the lack of engagement with politics and the loss of trust in political institutions [11].

Aichholzer state that "the internet holds enormous potential for facilitating information, sharing, discussion, awareness raising, and mobilization of collective efforts as well as for collaborating on policy decisions and their implementation in the pursuit of climate and energy targets" [40]. **E-Participation** enables citizen participation and engagement through the use of ICT-tools [16]. The goal of e-participation is to achieve greater input from stakeholders and to facilitate transparent, balanced, and widely supported decision-making processes [10]. Sanford and Rose define e-participation as "the extension and transformation of participation in societal democratic and consultative processes, mediated by information and communication technologies (ICTs)" [44]. The authors state that political processes and democracy are dependent on effective communication and informed decision-making about public issues amongst citizens, politicians, officers, and other stakeholders that the collective decision may impact [44].

Achieving the climate goals represents a huge governance challenge involving all levels; global, supranational (EU), national, regional, and local. Although researchers have pointed out that global governance will be essential to solve the climate issues [38], the scope of this study focuses on national and regional levels to keep the scope manageable. There are also several stakeholders and actors that can be involved in e-participation processes, including citizens, politicians, government institutions, voluntary organizations, or in general, stakeholders whose interests are affected by the policy under discussion [45]. These actors and stakeholders can also be divided into two groups; those who benefit from using a certain participation tool, and those who are responsible for administrating the participation tools [46]. This thesis focuses solely on young citizens and government officials.

Researchers have proposed different levels of e-participation adoption, categorized by the

stage of dialogue and participation. One article reports the five major levels: information provision, citizen consultation, citizen active participation, e-empowering citizens, and e-engaging [45]. *Information provision* involves the flow of information from government to citizens and typically involves using websites. *Citizen consultation* involves two-way interaction where the government enables citizens to provide feedback and opinion based on issues and questions they have defined. *Citizens' active participation* involves active citizen engagement in defining and shaping policy. *E-empowering citizens* involve facilitating active participation and bottom-up ideas to influence the political agenda, and *e-engaging* involves top-down consultation of citizens by the government where deeper contributions on policy issues are conducted [45].

Based on the different levels, various e-participation technologies can be appropriate. To improve the probability of success, it is important to first identify the objective of the initiative, and based on that, select the best-matching tools and techniques [47]. According to the framework presented by Phang and Kankanhalli [47], the best ICT tools for attaining information exchange are online discussion forums and online chats. Furthermore, it suggests that the best ICT tools for achieving the objectives of education and support building to inform citizens about the policy plans are tools like e-profiling, online chat, discussion forums with login features, video conferencing, and e-mail. To supplement decision-making, ICT tools such as structured surveys and visualization tools are the best. Finally, to collect citizen input, online survey questionnaires, Web comment forms, and data analysis tools are recommended [47], [45]. Another framework proposes e-mail, quick (online) polls, wikis, e-debates, and online community networks as technical tools for e-consulting [45], and e-debates, discussion forums, online communities, and social networks, among others, for e-involving [45].

Despite extensive research and high expectations of revolutionizing democratic participation, e-participation initiatives have frequently fallen short in delivering the anticipated results and engaging disengaged citizens [48]. The reasons behind the failure of these initiatives are related to failures typical to information systems projects, those emerging from the public sector context, failing to meet stakeholders' needs, and challenges related to the complex context of democratic participation [48].

Numerous studies have identified key success factors for e-participation initiatives. To effectively meet user needs and expectations, it is crucial to involve them in the design process, address their specific requirements, gather continuous feedback through demonstrations and prototypes, and create a system that is both appealing and user-friendly [49]. To provide value to citizens, certain aspects must be ensured, such as transparency, government responsiveness, accountability, consider citizens' convenience, e.g. one-stop solutions for e-participation, clear and understandable online content, provision of feedback to participants, demonstration of how the initiative strengthens the decision-making process, emphasis on the quality of contributions, and a focus on improving citizen satisfaction and well-being [49]. Other factors contributing to success include platform accessibility, provision of relevant information prior to participation, integration with the policy-making process, and the ability to influence decision-making on proposed ideas [50].

On the other hand, barriers to successful e-participation include lack of transparency, inadequate feedback mechanisms, concerns regarding platform security and verification processes, insufficient moderation, and inadequate engagement with relevant associations [50].

2.4. Youth-centered Participation and Engagement

Although considerable research has been conducted on identifying success factors for e-participation initiatives, little research has been conducted on designing new e-participation tools in a user-centered manner, ensuring e-participation tools are inclusive and promote participation from a broad group of users. There is a widespread hope that the interest of young people in politics can be raised if online communication channels are offered [11]. According to Pietilä et al. [16], digital systems need to be enhanced to meet youth needs that do not have extensive experience in societal participation to enable the sustainable development of society. However, there is a lack of research focusing on the user needs of youths that do not have extensive experience in societal participation.

The study *Understanding the Youth's user needs for Inclusive e-participation*, identifies ten user needs grouped into four categories: trust and safety, motivation to participate, integration into governmental processes, and efficient and effective use [16]. Anonymity was seen as both an enabler for discussions and a risk to attract trolls. Regarding motivation to participate, a personally interesting topic was one of the main motivations for youths to engage in e-participation. An adequate number of users was also deemed essential to make the platform credible. In terms of integration into governmental processes, youths believed that active participation from the government and local authorities was crucial to "having a real impact." Finally, related to efficient and effective use, search, and filtering features were deemed necessary. It was highlighted that having sufficient knowledge about the topic is necessary to participate in discussions, and therefore, materials to read before discussions should be provided to support this need [16]. These findings align well with general success factors for e-participation, discussed in the previous section. Others have found that a clear design that allows for the submission of ideas easily, and features inspired by social media, such as tags and thumbs up or down, are considered appealing for participation by young people [15].

While there have been some research efforts focusing on the needs of young citizens in e-participation tools, there appears to be a lack of studies specifically addressing this issue through design science research. This study aims to bridge this gap by expanding upon the existing literature on user-centered e-participation, with a specific focus on young citizens and government officials. A novel aspect of this study is its focus on climate policy and its utilization of design science as a research strategy. Table 2.1 summarizes the main findings from the relevant papers that the thesis builds upon.

Table 2.1.: List of Most Relevant Related Work

Reference	**Research Field**	**Content**	**Main findings**
Sustainably Unpersuaded: How Persuasion Narrows Our Vision of Sustainability (2012) [7]	Sustainable HCI	A critical review of previous work in persuasion in sustainability.	Calls for a systems thinking approach in SHCI.
Have We Taken on Too Much?: A Critical Review of the Sustainable HCI Landscape (2022) [8]	Sustainable HCI	Literature Review of Sustainable HCI literature in regards to critiques.	Suggest "Green Policy Informatics" as a potential pathway for Sustainable HCI.
HCI and Environmental Public Policy: Opportunities for Engagement (2017) [35]	Sustainable HCI	Identifies opportunities for HCI researchers to engage with environmental public policy.	Increasing direct communication with environmental public policymakers could be a wise step to take.
Governing Environmental Sustainability: A Literature Review (2018) [14]	Digital Governance and Environmental Sustainability	Literature review on digital governance in the context of environmental sustainability.	Highlights that research on the interrelationships between e-government, citizen participation, and environmental sustainability is surprisingly rare.
E-participation Initiatives: A Framework for Technical Tools (2012) [45]	E-participation	Framework for classifying suitable technical tools of e-participation.	Lists online polls, wikis, and e-debates as tools for e-consulting, and e-debates, discussion forums, online communities, and social networks, among others, for e-involving.
A framework of ICT exploitation for e-participation initiatives (2008) [47]	E-participation	Presents a framework for e-participation tools based on objectives.	Suggest online discussion forum and online chat as the best tools for information exchange, visualization and survey tools to supplement decision-making and web forums, data analysis tools and structured surveys for citizen input.

Success factors in designing eParticipation initiatives (2014) [49]	E-participation	Presents a framework for e-participation tools based on objectives.	Success factors include involvement of citizens in the design process, receiving continuous feedback, designing a system that is appealing, yet simple to use, ensuring transparency, ensuring government responsiveness and accountability, considering citizens' convenience, e.g., one-stop solutions for e-participation, clear and understandable content, ensure that feedback is provided to participants, show how the initiative strengthens the decision-making process, pursue quality of contributions
Decide Madrid: A Critical Analysis of an Award-Winning e-Participation Initiative (2020) [50]	E-participation	Analyzes the award-winning e-participation initiative Decide Madrid to identify the critical success factors and the main barriers that are conditioning its performance.	Success factors include platform accessibility, provision of relevant information before participation, integration with the policy-making process, and influence on decision-making for proposals. Barriers include lack of transparency, lack of feedback, concerns about the security of the platform and verification process, lack of moderation, and associations not being properly engaged.
Understanding the youth's user needs for inclusive eParticipation (2021) [16]	E-participation	Identifies inclusive ways for youth to take part in societal processes through digital tools.	Young user needs involve trust and safety, motivation to participate, integration into governmental processes, and efficient and effective use.

Digital services and youth participation in processes of social change: World Café workshops in Finland (2018) [15]	E-participation	Focuses on the role of digital services in empowering youths to participate in social change.	Youths can be more engaged to participate by using digital services and becoming active possessors of their human rights. A clear design and social media-inspired features can appeal to young people.

3. Method

The objective of this research study is to investigate how an e-participation platform for climate policy should be designed to promote participation and engagement from young citizens, and still ensure that the platform provides value to policymakers. Design science was chosen as a suitable research methodology as it aims to solve practical problems of general interests by creating innovative artifacts [51], [52].

When performing a design and creation project, additional methods of data generation, such as interviews, observations, questionnaires, or documents, are often utilized [20]. Interviews were chosen because the use of semi-structured interviews allowed for the possibility of gaining a deeper insight by talking to the participants and letting them elaborate more freely on the topics they considered relevant. Additionally, interviews fit the time constraints of the thesis and the number of participants available to contribute. Several methods were considered for data collection but were opted not to use. Questionnaires would provide the opportunity to identify patterns and generalize the results, but it would require a large number of participants and time to wait between distributing the questionnaires and receiving responses [20], and was therefore considered not feasible for this project. Additionally, questionnaires would not allow for deep insight into the users' needs to identify the root causes of the problem or detailed responses that capture the users' impressions of the artifact prototype.

The research process performed as part of the thesis is shown in figure 3.1. Two iterations of the process of define requirements, design and develop artifact and perform user testing to evaluate were performed. The first iteration included user testing with government officials and the second with young citizens. Subsequently, design principles were formulated, implemented in the artifact, and demonstrated to refine and validate them.

The rest of this chapter describes the methods used in the thesis. Section 3.1 explains the research methodology and framework used. Section 3.2 describes the methods used for data collection and how the data collection has been performed. Section 3.3 describes the data analysis process. Section 3.4 describes the approach used to formulate the design principles. Section 3.5 discusses the ethical considerations for the thesis.

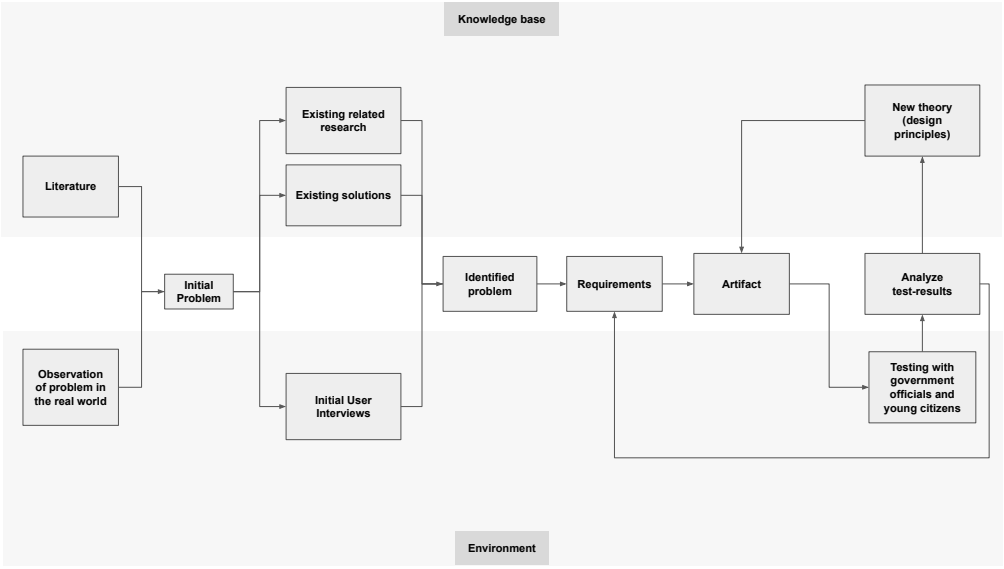


Figure 3.1.: Overview of the research process performed.

3.1. Research Methodology

3.1.1. Design Science

Hevner and Chatterjee [52] define design science as a research paradigm where the designer answers questions to human problems by creating innovative artifacts, thereby contributing to the body of scientific evidence through the creation of new knowledge. The artifact can solve the problem by improving an existing solution or providing a new solution. Four types of artifacts are used in design science research: *constructs*, *models*, *methods* and *instantiations* [51]. Constructs are terms, notations, definitions and concepts needed to describe the problem and solutions. Models are abstractions and representations of possible solutions [51], [52]. Methods are guidelines and processes on how to solve problems and achieve goals, and a method expresses prescriptive knowledge. Instantiations are working systems ready to be used in practice [51].

This master's thesis develops a method artifact in the form of developing design principles and design propositions that can facilitate the creation of future instantiations aimed at addressing the problem.

3.1.2. Design Science Research Methodology

This thesis follows the design science research methodology (DSRM) process proposed by Peffers et al. [19]. The framework presents six main activities: *Identify Problem and Motivate*, *Define Objectives of a Solution*, *Design and Development*, *Demonstration*, *Evaluation*, and *Communication*. These six activities constitute the division of the work

carried out in this thesis, and the activities are explained below. Additionally, the method framework for design science research described by Johannesson and Perjons [51] has been used to define the goals of each activity further. Through the proposed activities, the framework provides a structured approach that ensures rigor, relevance, and cumulative knowledge development through guidelines for activities to follow and relating the research to existing knowledge.

Even though the activities in the process are presented in sequential order, Peffers et al. [19] point out that research projects can start at any activity based on the starting point of the project. This thesis uses a problem-centered approach, meaning the starting point is activity 1, and the rest of the activities are performed in a nominal sequence but with several process iterations.

A design science research project needs to relate the activities and results to a knowledge base, to ensure original and well-founded results [51]. Relevant knowledge and previous related research are described in chapter 2.

Activity 1: Problem Identification and Motivation

This activity aims to precisely define the specific research problem and to justify the value of a solution, and requires gaining knowledge about the state of the problem and the importance of its solution [19].

The first sub-activity proposed to achieve this is that the problem needs to be *defined precisely* to avoid misinterpretations and help people develop a shared understanding of the problem [51]. At the same time, it is important to avoid narrowing the problem too much because this can lead to important aspects being omitted and exclude potential solutions. The second sub-activity is to *position and justify*, which aims to put the problem in context [51]. Finally, it is essential to *identify the root causes* of the problem to achieve a more detailed understanding of it. The resources included in this activity are knowledge from relevant literature and information from stakeholders.

The problem identification and motivation activity performed is described in section 4.4.

Activity 2: Define the Objectives for a Solution

The second activity is to derive the objectives of a solution by analyzing the problem definition and understanding what is possible and feasible [19]. A solution to the problem can either be quantitative, such as describing how a solution would be better than current ones, or qualitative, such as how a new artifact is expected to address problems that have not been addressed before [19].

This activity is performed by identifying and outlining an artifact that can solve the problem and defining requirements for the proposed artifact [51]. First, it has to be decided which artifact type to design to address the problem. The artifact can be a construct, a model, a method, or an instantiation. The next step is to define the requirements for the artifact to ensure it addresses the root problems identified in the

first activity. This activity requires knowledge of the state of the problem and current solutions [19], specified in section 4.4 and section 4.3.

This activity is described in section 4.5.

Activity 3: Design and Development

The third activity consists of creating the outlined artifact. This includes determining the artifact's functionality and architecture and then developing the artifact [19]. Peffers et al. [19] define a design science artifact as "any designed object in which a research contribution is embedded in the design."

The output of this activity is the artifact that fulfills the requirements defined in the previous activity, and prescriptive and descriptive knowledge [51]. Johannesson and Perjons [51] proposes four sub-activities to achieve this: *Imagine and brainstorm*, *assess and select*, *sketch and build* and *justify and reflect*. First, the researcher needs to generate new ideas or enhance existing ideas. These ideas are then assessed and one or more is selected as the best idea for the development of the artifact. This selected idea has to be sketched and later developed, resulting in the final artifact. Further, the knowledge gained by the researchers during this activity is documented through the justification of and reflection on the design decisions made [51].

The design and development activity is described in chapter 5.

Activity 4: Demonstration

The demonstration of the artifact consists of demonstrating the use of the artifact to solve one or more instances of the problem [19]. This could be performed through any activity considered appropriate based on the type of artifact and problem, such as using the artifact in an experimentation, simulation, or case study. The output of this activity is proving the artifact's feasibility and providing a proof of concept, and the demonstration can be considered a form of weak evaluation [51]. This activity also provides descriptive knowledge about how the artifacts work in the one case and explanatory knowledge about why it works [51]. This is done by first choosing or designing a case to demonstrate the artifact. Then the researcher has to apply the artifact to the case and document the outcome. The resources needed to perform this activity include knowledge of using the artifact to solve the problem [19].

The demonstration is described in chapter 6.

Activity 5: Evaluation

The fifth activity involves observing and measuring to what extent the artifact solves the problem, and includes comparing the objectives of a solution to the actual results from the artifact demonstration [19]. The form of the evaluation varies based on the type of artifact and problem and can include any appropriate type of empirical evidence or logical proof.

In order to choose the appropriate goals and research strategy for the evaluation, Johannesson and Perjons [51] emphasize the importance of considering the context of the evaluation environment. It can also be useful to distinguish between *ex ante* and *ex post* evaluations and between *naturalistic* and *artificial* evaluations. The main constraints of the evaluation environment in this study are a limited amount of time and limited access to government officials. Hence, conducting a time-consuming evaluation, involving a large number of participants from the government official stakeholder group is not feasible. Considering that the aim of the study is developing design principles that address the defined problem, the artifact will be evaluated as a prototype, without it being fully developed. The evaluation will therefore be performed as an *ex ante evaluation*, and be formative, meaning the artifact will be evaluated while under design to get feedback that will be used back in the design process. The evaluation will also be a *naturalistic evaluation* because it will be tested with real users using real systems to solve real problems [51].

The goals of the evaluation of the artifact will be to:

- Evaluate the utility of the artifact and determine to what extent the artifact is effective for solving the explicated problem
- Identify opportunities for improvement in further design
- Formulate and evaluate design principles

After the evaluation is performed, the researchers can decide to either iterate back to activity three to improve the artifact's effectiveness in solving the problem or proceed to activity six [19].

The artifact evaluation is described in chapter 6.

Activity 6: Communication

The final activity is to communicate the problem and its importance, the artifact created to solve the problem, its utility and novelty, the rigor of the artifact design, and its effectiveness to researchers and other relevant audiences [19]. The communication activity requires knowledge of the disciplinary culture. For scholarly research publications, the researchers can use this proposed process to structure the paper [19].

This activity is performed through the creation of this thesis.

3.2. Data Collection

This section elaborates on how the data was collected during the thesis, before, during, and after the development of the artifact.

3.2.1. Initial Interviews

Interviews were performed with different stakeholder groups and at different phases of the project to obtain insights and necessary feedback. The stakeholder groups included were citizens and government officials. Semi-structured interviews were preferred as they provided the flexibility to adjust the order of the themes and questions based on the conversation's natural flow [20]. Additionally, semi-structured interviews facilitated the inclusion of additional questions if interviewees raised relevant issues that were not initially prepared for. Compared to structured interviews, semi-structured interviews allowed interviewees to provide more detailed responses and bring up topics that they considered relevant to the research themes [20]. To enable participants to freely express themselves and provide more elaborate explanations, all interviews were conducted in Norwegian.

Interviews with citizens

The first interviews conducted were with young citizens during the problem identification activity. Semi-structured interviews were performed with six participants to gain insight into their thoughts and feelings regarding the climate crisis. The main goal of these interviews was to identify the primary pain points and barriers hindering greater contribution towards addressing the issue, finding information, and making a difference.

The participants included individuals of different genders with different views and perspectives on the climate issue. The interviews lasted between 40-60 minutes. Four interviews were conducted in person and two were conducted digitally because the participants were not able to meet physically. The interviews were audio-recorded and thoroughly transcribed to capture participants' perspectives and experiences accurately.

The semi-structured interview questions were designed to encourage participants to share their thoughts and feelings on the climate crisis, including the barriers and challenges they face in making a positive impact towards the green shift and tackling climate change. In addition, we sought to understand participants' thoughts and perspectives on sustainability and climate change, their engagement in environmental activities, their understanding of the climate situation, and their political engagement related to climate politics. Participants were also asked about their personal experiences and how they felt about their ability to make a difference. The interview questions covered topics such as personal habits and behaviors related to transportation and consumption, thoughts and feelings about sustainability and climate change, sources of information, use of applications related to sustainability, and engagement with friends regarding the climate issue. The interviews aimed to provide insight into individual perspectives on the challenges and opportunities for action related to climate change. A complete overview of the questions asked during the interviews can be found in appendix B.1.

The interview analysis was performed using a thematic analysis approach to summarize the findings and identify the root causes of the initial problem. The analysis method is described in subsection 3.3.1 and the results in section 4.1.

Interviews with government officials

During the process of defining the artifact requirements, it was necessary to gain a comprehensive understanding of the current practices of government officials regarding citizen involvement in climate-related cases, and to identify their specific requirements for an e-participation tool that can offer them substantial benefits. The interview subjects in this stakeholder group included a local politician engaged in climate politics, an employee at the Climate and Environment Department at the municipality, and two employees at the Ministry of Climate and Environment. One interview was conducted in person, while the rest were conducted digitally using the Microsoft Teams platform. The interviews aimed to collect insights into the government's current approach to involving citizens in the development and implementation of climate-related policies and initiatives.

The interviews began with an introduction, including the background and motivation for the thesis and a short overview of the goal of the interview. The questions asked focused on the government's approach to citizen involvement, the success and challenges of current practices and opportunities for improvement. Further, the interviews delved into the barriers encountered in the development and implementation of climate-related policies and initiatives and communication with citizens. The questions then progressed to the experiences with digital platforms and forums, the critical functionalities of a citizen participation platform, and the challenges encountered in implementing and using digital participation tools. Additionally, the interviews also explored the types of feedback that would be most valuable to the government. The questions asked in the interviews can be found in appendix B.2, B.3 and B.4.

A thematic analysis was used to analyze these findings as well, and the results of the analysis can be found in section 4.2.

3.2.2. User Testing

To conduct a formative evaluation of the artifact, user testing was performed using the research method of semi-structured interviews combined with artifact demonstration. The artifact was first tested with four participants belonging to the stakeholder group of government officials. These were the same as the ones that participated in the initial interviews. The feedback gathered from these participants was then used to update the list of requirements and incorporated into the artifact for a second iteration. Following the second iteration, the artifact was tested with five participants from the stakeholder group of young citizens. Each user test session lasted approximately 45 minutes. To ensure accurate documentation, all interviews were recorded with video and audio. Subsequently, a thematic analysis approach was employed to analyze the recorded data, further described in subsection 3.3.1

Semi-structured interviews were chosen as the evaluation method because it is an effective way to gather stakeholders' opinions and perceptions about the artifact [51], which is suitable to the objectives and constraints of the thesis. Semi-structured interviews offer

the flexibility to ask follow-up questions as necessary, enabling a more comprehensive exploration of stakeholders' thoughts and viewpoints.

During the user testing, the participants were requested to utilize and interact with the artifact while expressing their thoughts aloud. Following the testing phase, a set of semi-structured interview questions was posed to the participants. These questions encompassed various aspects, such as their impressions, suggestions for improvement, usage patterns, and more. The primary aim of these interviews was to evaluate the effectiveness of the artifact in addressing the explicated problem, assess the utility of each requirement, identify areas for improvement, investigate formalized knowledge, and help to formulate design principles. The questions asked during the interviews can be found in appendix C.

3.3. Data Analysis

3.3.1. Thematic Analysis

Thematic analysis is "a method for identifying, analyzing and reporting patterns (themes) within data" [21]. We used thematic analysis to analyze the data from the initial interviews and user testing. The following parts of this section will describe the five phases of the thematic analysis, inspired by the phases described by Braun and Clarke [21]. A thematic analysis was performed for two iterations of interviews and two iterations of user testing. The first time the analysis was conducted, during the initial interviews involving young citizens, it was performed physically using post-it notes and a whiteboard. This allowed for a visual representation of the data, which was useful when identifying the root causes of the problem and when using this method for the first time. The three following times, it was performed using an online document, because it proved to be more time efficient and allowed for a more structured data organization.

Phase 1: Familiarizing ourselves with data from the interviews

The first part of the thematic analysis was to get familiar with the data collected through the interviews. All the interviews were transcribed shortly after they were conducted, which is a good way to get familiar with the content [53]. This was also necessary to make sure we correctly captured the interviewee's answers. Afterward, all the transcripts were read thoroughly. We also discussed the content to share insights and understandings about the data.

Phase 2: Extraction of relevant data

Extraction of relevant data should be performed by identifying interesting opinions, thoughts, statements, or other findings in a systematic way. In this phase, we extracted parts of the interviews we found interesting with regard to the aim of the analysis. This was performed by systematically reading through each transcript and highlighting everything we found interesting and considered to possibly be part of a repeated pattern.

To ensure this part of the process was performed thoroughly, both of us read through all the transcripts. Afterward, we extracted all the highlighted pieces. There is a risk of losing the context of the statements during this part of the process [21]. We, therefore, made sure to cut out large enough sections to preserve the context of the statements. These pieces were then grouped together with other pieces that had similar expressions.

Phase 3: Searching for initial themes

This phase aims to place the data extractions into potential overarching themes. In this phase, it can be helpful to use visualizations to sort the data extractions into potential themes [21]. During the first analysis, this was performed by taking all data extractions, which were cut out in the second phase, and placing them on separate post-it notes. Afterward, they were grouped into potential themes on a whiteboard, creating a visual map of the data clusters defining each initial theme. Some data extractions did not belong in any of the themes defined in this phase and were placed in a separate "miscellaneous" cluster. At the end of this phase, the whiteboard visualization made up the initial thematic map.

During the three following analyses, this was performed by copying the data extractions from the transcripts and into another online document. In this document, the extracts were grouped together based on the theme.

Phase 4: Reviewing and refining initial themes

The initial themes were in this phase refined and further analyzed to create the final thematic map. This phase can be divided into two levels and is concluded when the themes and thematic map reflect the primary interview data [21]. First, all data extracts were read for each initial theme to ensure they were consistent with the theme and each other. If an extract was not coherent with the theme, it was removed from the theme. Some initial themes were also divided when it became apparent that the data extracts did not form one coherent theme. When all the data extracts formed a consistent theme and the themes reflected the content of the data extracts, we started on level 2 of this phase. We then looked at the entire dataset, and evaluated if the themes decided in level 1 accurately captured the content of the transcribed interviews.

Using post-it notes on a whiteboard allowed easy refinement of the themes and a visual representation of the data, which provided a helpful overview. This visual representation made up the final thematic map at the end of this phase.

Phase 5: Defining the final themes

This phase aims to clearly define what each theme is and what it is not, and give all themes a final name that clearly communicates their content [21]. We went through all themes and the data extracts they represent, and made sure we could describe the essence of each theme with a couple of sentences. Some themes were also divided into sub-themes to describe the difference within the theme better. We also reviewed the theme names to ensure they were concise and clearly described each theme. At the end

of this phase, we wrote a description of each final theme and the essence of the data extracts it contains.

3.4. Formulation of Design Principles

In order to capture and communicate the prescriptive knowledge regarding the design of the artifact, a set of design principles were formulated. These principles are considered to embody valuable insights and wisdom into the development of other artifacts within the same category [54].

The discovery of design principles can be influenced and inspired by input from various sources such as prior theories, design efforts to capture what worked and what did not work, the outcome of the design efforts such as an instantiated artifact, and results from formative and summative evaluation [54].

There are several different methodological prescriptions in terms of when design principles can and should be generated. One suggests that the discovery of design principles should be engaged in as part of the design-evaluate iterations cycles, while another points to a separate learning and reflection stage, where formalization and refinement of design principles are carried out in the reflection stage. A third approach is to formulate the design principles prior to implementing the artifact, while a fourth approach is to discover design principles after the deployment of the artifact. Another approach suggests returning to previous successful artifacts to generate design principles [54].

To formulate design principles this study adopted a combination of these approaches. Following two design-demonstrate-evaluate iterations, a set of tentative design principles was developed based on input from prior theories, experiences through the design cycles, from designing and building the artifact, user testing, and formative evaluation of the artifact.

The tentative design principles were implemented in the artifact and demonstrated to a subset of the participants to refine and validate before resulting in final design principles. This was performed through semi-structured interviews with three participants from the stakeholder group of young citizens, who had participated in the previous round of user testing. The demonstration entailed showcasing the relevant parts of the artifact while providing explanations for their functions. The participants were then encouraged to share their thoughts and opinions on each principle. The design principles were revisited and refined following the demonstration, based on the feedback from the participants.

The knowledge gained through the evaluation and user testing that were not implemented in the artifact or were not sufficiently tested and evaluated were formulated as design propositions, to serve as suggestions rather than guidelines for future design efforts.

3.5. Ethics

When conducting research, it is important to consider the ethical responsibilities towards those involved in the research [20]. It is also important to consider the ethical implications at the planning stage to ensure all subjects involved understand their rights before they consent to participate [55].

Since this project collects personal data through interviews and audio recordings, it is required by NTNU to notify Sikt, Norwegian Agency for Shared Services in Education and Research, about the project [56]. This ensures that the project follows Norwegian data protection laws. In connection with applying for approval from Sikt, a data management plan and a participant consent form were created. All interview participants were presented with the consent form before the interview and audio recording started. The form outlined general information about the project, how the personal data will be handled during and after the project, and the participant's rights. The consent form can be found in Appendix A

4. Identify Problem and Define Objectives of a Solution

This chapter explicates the initial problem of the study by defining it precisely, positioning and justifying its importance, and investigating its root causes [51]. In addition, the requirements of an artifact to address the defined problem are outlined and explained.

The study originated from the observation that many young individuals experience a sense of powerlessness and hopelessness when confronted with the large issue of climate change. The motivation behind this research was to enhance the environment through the introduction of a new artifact [57]. Given the complexity, vague expression, and incomplete understanding of the initial problem, further investigation was necessary to narrow down and refine its definition. To achieve this, interviews were conducted with young citizens, who constitute the stakeholder group encompassing individuals between 18 and 29 years.

In addition, related work was reviewed in cycles before and after the interviews as we deepened our understanding of the problem and ideas for an appropriate solution. The review of related work is elaborated in chapter 2 and the main findings shaping and being utilized in the thesis are summarized in table 2.1.

It is important to note that the research area of e-participation was not considered until after the interview with young citizens. By conducting interviews with young citizens, combined with reviewing relevant literature, the problem was reformulated to address active participation in climate policy for this demographic. Consequently, the stakeholder group of government officials, responsible for governing climate policy, was included. Interviews were conducted with government officials to gain insights into their perspectives, needs, and requirements related to the problem of citizen participation and engagement.

Taking the viewpoints of each stakeholder group into account, a more detailed problem definition was developed, breaking the problem down into sub-problems with root causes for each stakeholder [51]. Additionally, an extensive review of existing solutions and related work were undertaken to leverage prior knowledge, experiences, and expertise from similar problem domains, ensuring that the study's contribution would be innovative and novel.

The rest of this chapter presents the problem definition process and the requirements

defined for the artifact. Section 4.1 presents the findings from the initial interviews with young citizens. Section 4.2 presents the findings from the initial interviews conducted with government officials. Section 4.3 provides a review of existing e-participation solutions and citizen participation initiatives. Section 4.4 presents the problem definition, including justifying the problem's importance, precisely defining the problem and outlining the root causes. Section 4.5 presents the requirements defined for the artifact to address the problem.

4.1. Analysis of Interviews With Young Citizens

This section presents the findings from the thematic analysis performed on the data collected through citizen interviews and how it is used to narrow the problem. A more detailed description of how these interviews were conducted is explained in subsection 3.2.1. The aim of the analysis was to discover recurring themes and identify the common pain points that the interviewees raised. Figure 4.1 shows the main phases of the analysis and the outcome of each phase. The results were grouped and summarized into 12 themes and 4 sub-themes, and the ones considered relevant for the defined problem are described in the following subsection. The thematic analysis approach followed is described in subsection 3.3.1. A summary of the main findings is presented in table 4.1.

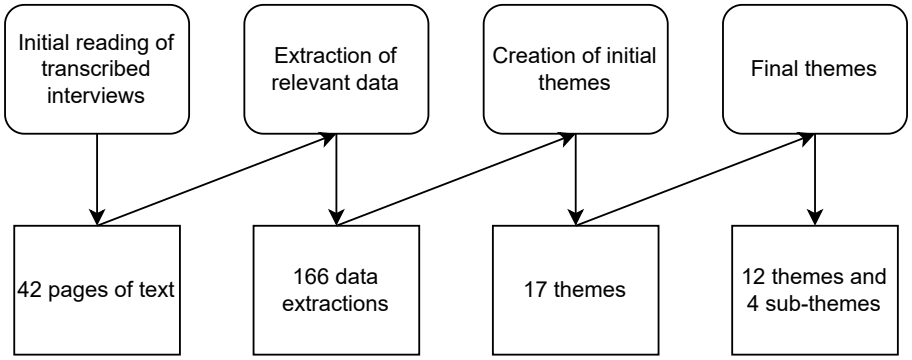


Figure 4.1.: Thematic analysis process

4.1.1. Interview Findings

Structural societal changes

There was a broad consensus among the interview participants that structural societal changes are necessary to address climate change. None of the interviewees believed individual behavioral changes alone were enough to solve the climate situation. One of the interviewees stated that "ultimately, it comes down to politics." Systemic changes are needed, and if people are to travel less, more locally, and by public transport, incentive schemes are necessary. Four out of six interviewees emphasized the economic perspective.

"Ultimately, it all comes down to money at the top," and "effective solutions are needed to make sustainable alternatives the most cost-effective and competitive option, otherwise people will lose money." One participant mentioned that society must facilitate choosing environmentally friendly alternatives by making them cheaper.

The way forward and what it will take to make a change

There was a widespread agreement that we are currently at a critical juncture in the climate crisis, and we may soon reach a point of no return. Some believed that new technology could potentially save us, but this would require the development of affordable, environmentally-friendly technology. Four out of six interviewees mentioned this point. Additionally, several interviewees expressed that addressing the climate crisis requires a shift in our understanding of what constitutes a high quality of life and that we will need to reduce our standard of living at some point.

Frustrations

The prevailing emotions regarding frustration related to the climate crisis were "helplessness," "hopelessness," and "injustice." All participants felt that they have little power to influence the climate crisis. Even those who have made lifestyle changes and strive to make a difference felt that their impact is small and may not be helpful until a larger portion of society or those in positions of power do more. One person expressed, "There is not much one can do about the climate crisis, because the individual impact is so small". Another felt that it is hopeless and that they can not have good discussions about the issue with others because everyone has different knowledge. One person expressed that they don't think enough will happen until it's too late and it has become a full-blown crisis, and then we will be causing harm to others later because we are enjoying ourselves too much at present.

Motivation and feelings

There was significant variation in the motivations and feelings expressed by the interviewees regarding the climate situation. Some mentioned that their engagement is due to their own conscience or because it makes them feel better. Others found the situation quite bleak and tried not to dwell on it too much. Two out of six mentioned having climate anxiety, and they were also the ones who spent a lot of time making adjustments and taking action in their daily lives.

On the other hand, one person mentioned that their most significant barrier to acting more sustainable is to have enough motivation for the climate for it to come before their "own desires." Another person mentioned that making significant changes in their daily lives should come last on the list of possible actions, as they have little faith that it helps and, therefore, do not make any conscious climate choices.

Barriers to addressing climate change

Several different factors are cited as the major barriers to addressing climate change. Political barriers, such as inadequate international collaboration and insufficient regula-

tions, are mentioned by some participants. Financial considerations, including the higher cost of climate-friendly alternatives and the continued profitability of high-carbon industries, were also considered significant barriers. One interviewee mentioned technological barriers and that technology has not yet progressed far enough to provide climate-friendly alternatives to maintain our current way of living. Others mentioned that humans are creatures of habit and have become accustomed to a very high standard of living, and are not willing to change without personal incentives. Finally, one participant noted that it is still a challenge to find environmentally friendly products, such as vegan products, in the stores.

International cooperation

The general agreement was that change must come from higher authorities, and there must be political and international cooperation. One person mentioned that Norway would benefit from joining the EU because there can only be limited progress without community cooperation, and the EU has more real influence than many other organizations. Another suggested that the focus must shift away from other types of political issues, which is challenging because everyone has different ideas about what is important.

Norway versus the rest of the world

The participants highlighted that even though Norway is one of the wealthiest countries in the world, with a highly educated population, there is still a lack of knowledge, and the necessary changes are not being made. One person said, "It feels like we have so little influence when not even Norway can achieve the climate goals. How will the rest of the world manage it?" Furthermore, the participants mentioned that Norwegians tend to believe they are the best at everything, but Norwegians still have one of the highest levels of consumption in the world and we still face significant climate skepticism despite a highly educated population.

Possibilities for influence

In general, the interviewees believed they have little individual influence on the climate crisis. Many believed that in order to make a significant impact, they would need to get involved at a higher level, such as becoming more politically engaged or utilizing their industry. It was also noted that making individual changes can influence others, but most did not believe their contribution alone would make much of a difference.

Politics

The theme of politics ended up being quite large and multifaceted, so it was divided into four subcategories: staying updated, engagement, trust, and influence.

Staying updated

There were some differences in how much the interviewees stayed updated on current politics. Some followed political developments to some extent but did not actively participate. One person noted that politics can be too complex to fully comprehend.

Several mentioned that other political issues take priority and require more immediate action, leaving climate change a lower priority for politicians. Some felt they had a decent overview of political developments but lacked detailed knowledge.

Engagement

All the participants said that they did not actively participate in politics themselves. Several expressed that the only way they could think of to engage more in politics was to become a politician themselves, which they did not have an interest in doing at the moment.

Trust

One interviewee had limited trust in politicians because it felt like they talk a lot about changes, but it is difficult for them to actually implement the changes. However, most participants still had a relatively high level of trust in politicians. One person expressed that a problem with politics is that politicians often hesitate to do or say things that can make them lose voters or make them unpopular. Some participants mentioned that politicians have a responsibility to govern the country effectively and also have to address a multitude of other issues. One interviewee also mentioned that there has been a lot of focus on symbolic political issues, which can create a false impression of progress.

Influence

There was general agreement among the participants that politicians have the ability to influence change if they have the political will to do so. One interviewee argued that since politicians can create laws, they have the power to implement the necessary changes. Another participant noted that while politicians have significant influence, they are not experts in all areas, making it challenging for them to know what is the best course of action. One person suggested that there needs to be more honesty and realism in political plans and that political will is needed to implement changes. Another participant suggested that we need more young politicians with diverse backgrounds to bring fresh perspectives and a more realistic approach to politics.

Everyday talk

The topic of climate change was generally not something the participants discussed with other people. Reasons for this included the negative outlook, that people don't want to lecture others, differences in perspectives and knowledge making it difficult to have good discussions and conversations, that it is not the preferred topic of conversation when meeting friends, and that their friends have little interest in it. Those who did discuss the climate crisis with their friends tended to do so with like-minded individuals. The discussion topics mentioned often center around the severity of the situation, sharing everyday tips for environmental awareness, and innovation in energy solutions.

There were varying attitudes toward if they should talk more about climate change. Some believed they could do more to inform their friends and share their knowledge, but ultimately hoped people would form their own opinions. Others felt the topic has

been thoroughly debated, and that people generally agree on the problem but differ on the best solutions, making it a challenging topic to talk about. For some, it was easier to avoid the subject altogether as they feel that, as individuals, they cannot make a significant impact anyways.

Individual actions

The general agreement was that the participants did not believe their individual actions had a significant impact on climate change. However, one person suggested that individuals could have an impact by being open-minded toward accepting change and adapting. Some discussed that while the effect of individual actions on emissions may be small, it could still have an impact by influencing others to make more environmentally friendly choices and become more aware. One person expressed that the impact of individual actions is limited unless one is a prominent figure who can showcase changes to many, such as a politician or someone high-up in the business world with greater influence.

Attitudes

The attitudes towards climate change varied among individuals, with some driven by personal experiences or literature, while others found it stressful and challenging to determine the effectiveness of their actions. Climate anxiety was also mentioned as a motivating factor for actions and the focus it takes in everyday life.

Those who were less concerned about the issue saw it more as a complex collective problem that requires the participation of everyone, with no immediate or obvious impact of individuals. One participant mentioned that since they do not immediately feel the effects of their actions, because they are more long-term, it makes the issue more challenging to relate to. Someone also mentioned a perception of the ones most concerned about the climate as overly activist and not relatable. Additionally, people struggle with the trade-offs between making the "right" choices and questioning the actual impact of their actions.

Information

In general, the interviewees felt that they had a good overview of the state of the climate situation, and they stayed updated on what was happening. But still, several mentioned that this is not information they seek but that they get through news and debates. Most interviewees stayed updated on the climate situation through the news, mostly NRK, VG, and Aftenposten. Two of the participants mentioned using Instagram as an information source. One person read international news and books and watched documentaries about the topic.

There were varying opinions on how easily available climate-related information is. Several participants found it challenging to obtain information as it requires knowing where to search for it. Additionally, one interviewee also found it challenging to prioritize and become informed because there are too many sources of information available. Some expressed that the climate situation has considerable media coverage, but it is difficult to

know how biased this information is. Furthermore, an interviewee noted that information on climate change is often presented with varying perspectives and motivations. One interviewee expressed a desire for more specific information about actions they can make themselves. Another wanted more concrete information about how the situation is progressing and how much emissions we are able to cut.

Applications

None of the participants mentioned using apps that promote more climate-friendly behavior. Some of the participants mentioned using the sustainability apps Finn, Tise, and TooGoodToGo, but none reported using any other such apps.

Table 4.1.: Summary of Interview Findings

Theme	**Main findings**
Structural societal changes	The interviewees believed structural societal changes are necessary and individual behavioral changes are not enough.
The way forward and what it will take to make a change	Participants felt that we are at a critical moment in the climate crisis, approaching the point of no return. They mentioned new technology might be necessary, and a need for reevaluating our definition of high quality of life and reducing our standard of living.
Frustrations	Participants felt frustrated and hopeless about the climate crisis. They believed their individual impact was limited and that broader societal and institutional changes were needed.
Motivation and feelings	There were varied feelings regarding the climate crisis. Some were motivated by personal conscience, mentioned having climate anxiety, and found the situation bleak. Others struggled to prioritize climate concerns over personal desires.
Barriers to addressing climate change	The participants mentioned the main barriers being political barriers, financial considerations, both personal and industrial, technological barriers to developing climate-friendly solutions, and human resistance to change.
International cooperation	There was a general agreement that change needs to come from higher authorities and through political and international cooperation.
Norway versus the rest of the world	Participants expressed concern over Norway's failure to implement necessary changes, despite being a wealthy and highly educated nation. They highlighted the high consumption levels and climate skepticism within the educated population.
Possibilities for influence	Participants agreed that individual actions have limited influence, emphasizing the need for higher-level engagement. Some mentioned that individual changes can still have some impact by influencing others.

Staying updated on current politics	Interviewees varied in how much they stayed updated on current politics. Some felt they had a general understanding of political developments but lacked detailed knowledge, and that politics can be too complex to understand fully.
Political engagement	None of the participants were actively participating in politics. They thought the only way to influence policies was to become a politician.
Trust in politicians	Participants expressed a fairly high level of trust in politicians. Still, some had concerns about politicians hesitating to take unpopular actions, and their responsibility to govern effectively across various political areas in addition to climate.
Possibility of influencing politics	The interviewees agreed that politicians can influence change with the right political will. However, honesty and realism in political plans and a more realistic approach were considered necessary.
Everyday talk	Participants avoided discussing climate with friends due to negative outlooks, reluctance to lecture others, differing perspectives and knowledge, and lack of interest from friends. When discussed, it was typically among like-minded people.
Individual actions	The participants believed individual actions had a limited impact. However, the importance of open-mindedness and adaptation was emphasized. And that individual actions can influence others and promote environmental awareness despite small emissions effects.
Attitudes	Attitudes towards climate change varied. Some were motivated by personal experiences or literature, while others struggled with trade-offs between making "right" choices and questioning the impact of their actions. Climate anxiety was mentioned as a driving factor. The long-term effects of their actions made it difficult to relate.
Information	The interviewees felt they had a good overview of the climate situation, but stayed updated mostly through media coverage, which could be biased and presented with varying motivations. Opinions on the availability of information varied, with some finding it challenging to obtain.
Applications	Participants mentioned using the sustainability apps Finn, Tise, and TooGoodToGo, but none reported using any other climate-friendly apps.

4.1.2. Narrowing the Problem

The analysis of the interviews with young citizens revealed that all participants held a pessimistic outlook on the future with regard to climate change. They shared a common perspective that their individual capacity to effect change in this regard was limited, and recognized the necessity of structural changes and political involvement to effectively

address the crisis. However, the participants expressed limited trust in politicians' ability to implement the necessary policies, and most expressed skepticism about their own ability to influence political processes. They shared a common belief that the only way to influence politics effectively was through direct participation as politicians, a path they had no interest in pursuing. In addition, while climate information and an overview of climate policy were somewhat accessible through news sources, obtaining a comprehensive understanding proved challenging. Consequently, the problem was refined to the following:

Young citizens perceive sufficient policy measures as vital for resolving the climate crisis, yet they find participation and engagement in climate policy unappealing and with a high threshold.

The root causes discovered through the interviews are:

- Knowing how to engage in climate policy is not obvious
- Information on climate policy can be hard to navigate in
- Obtaining a comprehensive understanding of the climate situation is troublesome

From this problem definition, we further decided to conduct interviews with government officials to help uncover the root causes for the lack of involvement of citizens in climate policy and gain a deeper understanding of the issue from their perspective. It was also necessary to gain a greater understanding of how citizen involvement in the development of climate policies is performed today.

4.2. Analysis of Interviews With Government Officials

A description of how the interviews with government officials were conducted is elaborated in subsection 3.2.1. Given that the interviews conducted with government officials included people with diverse backgrounds and perspectives due to their work experiences, each interview was analyzed separately. This subsection presents the results of the analysis by outlining the main points and insights relevant to the problem and proposed artifact from each type of government official.

Climate and Environment Department in Trondheim Municipality

The representative from the Climate and Environment Department in Trondheim provided insight into the municipality's plans, goals, and strategies concerning environmental sustainability. They also talked about how they work with citizen involvement and their experiences regarding this.

The municipality is currently developing a new climate and energy sub-plan, which is expected to be available for public review later this year. In connection with this, several citizen involvement activities have been performed, such as hearings, climate evenings, visiting schools, and conversations with relevant actors from the business sector. Some

digital activities have also been performed, including the website "klimatrondheim.no", which is used for sharing information with citizens and promoting citizen involvement activities. The website includes the feature "Mitt klimatiltak", which allows all citizens to send their proposals for climate measures to the project group working with the new plan. The site was also used to promote an activity called "climate evening", where the citizens could download an activity plan created by the municipality, perform the activities with friends or family, and then send in the results through the website.

The experiences from the digital citizen involvement activities have been that it is hard to reach out to the citizens and make them engage. The representative shared that they got 35 suggestions through "Mitt klimatiltak", but most of them are things they are already doing. This shows they also have problems reaching out to the citizens with information about what they are working on and have already done. The climate evening initiative only got one response and was not a very successful measure. The representative noted that this type of initiative had been performed with greater success during other projects, such as urban development. So it seemed that the climate topic made it harder to get citizens involved, which also aligns with their previous experiences. The representative expressed that this could be because the topic is more distant for the citizens than, for example, urban development, and that this makes it harder for people to engage. But still, it is evident from citizen surveys performed by the municipality that people are very concerned about climate issues.

The interview also provided insight into some digital citizen involvement outside the project of creating the new climate and energy sub-plan. This included a digital map used for citizen suggestions on improvements around the city, which has been a successful tool. The representative stated that one reason for the success was probably that there were no requirements to log in or register as a user before sending a suggestion. In addition, the suggestions were regarding the physical surroundings of the citizens, which usually generates greater engagement than more distant issues like the climate.

Ministry of Climate and Environment in Norway

This interview was conducted with two employees at the ministry who provided insight into how the Norwegian government works towards achieving the climate goals and how they involve citizens in the process. The main responsibility of the Ministry of Climate and Environment is to carry out the environmental policies decided by the government [58]. The ministry acts as a secretariat for the current government and provides them with the necessary knowledge to make decisions and implement their policies.

Regarding citizen involvement, the employees explained that the Ministry of Climate and Environment use various activities to communicate with the public. The most common form of citizen involvement is that the Minister of Climate and Environment invites to an input meeting where citizens can present their opinions, suggestions, and concerns. However, the employees explained that it is challenging to receive concrete suggestions for policy changes in these meetings. The feedback received is often too general, commonly a desire for stricter climate policies, but without many concrete suggestions.

Written feedback for hearings is usually more helpful in providing specific and actionable recommendations. However, the employees emphasized that they get a lot of input in connection with hearings from larger organizations, but it is a more challenging involvement opportunity for individuals because there is a lot of information to familiarize yourself with to create valuable feedback. One example of this is the climate report which is 1300 pages. They mentioned that a challenge is, therefore, to find the correct format to receive feedback and make the process convenient to individuals as well as larger organizations. They have to be able to convey the knowledge foundation well so that it is possible to provide input on relevant parts of it, and in a way that is manageable and more accessible for individuals.

The employees acknowledged that climate policy is complex and can be difficult for citizens to fully understand. This makes it harder for people to provide relevant feedback that can be used to improve policy. They explained that it is important to communicate the technical aspects of climate policy effectively to enable the public to provide useful input.

According to the employees, although digital forms of citizen engagement exist, they are not widely utilized. However, they did cite "Klimautvalget 2050" as a successful digital initiative, which suggests that it is easier to integrate citizen input when the focus is on specific questions. They emphasized the need for a clear and relevant channel for public input to ensure that the feedback received is practical and valuable. Another example of digital initiatives today is "Miljøstatus.no", which provides information on the state and development of the environment in Norway, but does not have any citizen participation features. The employees explained that the Ministry of Climate and Environment also uses social media to reach out to citizens with information but that it is difficult to know the effectiveness of this.

Local politician engaged in climate politics

To obtain a greater understanding of how politicians work with developing climate policy and their communication with citizens, an interview with a local politician who possesses a particular interest in climate and environmental politics was conducted.

The interviewee elaborated on the different ways citizens can actively participate to impact local climate politics. This included getting involved in the policy development process of a political party. This policy framework determines the guidelines for how the political party will operate during the next period. Citizens can influence this policy plan by directly contacting local politicians, usually by reaching out to elected representatives of the municipality council and expressing their suggestions. External stakeholders are also integrated into the policy development process to provide the political party with insight into the community's perspective.

Another widely used possibility of exerting influence by citizens, according to the politician, is through email communication with elected politicians within the municipality council. Many citizens adopt this approach by sending individual emails to specific politicians or

collective emails to all elected officials in the municipality council. This method has a low barrier for citizens to exert influence and share their suggestions. Additionally, the politician mentioned that another method for influencing current politics is by contacting the administration and the municipal director.

Considering digital citizen involvement processes, the politician expressed that it was used sometimes, especially during the COVID-19 pandemic. Platforms such as Google Meet and online questionnaires were used to facilitate public participation, and many citizens submitted their input for hearings via email. There was also a combination of digital and physical meetings. However, these activities were mostly digital versions of physical citizen involvement methods, and there are no digital platforms that facilitate a continuous communication possibility between politicians and citizens.

Regarding the form of citizen input, the politician expressed that it is important to have concrete suggestions for changes or policies. It is important that citizens familiarize themselves thoroughly with the issue so they can provide very specific proposals if they want the best chance of getting their proposal considered. According to the interviewee, it is usually the ones with the most knowledge and the ones who are most prepared that gets their opinions heard.

When it comes to barriers regarding citizen involvement from the politicians' side, the interviewee considered the largest to be the amount of time and resources needed. The process of gathering information on citizens' opinions for a political party is often performed by hiring external entities to perform surveys or polls among the public. This requires extensive resources and is, therefore, often not prioritized. However, the interviewee believes that there should be more involvement of citizens in shaping party policies and local politics. The politician also mentioned that it appears that many people perceive a considerable gap between the public and elected officials and called for a lower threshold for citizens to reach out and communicate with their elected representatives.

The interviewee emphasized that there are some challenges regarding citizen involvement that specifically apply to climate politics. It was mentioned that the climate issue is more difficult to talk to people about because it requires a certain level of knowledge and understanding of the issue. The climate crisis is also a complex issue interconnected with many other areas, and all changes made will therefore have consequences that need to be considered and evaluated. Thematically, climate policy is also challenging because it is more distant for people compared to, for example, education policy, which feels closer to them and therefore generates more engagement.

4.3. Existing Solutions

To gain a comprehensive understanding of the state of existing solutions, a quick review of existing e-participation solutions and citizen participation initiatives was conducted. The aim was to assess the functionalities and limitations of the existing solutions already

available to the interviewees in the study, identify successful aspects, determine existing deficiencies, and pinpoint opportunities for enhancement.

The municipality of Trondheim has implemented various citizen involvement methods, as highlighted in section 4.2. *Klimatrondheim.no* serves as a platform for sharing knowledge, information, and promoting citizen engagement activities. The website uses Google forms to gather initiatives from citizens. A challenge identified by the municipality was the redundancy of ideas and initiatives already being worked on by the municipality. *Borgerkraft.no* facilitates citizen participation processes and is built using the open-source software Decidim [59]. However, the interviewee from the municipality expressed concerns about its lack of updates, project-specific focus, difficulties in navigating, and poorly structured interface of the Decidim software. *Trondheim2030.no* is dedicated to urban development and includes interactive maps for people to provide suggestions, although no specific comments were provided by the interviewee regarding this initiative.

A challenge we encountered during the review of these initiatives was that they were spread across various websites, making it difficult to be aware of the range of available initiatives and where to engage. Furthermore, all websites were experienced as challenging to navigate in and locate relevant information. Additional information often relied on external website links instead of being integrated within the websites themselves.

The Ministry of Climate and Environment had limited e-participation initiatives in place, as mentioned in section 4.2. Their primary approach to involving citizens was by inviting them to attend meetings, which often proved ineffective in generating actionable or concrete input. During the review of the website *Regjeringen.no*, which serves as a platform for communicating policy measures to citizens, including the Ministry of Climate and Environment's work on "climate and environment" [60], we found that the website contained an overwhelming amount of text. This made it challenging to quickly grasp the current focus areas, critical issues, ongoing actions, and future plans. While consultations were available as a form of e-participation, it was difficult to discern the opportunities to engage in these consultations and understand how to get involved [61].

Overall, while certain e-participation initiatives to engage with climate policy in Norway and Trondheim already exist, we consider these solutions to pose several limitations based on insights from the interviews and our own assessment. These include poor user interfaces, fragmented distribution of initiatives across multiple websites, an overload of information, and a lack of clarity regarding the participation process.

4.4. Identify Problem and Motivate

Through conducting interviews with young citizens and government officials, researching additional resources, and reviewing existing solutions and related work, the problem was refined and a greater understanding was gained. In this section, we define the problem by justifying the problem's importance, defining it precisely, and outlining its root causes.

The problem identification activity is described in section 3.1

4.4.1. Problem Definition

Climate change represents the foremost global challenge of our time. A recent UN report emphasizes the critical need for action and outlines that effective political measures are critical for communities to decrease or prevent the usage of carbon-intensive consumption methods [25]. A significant number of young citizens worldwide are increasingly frustrated by the perceived lack of action from politicians in implementing effective climate policy. In a recent UNICEF report, a large majority of 700 Norwegian children and young people responded that they feel anger, fear, and hopelessness due to climate change. A total of 62% of the participants believe that those in power in Norway are not doing enough to mitigate human-induced climate change, while 18% are uncertain about the government's actions in this regard [5].

Through interviews conducted with young citizens, it became evident that despite expressing concerns about climate change and acknowledging the necessity of appropriate policy measures, none of the participants displayed a strong interest or knowledge of how to effectively influence climate policy without entering politics themselves. It appears that there are limited, appealing, readily and easily accessible avenues for engaging in policy-making processes. Consequently, many young citizens become passive [15].

E-participation and digital governance have been seen as a promising way to involve citizens in political processes actively. The aim is to make policy more transparent and efficient and inform better decisions by the use of ICT to increase access and availability to participation [62]. Although e-participation and digital governance have been much studied by researchers through the years, there is a lack of research on the interrelationship between e-participation and climate change [14]. In addition, most e-participation initiatives do not live up to their expectations, and one of the most important reasons for the failure is the complexity of socio-technical systems, with the complex environment of democratic participation, and failure to meet stakeholders' needs [48].

The UN's E-Government Development Index 2022 reveals that Norway has significant room for improvement when it comes to involving citizens, being number 43 on the e-participation index list among 193 countries, between Ecuador and Saudi-Arabia, despite good conditions for digitization [63]. Although involving citizens more in political processes is desirable and several e-participation initiatives exist, there are several limitations to these. One issue is that input from citizens is often vague and not actionable unless they have spent a sufficient amount of time reading up on an issue and preparing a well-formulated idea or proposition. Suggestions for new policy need to be based on sufficient knowledge about the specific case and knowledge of existing policy measures. This makes the threshold for an individual citizen to impact policy alone high, compared to Non-Governmental Organizations and businesses. In addition, gathering information on opinions can require tremendous resources, and existing e-participation

initiatives hold several limitations such as bad usability, low participation rate, being costly to maintain, and being spread across various websites, making it hard for citizens to be aware that they even exist.

From the investigation of the problem and its root causes, the problem is narrowed and defined as two sub-problems, representing the undesirable current state of the environment for each stakeholder group included in the study. The diagram shown in figure 4.2 visualizes the root causes of the identified problems.

Current state:

- **Young Citizens** find participation and engagement in climate policy unappealing and with a high threshold.
- **Government Officials** find reaching out and gathering citizen input for climate policy challenging and resource-demanding.

Ideal state:

- **Young citizens** find climate policy accessible, transparent, and appealing to engage and participate in.
- **Government Officials** find reaching out and gathering citizens opinions' easy and efficient.

Although this study specifically focuses on young people in Norway, the issue at hand holds global significance and relevance for all demographic groups. However, the study deliberately concentrates on the younger generations due to their heightened vulnerability to climate-related impacts and challenges [4]. Additionally, existing literature suggests that young people should have increased influence over their environmental and climate affairs, along with greater involvement in citizen science initiatives [64]. Given that climate change represents the most critical global challenge of our era, coupled with the immense potential of e-participation, the pursuit of more engaging, efficient, and user-centered e-participation solutions to address climate change becomes a matter of major importance.

We will address the defined problem with the development of a "method artifact" or a prototype to obtain knowledge on design strategies to improve the current state of the environment and close the gap between the current and the ideal state.

4.5. Define Objectives of a Solution

To address the problems defined in section 4.4, a method artifact is developed. Methods are guidelines and processes on how to solve problems and achieve goals, and a method expresses prescriptive knowledge [51]. This type of artifact was chosen because the existing research was not mature enough for a working instantiation to be created, and due to the time frame of a master's thesis. Developing an instantiation of a solution with

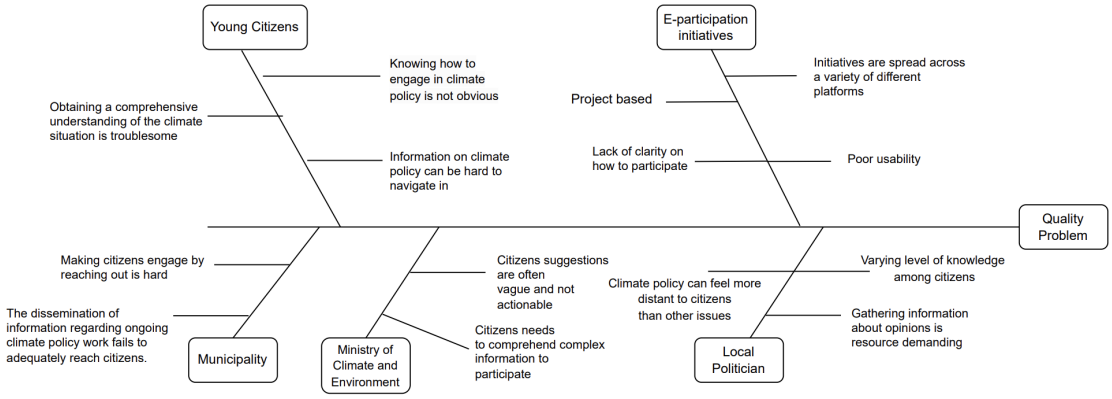


Figure 4.2.: Ishikawa diagram of root causes.

the desired level of complexity would demand significant additional time and resources [48].

The requirements in table 4.2 define the main functionality for the artifact that was considered necessary to address the problem, and the inspiration sources for each requirement.

FR5 and FR6 are the main functionalities for active citizen participation and citizen consultation. To facilitate citizen participation and engagement in shaping climate policy, the government can publish climate-related policy proposals and receive feedback from citizens. Additionally, to further enhance citizen participation and their sense of influence, the platform enables citizens to publish their own policy suggestions. This empowers individuals to contribute their ideas and perspectives to the policy-making process. Furthermore, citizens should be able to engage with each other's suggestions by leaving comments. These requirements aim to address the needs expressed by citizens in the interviews, highlighting the limited ways to impact politics and the frustration related to the structural challenges associated with climate change. The features are inspired by previous research [50] that emphasizes the integration of e-participation with the policy-making process and the influence of citizen input on decision-making for proposals.

Pietilä et al. [16] found in their study that anonymity was beneficial to enable youth to participate in discussions actively and to enable open discussion. The participants in their study also mentioned that anonymity could increase the risks of provocative discussions and trolls. To address this, FR8 defines the requirements regarding anonymity. The citizens should be able to be anonymous when interacting on the platform but still be required to authenticate themselves before given to option to interact. Regarding the level of anonymity, the artifact will display the age and occupation of the person but not their name. This will give other users some perspective of who the user is while maintaining the anonymity needed to enable open discussions.

Table 4.2.: List of Requirements

ID	Requirement Description	Inspiration source
FR1	The system should offer information and data visualizations on the status of the climate situation, which is reliable and quality-assured.	Citizen interviews, Scharl [65], Abu-Shanab and Al-Dalou [45], and Phang and Kankanhalli [47]
FR2	The system should enable citizens to share thoughts, have discussions, and interact with each other.	Citizen interviews, and Phang and Kankanhalli [47]
FR3	The citizens should be able to link to information sources related to their posts or policy suggestions.	Our own innovation
FR4	The system should enable content filtering based on location and level of governance.	Our own innovation and government officials interviews
FR5	The system should enable citizens to view policy suggestions from the government and share their opinions about the suggestion.	Citizen interviews and Royo et al. [50]
FR6	The system should enable citizens to suggest new policies and receive feedback from others.	Citizen interviews and Royo et al. [50]
FR7	The system should enable content filtering based on themes related to the climate issue.	Our own innovation and Pietilä et al. [16]
FR8	The system should provide anonymity for citizens when interacting on the platform, but still require authentication and contextual information.	Our own innovation and Pietilä et al. [16]
FR9	The system should enable the government to share the knowledge foundation for new policy suggestions.	Government officials user testing
FR10	The system should facilitate engagement in topics of interest based on the citizen's preferences.	Our own innovation and Pietilä et al. [16]
FR11	The system should showcase government interaction through labels.	Testing with local politician

Discussion forums can be a good contribution to e-participation platforms with the objective of information exchange and education and support-building [47]. Participation in political discourse through discussion forums may also increase citizens' opportunities to influence agenda setting, and the likelihood of considering all possible alternatives for tackling the problem [47]. To facilitate for political discourse through a discussion forum, FR2 was created.

To engage users it is important for the platform to present them with content they feel is relevant. The artifact should, therefore, enable citizens to filter the content. The requirements to accommodate this is described in FR4, FR7, and FR10. FR7 captures

the need for organizing content based on categories and allowing citizens to use these categories to filter content. In the study on youth's needs for e-participation services performed by Pietilä et al. [16], the researchers discovered user needs related to efficient and effective use, where search features such as filtering discussions were mentioned. As climate policy is a complex field, including a variety of different issues, we believe that categorizing the content into different parts of the climate issue makes it easier for the user to navigate and find relevant topics to engage in. FR10 facilitates engagement in topics of interest and relevance to the citizens and is also inspired by the study on youth's needs for e-participation services [16], which found that one of the main motivations to participate was personally interesting topics.

The governance in Norway is divided into three levels with different responsibilities; the state, the county municipality, and the municipality. The state serves as the national governing body, the county municipality represents the regional governing bodies, and the municipality represents the local governing bodies. All three levels of governance are responsible for different areas related to climate policy. To support the actions that can be taken on all levels, the artifact needs to accommodate differentiation based on the governance levels. This was also expressed by government officials during interviews as a necessary feature for the artifact. Additionally, it is necessary for users to be able to filter content based on location and not only the governance levels so that they can view the content for only one chosen county or municipality. This part of the requirement is inspired by our own ideas for the artifact. The need for accommodating different governance levels and filtering based on location is captured by FR4.

One recurring topic from the citizen interviews was the amount of information available and that climate issues are a difficult topic to discuss because people have different knowledge. Additionally, when creating new climate policies, it is important to base them on a good knowledge foundation. To address this, several requirements introduce the need for knowledge to be available on the artifact. FR1 is important because it creates common and shared knowledge on the state of climate change, which we believe is a necessity to facilitate good discussions and is also mentioned as a prerequisite for informed decision-making by Scharl [65]. Another important feature to facilitate good discussions is the possibility of linking to information sources to content. This is covered by FR3 and is inspired by our own ideas.

Two of the requirements were added after the first iteration of user testing performed with government officials, which is described in Section 6.1. When the government suggests new policies, they first gather the necessary knowledge on the subject from experts to make the best possible decisions. In the user testing with the representatives from the Ministry of Climate and Environment, they suggested that this knowledge should be shared on the site, together with the policy proposals, in a format that is understandable and not overwhelming to citizens. This requirement is captured in FR9. Additionally, to further increase citizens' feeling of influence, the artifact should clearly showcase proposals that have been successful by being approved or further pursued by politicians. This was proposed by the local politician during the first iteration of user testing, as

they believed that citizens would be more likely to sustain their engagement with the platform over time if it clearly demonstrated the impact of their contributions. This is defined in FR11.

5. Design and Development

This chapter describes the design and development phase of the specified artifact, which aims to meet the requirements outlined in section 4.5. The design and development phase comprises the four sub-activities: *imagine and brainstorm*, *assess and select*, *sketch and build*, and *justify and reflect* as described in further detail in subsection 3.1.2 [51]. Throughout this phase, there is a continuous iteration between constructing the artifact, evaluating it, and incorporating feedback to further refine the design [57]. The primary objective of the design and development phase is to generate and evaluate various design alternatives in accordance with the requirements until a satisfactory design is achieved [57]. Simultaneously, valuable knowledge is acquired during this phase, which can be translated into design principles [54].

Section 5.1 describes the methods and tools used in the process of designing and developing the artifact. Section 5.2 describes the artifact developed and how it is designed to address the defined requirements.

5.1. Design and Development Activities

5.1.1. Design Sprint

To facilitate the generation and selection of effective design alternatives, inspiration was drawn from the design activities outlined in the book *Sprint* by Jake Knapp [66], which presents the "Google Design Sprint" methodology. While originally created for solving critical design problems in business settings, we adapted this methodology for our research purposes. The design sprint approach employs highly visual techniques, utilizing whiteboards, sticky notes, pen and paper, and a system of "dots" for idea selection. The main objective of a design sprint is to rapidly generate and validate promising ideas in order to gain comprehensive insights into the design aspects of the most crucial problem at hand. Our adaptation of the design sprint was customized to fit within our available time and resource constraints, which is elaborated in the following sub-sections, as the original framework typically spans five days and involves multiple participants.

5.1.2. Imagine and Brainstorm

To set the proper focus for the generation of ideas, the desired long-term goal along with the stakeholders involved in the process were mapped out on a whiteboard. As

elaborated in section 4.4, the goal of the artifact was to make climate policy more accessible, transparent, and appealing to engage and participate in for young citizens, while providing valuable input to government officials. The defined problem and goal were directly addressed by the artifact requirements outlined in section 4.5.

To transition from high-level requirements of the artifact to concrete design alternatives, the design sprint provided practical methods for generating and sketching out ideas. We began by reviewing other solutions that address similar problems in different domains, drawing inspiration from platforms such as Reddit [67] with its forum features like discussion threads, up-voting, and topic-based interests to follow. Additionally, sources like Medium [68] with its clean and minimalist design, as well as "polls" and sharing posts on Twitter [69], contributed to the idea generation process. Throughout this phase, we incorporated empathetic thinking [51], ensuring that the needs of the stakeholders remained at the forefront of the ideation process. The focus during this stage was on expressing ideas on paper rather than emphasizing visual aesthetics.

5.1.3. Assess and Select

The subsequent design activity focused on the selection of the most promising ideas, employing convergent thinking to narrow down the solution space and eliminate less favorable concepts, while adhering to the defined requirements [51]. Studies have demonstrated that a combination of individual and group work is often advantageous for generating the best ideas [51]. In this phase of the design sprint, the generated ideas were presented on a whiteboard to facilitate their evaluation through a silent review process. We individually assessed the ideas and indicated our preferences by placing sticky dots on the whiteboard beside the respective concepts. This approach aimed to eliminate potential biases. Following, the ideas underwent a comprehensive critique and discussion phase, delving deeper into each idea, analyzing its strengths, weaknesses, and alignment with the artifact's requirements. This determined which concepts should progress further in the design process.

5.1.4. Sketch and Build

Sketch

The following sub-activities involved the iterative processes of sketching and building the artifact. The selected ideas from the previous sub-activity were combined into a cohesive storyboard, which served as a comprehensive representation of the artifact's envisioned features and interactions. The storyboard contributed to refining our understanding of the artifact, facilitating effective communication, and guiding further design efforts. Building upon the storyboard, a "high-fidelity prototype" was rapidly constructed using the web-based design tool Figma [70]. The Figma prototype served multiple purposes, including effective and detailed communication of the design and ensuring ongoing alignment with the artifact's development goals.

Build

Subsequently, the artifact was built utilizing the no-code tool Appfarm, which facilitated rapid development of a functional prototype. No-code/low-code development empowers software application development through high-level visual abstractions based on model-driven engineering principles [71]. The development process was guided by the high-fidelity prototype in Figma, with continuous refinement and adjustments during the development phase.

While Appfarm enabled the development of a fully functional artifact, our end goal was not to make a functioning artifact. Instead, we aimed to test ideas to guide the formulation of design principles that address the defined problem. Hence, the artifact was intentionally developed to simulate a realistic user experience, achieving only partial functionality. This approach reduced the time and effort invested in development and allowed us to focus more on testing and validating the ideas and design of the artifact.

To support the design and development process, we employed *pair design*, an agile development method in which both team members worked collaboratively to develop the artifact simultaneously [51]. Additionally, we utilized a *walk-through* method, that involves presenting and discussing specific parts of the artifact while other stakeholders and team members asked questions [51]. Our supervisors, each other, and other master's students participated in these walk-through sessions.

5.2. Artifact Description

This section describes the artifact developed and its behavior, with focus on how the requirements described in section 4.5 are implemented. The artifact was named "Accel", as in "acceleration" of the net-zero transition. As the artifact went through several iterations, the artifact presented in this chapter is the artifact from the second iteration described in section 6.3.1, which was the final iteration performed before formulating the initial design principles. A complete list of the requirements with a more detailed description and an ID can be found in table 4.2. In the following section, each requirement will be referred to by the corresponding ID.

Figure 5.1 showcases the discussion forum, which facilitates a way for users to engage in discussions and share information. The forum represents the primary feature to address FR2, providing various interaction options with varying thresholds to encourage active engagement from a diverse user base. Users have the ability to publish posts encompassing a wide range of content, including thoughts, questions, tips, or any other information they wish to share. Other users can then engage in the conversation by commenting on and up-voting these posts. Furthermore, the forum offers the functionality to create polls, enabling data collection in a structured format that is more easily processed on a larger scale compared to free-text posts. The option to vote on polls also presents a more accessible interaction opportunity for certain citizens since it has a lower engagement

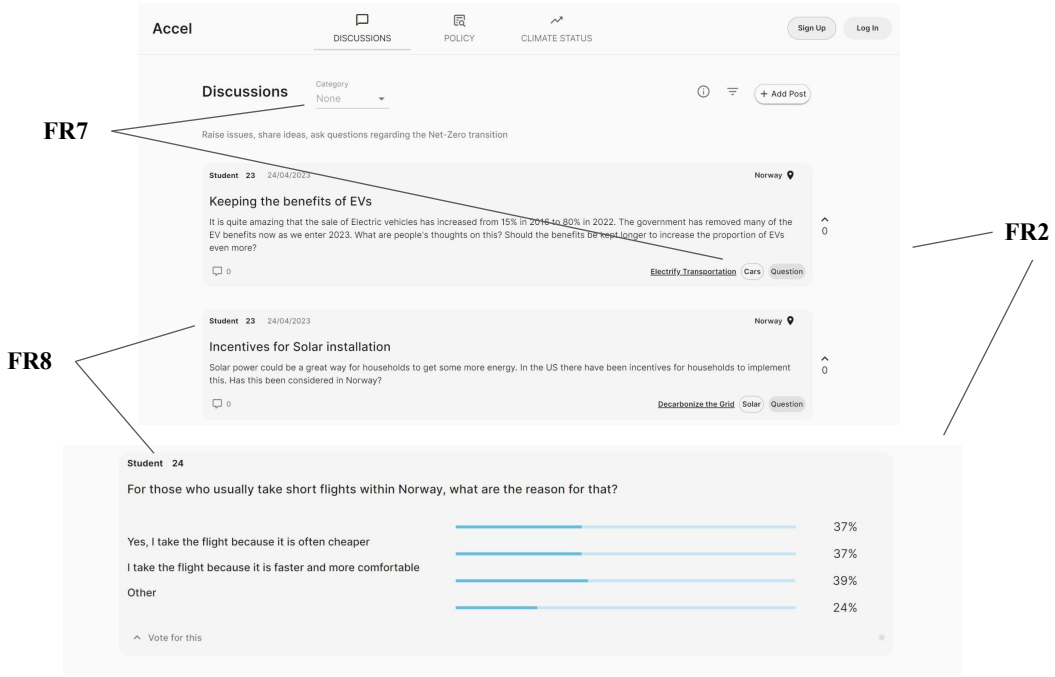


Figure 5.1.: FR2, FR7, and FR8 - The discussion forum page on the artifact.

threshold.

In accordance with the requirements outlined in FR7, the platform accommodates the filtering of content based on categories, thereby enabling content customization for citizens. This feature is implemented by allowing users to select a category, and potentially a sub-category, at the top of the discussion site.

Moreover, Figure 5.1 serves as a visual representation of the realization of user anonymity, as specified in FR8. Notably, the discussion posts exhibit information regarding the occupation and age of the respective users, while deliberately withholding their personal names, thus preserving their anonymity.

Figure 5.2 presents the implementation of the active citizen participation and citizen consultation component within the platform, addressing the requirements specified in FR5 and FR6. In Figure 5.2a, the page dedicated to government proposals is shown, thereby addressing the requirement FR5. To demonstrate an implementation to address FR11, the example proposal put forward by "Miljødirektoratet", shown in Figure 5.2a, is marked as "approved." This labeling serves as an informative indication for users, signifying that the policy proposal has received official approval from the government and has been effectively implemented.

Figure 5.2b showcases the incorporation of citizen policy suggestions, which serves as

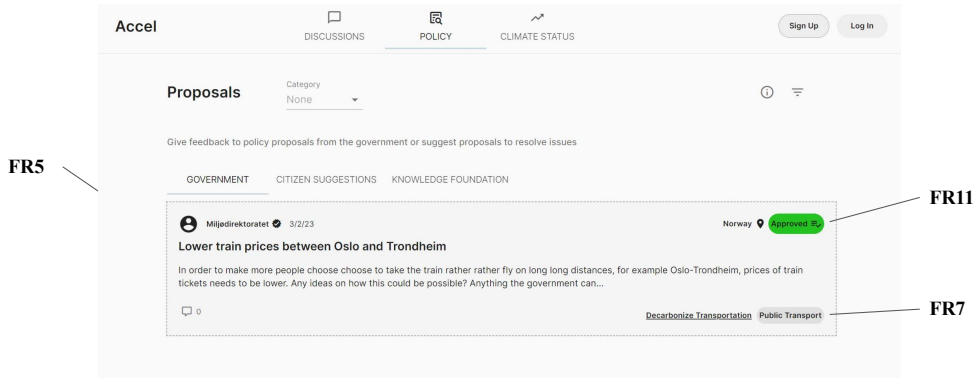
the realization of FR6. These citizen suggestions contribute to the active participation of citizens in the decision-making process through the platform. Both the citizen suggestions and the government proposals can be filtered based on categories to support the requirement specified in FR7. Furthermore, they are also marked with location labels to address requirement FR4. This feature allows users to determine not only the geographical location but also the corresponding level of governance to which each proposal is targeted.

Whenever the government puts forth new policies, they collect relevant information about the topic from experts. In accordance with FR9, this knowledge should be made accessible on the platform, facilitating citizens' ability to peruse this information prior to creating new proposals or providing feedback on existing ones. Figure 5.2c portrays this knowledge base for the selected category and showcases how this is integrated into the platform.

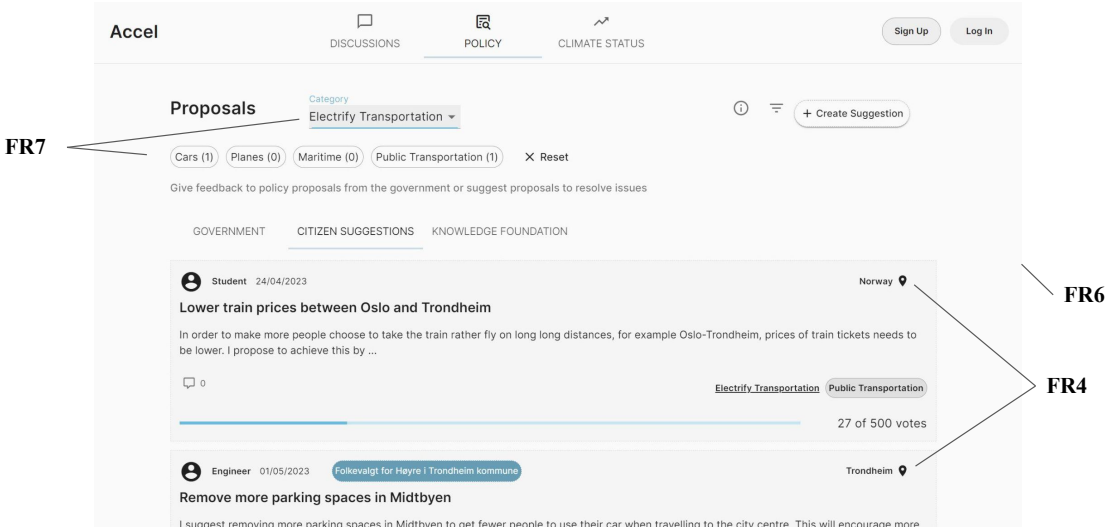
The dialog for creating a new discussion post is shown in Figure 5.3 and consists of two main elements. The left section of the dialog is dedicated to the main content of the discussion posts. At the bottom of this section, there is a specific field enabling users to include links to relevant information sources as references. This feature is designed to fulfill the requirement outlined in FR3. The right side includes functionality related to FR4 and FR7. Users are asked to indicate a geographical location for their post, such as a city, county, or the entire country. This feature serves a dual purpose: it meets the requirement of including location-based information and corresponds to the relevant governance level being discussed, addressing FR4. Additionally, users are prompted to select a category from a predefined list that is consistently used throughout the platform. This feature supports the requirements specified in FR7 by enabling users to filter content based on these categories on both the policy site and the discussion page. Further down on the right side, users can add additional "tags" to further specify the content of their post, also facilitating content filtering.

Figure 5.4 illustrates the implementation addressing requirement FR1, which entails the platform's inclusion of information and data visualizations describing the state of the climate. This functionality serves two primary purposes. Firstly, it allows users to stay updated on the current status of the climate, ensuring they have access to recent information. Secondly, it provides a reliable and consistent information source that users can utilize as a reference in discussion posts, policy suggestions, or comments.

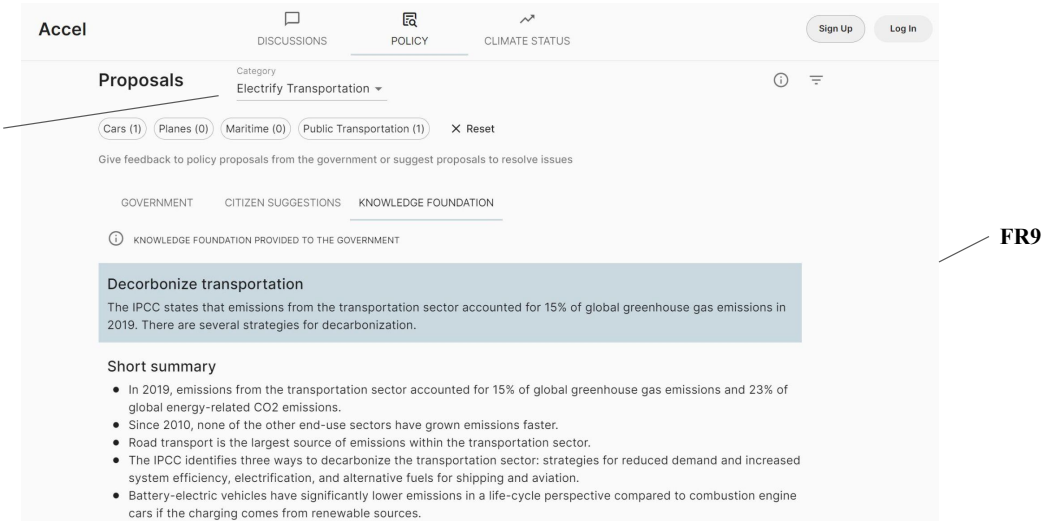
FR10 describes the requirement for engagement in topics of personal interest. This was implemented through a "personalization feature", inspired by existing social media and forum sites. The feature allows citizens to select interests when registering as a new user, as shown in Figure 5.5.



(a) FR5, FR7, and FR11 - Implementation of government policy proposals.



(b) FR4, FR6, and FR7 - Implementation of citizen policy proposals.



(c) FR7 and FR9 - Implementation of knowledge foundation.

Figure 5.2.: Policy proposals page on the artifact.

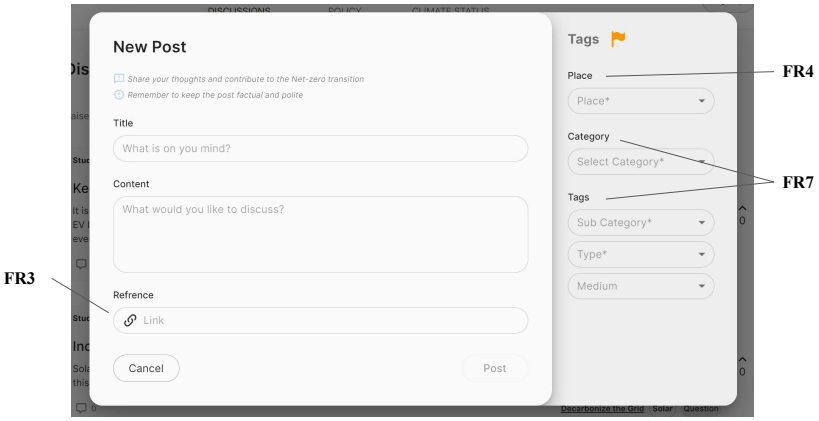


Figure 5.3.: FR3, FR4, and FR7 - Implementation of creating a new discussion post.

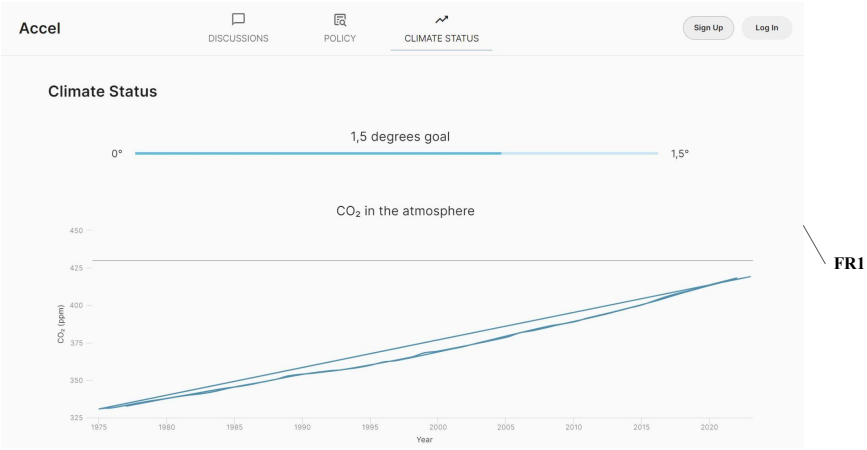


Figure 5.4.: FR1 - Implementation of climate status information.

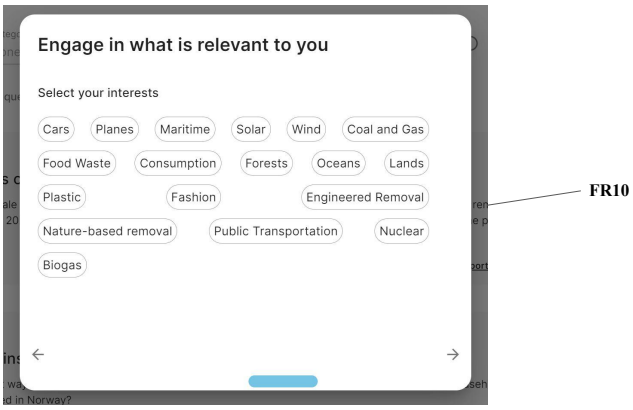


Figure 5.5.: FR10 - Implementation of personalization feature.

6. Demonstration and Evaluation

This chapter describes the results of the demonstration and evaluation of the artifact. Additionally, design principles and design propositions are outlined based on the findings.

The artifact was demonstrated and evaluated in two iterations; one with government officials and one with young citizens. As explained in subsection 3.1.2, the evaluation of the artifact was formative, hence the feedback was used back in the design process. The goals of the evaluation were to determine to what extent the artifact is effective for solving the defined problem, evaluate the utility of the requirements of the artifact, identify opportunities for improvement in further design, and formulate appropriate design principles.

The study follows the evaluation strategy selection framework by Venable et al. [72], and the evaluation is, based on the framework, categorized as a naturalistic and ex post evaluation. A combination of artifact demonstration and a semi-structured interview was chosen as appropriate evaluation methods, as described further in subsection 3.2.2.

The rest of this section proceeds as follows. Section 6.1 presents the demonstration and evaluation of the artifact from the first iteration and a description of to what extent this edition of the artifact is effective for addressing the problem. Section 6.2 presents the updates made to the artifact based on the results from the first iteration, the demonstration and evaluation of the artifact from the second iteration, and a description of to what extent the updated artifact is effective for solving the problem. Section 6.3 describes new updates made to the artifact based on the results from the second iteration and the ideas for design principles, and presents the demonstration of the initial design principles. Finally, it presents and elaborates on five final design principles along with three design propositions, and the process of refining and validating them.

6.1. Iteration 1: User Testing With Government Officials

6.1.1. Demonstration With Government Officials

User testing with government officials of the developed artifact was performed as the artifact demonstration in the first iteration, with the same participants as the initial interviews. This included two employees at the Ministry of Climate and Environment, one employee at the Climate and Environment Department in Trondheim Municipality, and one local politician engaged in climate politics. The method for the testing is described

in subsection 3.2.2. After the demonstration was performed, the results were analyzed using a thematic analysis approach, as described in subsection 3.3.1. The rest of this section will describe the evaluation of the artifact, which includes the outcome of the analysis.

6.1.2. Evaluation With Government Officials

Policy page

The Ministry of Climate and Environment employees emphasized the benefits of making existing information more accessible and engaging through this page. They expressed that the policy page is beneficial since it allows citizens to provide feedback on proposed measures, thereby facilitating a less formal approach to the decision-making processes. They recommended linking the artifact to the knowledge base that policymakers rely on, enabling the extraction of essential knowledge relevant to individual users. Additionally, they highlighted the need for the artifact to provide information on the behavioral changes required to transition to a low-carbon society. This way, such information could be easily accessible on the platform and reach a wider audience. Additionally, they mentioned liking that the policy page allows for filtering between government and citizen policy suggestions and between the different categories.

The employee from the Climate and Environment Department at the municipality expressed the need for receiving feedback on specific projects, which this part of the platform could support. They also liked that this page could be used to present current policy proposals and receive concrete feedback on their ongoing processes.

The local politician provided valuable insights regarding the differentiation of proposals from governmental administration versus those from elected representatives. They proposed separate tabs for each category, one for citizen proposals, one for governmental administration, and one for individual suggestions from elected representatives, to distinguish between them clearly. The local politician emphasized the importance of having a dedicated tab for proposals from elected officials because it would allow for the development and testing of new policies by letting citizens vote on them. To ensure transparency, they recommended including detailed information about the proposing representative, such as their full name, party affiliation, and the level and location of the elected official.

Discussions page

Both participants working with local politics mentioned that the discussion page would be useful for them. One emphasized the importance of focusing on local issues and aligning them with the themes outlined in the city's climate plan. Additionally, they highlighted the need to receive feedback specifically on topics related to local climate politics for it to be useful to them. The participants working with national politics were somewhat more skeptical about how they could use this discussion page in a way that provided value to them because of the large amount of content it could potentially generate. However,

they liked the possibility of creating polls more than open-text discussions and comments. All participants expressed concern about the potential of provocative discussions and trolls when users are allowed to write freely and the need for moderating the content to prevent this.

Climate status page

All participants agreed that there is a need for knowledge on the platform. Still, there were varying opinions on whether the climate status page and the way it was implemented in the artifact, is the best way to convey the knowledge. One participant expressed, "This one is very important". Another mentioned that the page should have climate emissions at the top, how they have developed since 1990, and how much the emissions need to be reduced to reach the climate goals. It was also mentioned that this page could be used to convey the graphs and information from the climate status and plan reports created by the Ministry of Climate and Environment each year to inform the government.

Format of citizen-generated data to provide value

The participants had varying opinions of what form of citizen-generated data provides value and can be utilized by the government. However, all participants liked the possibility of receiving concrete feedback on government policy proposals.

The representatives at the Ministry of Climate and Environment emphasized the challenge of managing open-text contributions due to the potential for non-constructive comments and the overwhelming volume of data. As a consequence, when dealing with a large volume of data, the contributions will need to be filtered and summarized before presenting them to politicians, which can result in citizens feeling unheard and their suggestions being overlooked. One possible solution is incorporating structured voting mechanisms to gather feedback and prioritize ideas. This approach offers a more manageable way to analyze public sentiment and avoids the need for extensive moderation. Additionally, allowing users to vote on proposals in the knowledge base enables them to express their preferences and highlights which measures should be prioritized by the government. Using voting systems and up-votes can provide valuable insights without relying solely on lengthy comment sections.

The local politician acknowledged the value of policy proposals, discussions, and voting. However, they noted that it is important to highlight the good and relevant suggestions that can be realistically addressed. There was concern that the abundance of data might overshadow many of the valuable proposals, resulting in a lack of actionable outcomes for elected officials. The up-vote/down-vote system was mentioned as a feature that could potentially address this issue by ensuring the most impactful suggestions rise to the top. The participant expressed interest in actively participating in discussions, potentially through inquisitive engagement, to gain greater insights into public opinions. Additionally, it was mentioned that exploring policies and decisions made in other municipalities could provide valuable perspectives and ideas.

The employee from the Climate and Environment Department at the municipality said

discussion posts and comments would be valuable for them if they were associated with an ongoing process.

Challenges and Barriers to Success

The main challenges for the system are the amount of resources needed to create and maintain it, which was mentioned by all participants. Additionally, all participants expressed the need for moderating the content published by citizens, especially in the discussion part of the system. It was mentioned the importance of reaching out to citizens with information about the system to get as many as possible to use it. Ensuring meaningful engagement without turning it into a "dumping ground" for contributions would be crucial. A challenge mentioned was also keeping the system updated because if not, it would make it less appealing for citizens to use it. One recurring topic during the interviews that could also be a challenge is the general public's lack of knowledge about the responsibilities of the different governance levels in various areas.

Other

The representatives from the Ministry of Climate and Environment mentioned that it is important for the ones that are the recipients of the citizens' suggestions to be the ones "owning" the platform. One participant also mentioned that the European Union is implementing many good measures regarding climate policy, and it would also be a good supplement to incorporate updates in these measures on the platform.

6.1.3. To What Extent Is the Artifact Effective in Addressing the Problem

The current state of the problem for the government official stakeholder group, explicated in section 4.4, was defined as "government officials find reaching out and gathering citizen input for climate policy challenging and resource-demanding". The ideal state was defined as "government officials find reaching out and gathering citizens opinions' easy and efficient".

The feedback on the concept, in general, was primarily positive. Three of four government officials mentioned that a system like this would be valuable and is missing. One of the participants from the Ministry of Climate and Environment in Norway marked, "If dedicated resources were allocated to this, I believe it could be great."

The local politician from Trondheim stated, "I believe that allowing citizens to submit proposals is what seems most impactful for them and can lead to success because the sense of impact generates engagement." In addition, they pointed out, "Conducting surveys to gather people's opinions costs a lot of money, so it is often deprioritized. Using something like this to receive feedback on, for example, which policies should be included in the party program, would be valuable."

In addition, the Ministry of Climate and Environment representatives emphasized the benefits of making existing information accessible and engaging through this page. The

local politician also emphasized that gathering everything happening in climate policy in one place is good. “If it is possible to retrieve information (perhaps automated) about what is happening and being decided at different levels and places, and gather it in one place, it would be a useful tool for many.”

The participant from the municipality expressed that there is a need for new ways to engage citizens in the development of policies but said it is difficult to determine if this type of system contributes to that. They also expressed the need for receiving feedback on specific projects, which this platform could support. They liked that this system could be used to present current policy proposals and receive concrete feedback on their ongoing processes.

6.2. Iteration 2: User Testing With Young Citizens

6.2.1. Artifact Updates

After the evaluation with government officials was performed and analyzed, we iterated back to activity 3, *design and development*, to attempt to further improve the effectiveness of the artifact [19]. First, the requirements were updated based on the evaluation from the first iteration. This resulted in the addition of the requirements FR9 and FR11. Afterward, the artifact was updated, incorporating the new requirements and other findings from the evaluation. The rest of this subsection presents the new features implemented in this iteration. Further details on how the requirements were implemented and figures of the artifact were described in section 5.2.

Integrating knowledge base

Requirement *FR9 - The system should enable the government to share the knowledge foundation for new policy suggestions* emerged from the user testing with the representatives from the Ministry of Climate and Environment. They expressed that the knowledge base created to inform the government to support them in creating new policies created by experts in the related fields could be available on this site. The knowledge foundation is published and available to everyone today. Still, it is usually a very long report and requires extensive time and effort to comprehend the content. Therefore, it is mostly representatives from the business sector and advocacy groups that provide feedback during hearings. It could therefore be beneficial to integrate this knowledge on the platform and present it in a way that is comprehensible to individuals and does not require extensive prior knowledge of the field to be understandable.

"Approved"-tags on proposals

Requirement *FR11 - The system should showcase government interaction through labels* was proposed by the local politician during the first iteration of user testing, as they believed that citizens would be more likely to sustain their engagement with the platform over time if it clearly demonstrated the impact of their contributions. This was

implemented in the updated artifact by adding a label with the text "Approved" to some of the policy proposals.

6.2.2. Demonstration With Young Citizens

The demonstration in the second iteration was performed with young citizens with the updated artifact. The method for the testing is described in subsection 3.2.2. After the demonstration was performed, the results were analyzed using a thematic analysis approach, as described in subsection 3.3.1. The following subsection will describe the evaluation of the artifact, which includes the outcome of the analysis.

6.2.3. Evaluation With Young Citizens

Discussion Page

The discussion page was introduced as the second page during the user testing session, following the welcome page. Participants had varied initial reactions, with some comparing it to a Facebook group or Piazza, while others expressed uncertainty about what they would discuss. However, one participant mentioned liking the discussion page, as they often feel "small" in discussions and appreciated a discussion forum on a platform dedicated specifically to the climate issue, making it feel more significant than Facebook in that regard.

Policy Proposal Page

The participants all agreed that the "policy page" holds the greatest importance and appeal. One participant explicitly mentioned that it offers something concrete and tangible, representing an authoritative process rather than just arbitrary user opinions. Several participants emphasized the value of gaining insights into policymakers' thoughts and actions, noting that it can be challenging to stay informed about their perspectives consistently, making the policy page highly useful. They found it intriguing to see actual proposals and appreciated the opportunity to have their opinions heard and make an impact in a straightforward manner. The policy feature, according to one participant, allows individuals to address specific issues and receive feedback on their policy proposals.

When comparing the policy-proposal page to the discussion page, many participants pointed out that the latter seemed more like a typical comment section susceptible to spamming, while the former provided a platform where meaningful impact could be made. One participant remarked that the discussion page resembled a generic comment section akin to those found on news websites, while the policy page facilitated concrete actions that could be commented on. This aspect brought a sense of enjoyment, as participants felt their contributions could genuinely make a difference. Another participant took some time to understand the distinction between discussions and policy but ultimately concluded that the policy page was of paramount importance; "this has to be the main

page. It is the foundation for the discussions in a way. There is no point in discussing without having a basis for discussion."

Knowledge foundation

The majority of participants expressed the need for a dedicated "knowledge page" within the platform. In the prototype, a feature called the "knowledge foundation" was implemented, which served as a third bar alongside the policy section. While two participants appreciated this feature, others suggested that it should be placed at the top bar and potentially integrated with the climate status page. One participant who liked the "knowledge foundation" feature mentioned "policy" and "knowledge foundation" were the aspects that appealed to them the most, as they often struggled with connecting existing knowledge to ongoing discussions; "I feel like today these two things are what I struggle with the most; to just tie knowledge to what they are discussing today. Because I don't know everything, which is why I listen to podcasts and things like that".

Climate Status Page

The majority of participants agreed that having a feature to stay updated on the current climate status was useful, and they also emphasized the importance of data presentation and visualization. Some participants expressed that the current graphs primarily showing temperature rise lacked informative value. They suggested that it would be more impactful to focus on the consequences of not achieving climate goals and make the page more interactive and relatable. For example, displaying scenarios like "what happens if we don't reach the climate goals" or showcasing specific impacts on cities, such as the reduction in ski days from 57 to 20 in Trondheim.

Furthermore, three participants highlighted the potential for integrating or combining the climate status feature with news or reports. They mentioned that news items often come at different times, and having a summary of everything over time would provide informative and convenient updates. One participant suggested diversifying the information by not solely focusing on CO2 levels, but also including news on positive developments and the reasons behind them. Another idea proposed was to integrate the "knowledge foundation" more prominently into the climate status page. This would allow users to access additional information and insights about the climate status.

Linking content and information

Two participants emphasized the importance of linking content and information across different pages to the policy proposal section. One of them suggested linking relevant information or research from the "knowledge foundation" or "climate status"-page and connecting discussions to specific proposals, believing it would be valuable to refer back to well-informed discussions that had taken place on particular topics. Additionally, they highlighted the challenge of dealing with conflicting information and proposed that linking to research or authoritative sources could help address this issue. Moreover, incorporating "info markers" in the proposals that would link to relevant sections of the climate status or knowledge page, could enable users to delve deeper into the topic if

they desired.

Anonymity

The participants held divided opinions regarding anonymity on the platform. Two participants expressed a positive view, highlighting the benefits of anonymity. They believed it would lower the barrier for suggesting unpopular opinions and appreciated the idea of not leaving public traces everywhere. One participant mentioned, "I think I would like it just because I'm that kind of security student who doesn't like to leave too many traces, I like to be a little anonymous, I don't like my name to be everywhere."

On the other hand, two participants were against anonymity or did not see its purpose. They argued that individuals should take responsibility for what they post and that including their names could add credibility to their contributions. One participant acknowledged both perspectives, recognizing that anonymity might lead to the posting of undesirable content from internet trolls, but also acknowledged the need for anonymity to ensure that the threshold for people to share their thoughts does not become too high.

A middle ground was proposed by three participants, suggesting optional anonymity or varying degrees of anonymity. For instance, users could choose between using their full name or providing a more general identifier like "male, 47 years old from Trondheim." One participant emphasized that having some basic information about the person's location could potentially add value compared to just anonymous labels like "student."

Verification

User verification emerged as an important feature. Three participants highlighted the need for verifying users' identities and positions to increase credibility. They proposed a "verified user" status displaying information such as employment or field of expertise, similar to the "verified tag" used on social media platforms. Suggestions were also made to incorporate secure electronic IDs like "MinID" or "bankID" during sign-up and login for enhanced security [73], [74].

Personalization

Participants held mixed opinions on personalized content. Some expressed skepticism and raised concerns about the drawbacks of personalization, such as potentially missing out on discovering new topics by only being exposed to what aligns with their existing interests. One participant also pointed out that they appreciated the idea of the page being similar for everyone. Another participant highlighted the interconnectedness of various topics and questioned the significance of personalizing content to a few specific topics, stating "I understand the idea, but I think things influence each other in any case. So whether it's the car industry or fashion that has the highest footprint, it doesn't matter to me. My goal is to understand how much (CO2) we use in total." However, there was one participant who expressed positivity towards personalization, acknowledging that filtering out certain content based on personal interests could be beneficial, especially when there is a particular area of interest.

Structuring of Content

The participants emphasized the importance of having an organized and easily navigable site for it to be a success. One participant expressed a desire for a structured layout, differentiating it from social media platforms with random posts and the need for extensive searching. Another participant referred to the EU's website and the challenge of obtaining a clear overview due to numerous policy changes, stating, "You have to make sure it's not too much to understand for ordinary people".

Regarding how the content should be structured, participants had differing ideas. Some emphasized the significance of search functionality and filtering options to find relevant themes and topics, and the ability to follow individuals with similar interests. In terms of the policy proposal site, one participant suggested organizing proposals based on phases or status, similar to a Kanban board or timeline, rather than a lengthy list.

The solution already included categories and subcategories to facilitate navigation and content discovery. However, participants expressed skepticism about categories, noting issues such as uncertainty about which category certain posts fit into or the limitations they might impose. Some participants proposed the use of tags instead of predefined categories, allowing users to have more freedom and avoid stifling creativity. One participant mentioned the advantage of user-generated tags to promote inclusivity and unrestricted expression.

Moderation

The risk of spam and trolls was a common concern raised by all participants during the interview. One participant mentioned that the platform's moderation and whether or not they encounter inappropriate content would be the key factor that would determine their trust in it. Another suggests that the prevalence of irrelevant content may require deletion, but acknowledges the drawbacks of that approach as well.

Usage

Regarding usage, three participants expressed their intention to primarily use the platform for staying informed about political matters. They emphasized the need for factual information and saw it as an information hub. In terms of participation in discussions, all participants were uncertain about actively posting their own content. Several pointed out that they would "like" or "up-vote" posts that aligned with their views to drive change, rather than posting things themselves. One participant mentioned that they would likely only post if they had a specific idea that could drive change. Participants also expressed curiosity about reading others' opinions and engaging with comments on proposals and issues. Polls were highlighted as a valuable interactive feature, providing immediate responses and numbers behind what people are curious about. Participants also recognized the platform as an opportunity to pose critical questions to politicians and hold them accountable. They saw it as a chance to address overlooked topics and challenge the status quo. Additionally, one participant noted that the platform could serve as a useful tool during elections for gaining an overview of political dynamics.

Themes and Topics

When considering themes and topics for engagement, two participants emphasized issues that directly affected them on a personal level, such as travel or driving. Two other participants expressed the need for larger-scale matters. One participant mentioned offshore wind as a significant topic, while another highlighted national policies concerning electricity production.

Government-run platform

All participants agreed that it would be beneficial for the government to operate such a platform, citing the high level of trust in the Norwegian government. However, they also raised some potential concerns. One participant mentioned the risk of the state using the platform to portray itself positively, although this may not be an issue in Norway. Another participant questioned the government's ability to effectively manage the platform, considering the perceived slowness of state-run initiatives compared to industry counterparts. The question of whether the government should handle the platform internally or engage external consultants was also raised as an important consideration.

Looks

Opinions on the platform's aesthetics and design varied among the participants. One participant appreciated the clean and user-friendly interface, although they did not immediately associate it with climate change. They stated, "It's very clean and easy to use, which is important. However, I wouldn't have immediately linked it to climate change." On the other hand, a couple of participants found the natural and colorless design somewhat dull but acknowledged the advantage of its association with a government feel. One participant noted, "The gray color increases trust and gives it a government-like vibe."

Faith

The participants expressed a moderate level of optimism regarding the platform's potential to accelerate structural changes for the net-zero transition. They emphasized the importance of government involvement and the need for a substantial user base to establish trust and credibility. One participant stated, "I have a lot of faith actually. Having the government on board and gaining their trust would be crucial for gaining trust in the platform as a whole. Without that, it could be challenging."

Government engagement with citizen generated content

The "Approved"-label on policy suggestions, showcasing active government engagement by communicating that the government has approved the suggestion, was noticed by some of the participants during the user testing but not everyone. However, those who did notice the label mentioned it as a valuable feature to motivate citizens to use the platform because it increases the feeling of having a real impact.

6.2.4. To What Extent Is the Artifact Effective in Addressing the Problem

The current state of the problem for the young citizen stakeholder group, explicated in section 4.4, was defined as "young citizens find participation and engagement in climate policy unappealing and with a high threshold". The ideal state was defined as "young citizens find climate policy accessible, transparent, and appealing to engage and participate in".

All five participants belonging to the stakeholder group "young citizens" recognized the concept's potential to reduce barriers to participation and engagement in policy-making. They expressed their views on the concept, using terms such as "cool," "nice," "interesting," and "exciting." One participant mentioned the possibility of fostering more direct democracy, which could be crucial for the future. Another participant believed it would benefit individuals who need to express themselves, as it may address their concerns about being heard.

Furthermore, it was highlighted that consolidating various avenues for participation in climate-related matters into a single platform would lower the entry barrier and simplify engagement; "if one wants to engage in climate policy today, one must pursue it actively. This requires going into the knowledge side, reading the news, and seeing what's happening. There are several platforms one must consider. Here, I believe everything is gathered in one place." Another participant stressed the importance of politicians and the government connecting with the general public and suggested that the concept could enhance people's sense of ownership by allowing them to participate in and influence decision-making. One participant noted, "I think a small person can feel important in the discussion because it is so easily accessible, and one is somewhat anonymous behind it."

Overall the participants expressed moderate optimism regarding the artifact's potential to affect structural changes for the net-zero transition by facilitating citizen participation. While most participants stated that they did not believe they would use the platform to publish proposals or start discussions themselves, they liked the idea of being able to read other people's opinions, react to policy proposals, up-vote what they agreed with, and express their views through polls.

6.3. Formulation of Design Principles

Drawing upon insights from the evaluations of the artifact, inspiration from related work, the design process, and the artifact itself, we formulated six initial design principles and two design propositions. Some of the design principles and propositions build upon the initial requirements, while others are derived from other findings during the evaluation. These encompass knowledge generated in the study and serve as guidelines to inform and enhance future design efforts within related contexts. The design principles were

implemented into the artifact and subsequently evaluated through a final demonstration to revise and refine them. Following the demonstration of the proposed design principles, one principle was updated, and another was reformulated into a design proposition. This resulted in five final design principles and three design propositions which are presented in subsection 6.3.3 and subsection 6.3.4.

6.3.1. Artifact Updates

In accordance with the proposed design principles and in response to the findings from the second iteration of user testing, specific updates were made to the artifact. These updates did not entail significant changes to the requirements themselves, but rather focused on refining how the existing requirements should be implemented within the artifact.

Several participants were skeptical of the use of predefined categories for user-generated content. To address this, free-text tags were implemented instead as a means of facilitating content filtering while providing users with greater freedom in categorizing their content. This solution is also more suitable for addressing the diverse and complex issue of climate change. The participants emphasized the importance of linking to sources to support arguments and policy suggestions. The possibility of linking to external sources when creating a post was implemented before the user testing. However, the artifact was, after the second iteration, updated to visualize the opportunity to add multiple sources and link to content such as files, and other content in the system such as previous discussions.

The participants had varying opinions regarding anonymity on the platform. Optional anonymity was therefore implemented in the updated artifact, allowing citizens to choose between using their full name or only presenting age, location, and occupation when posting and interacting with content. The knowledge foundation, presenting the foundation on which government policy proposals are based, was moved to a "pop-up" that can be accessed from each proposal. Additionally, the concept of communicating to citizens the government's activity on the platform to increase their feeling of influence was incorporated further after this iteration. In addition to the "approved"-label that will be visible on citizen suggestions that have been accepted by the government, a "Seen by Government"-label and "In Consultation"-label was implemented.

6.3.2. Design Principles Demonstration

A final demonstration of the proposed design principles was conducted to gather feedback to validate, refine and revise them. The feedback on each implemented design principle is summarized in table 6.1 where "+" indicates positive feedback, "-" indicates negative feedback, and "+/-" indicates a combination. All design principles are explained in detail in subsection 6.3.3 along with their rationale. While most of the implemented design principles received primarily positive feedback and have been retained in the final

list of design principles, one was rephrased, and another was reformulated as a design proposition.

DP1: Enhanced Content Categorization and Filtering Through Tags

Using tags rather than predefined categories for structuring content, was generally favored by all participants in the demonstration. One participant pointed out that there is an advantage in having multiple tags available, so you can filter in more detail. Another benefit pointed out was the ability to combine different tags, and filter with union or intersection to find content of interest.

DP2: Transparent and Responsive Government Engagement

Receiving feedback on the government's engagement through labels was seen as a good way to increase citizen engagement by all participants. One participant pointed out that the implementation of this requirement can be risky, and depends on active government engagement; "If it is done well, it can boost engagement, but if it is poorly executed, I think it can have negative consequences."

DP3: Quantitative Opinion Collection Through Low-Threshold Interaction

This design principle was already implemented through polls, votes, and up-votes, and received positive feedback during the first and second iterations of user testing. Therefore, it was not further implemented or tested during this demonstration.

DP4: Required Source Linkage for a Comprehensive Knowledge Foundation

All participants agreed on the importance of linking multiple sources, but they suggested that it should be voluntary rather than mandatory. Consequently, we revised this principle to exclude the requirement of source, rephrased to *DP4: Source Linkage for a Comprehensive Knowledge Foundation*. One participant suggested that if there were some way to indicate that a source has not been added, it could encourage people to do so.

DP5: Accessible Knowledge Foundation for Informed Feedback

Making the government's knowledge foundation accessible and easy to comprehend was seen as a valuable feature among all participants. One participant commented "I am a big fan of this feature. Certain news applications are doing this now". All participants agreed that they believed would use this feature.

DP6: Contextual Anonymity and Secure Authentication

Flexible anonymity with contextual information generated some skepticism. One concern that was raised was that it might be more obvious who an anonymous user is due to the contextual information if the number of users is small. Another was that it might be problematic that people who are anonymous can debate with people who are not anonymous. However, the participants did not suggest any alternative solutions.

Therefore, we propose it as a design proposition rather than a principle, as this should be further tested.

Table 6.1.: List of Initial Design Principles

Initial Design Principles	**Feedback**
DP1: Enhanced Content Categorization and Filtering Through Tags	+ Better way of structuring and finding content than predefined categories + Advantage that there are multiple tags available, so you can filter in more detail + Nice to be able to filter with union or intersection
DP2: Transparent and Responsive Government Engagement	+ Receiving response from the government increases engagement + The labels make sense − It may create more stress for the government +/− The implementation is dependent on active usage from the government
DP3: Quantitative Opinion Collection Through Low-Threshold Interaction	No changes in implementation
DP4: Required Source Linkage for a Comprehensive Knowledge Foundation	+ Being able to link to information and multiple sources is great − Source should be optional so that people can express opinions as well
DP5: Accessible Knowledge Foundation for Informed Feedback	+ Useful feature + "Big fan of this feature. Certain news applications are doing this now" + "Would definitely use this"

DP6: Contextual Anonymity and Secure Authentication	+ Good for those who prefers to be anonymous online + ID verification helps against online trolls − In a small sample it might be more obvious who the person is − It might be problematic that people who are anonymous can debate with people who are not anonymous

6.3.3. Final Design Principles

This section outlines the final design principles and provides a clear rationale for its inclusion.

A number of participants expressed a greater likelihood of engaging in topics that personally affected them or aligned with their interests. As highlighted in the article *understanding the youth needs for inclusive participation* [16], the inclusion of personally interesting topics and the ability to filter and search for relevant content were considered crucial for fostering engagement. In the initial artifact, we aimed to address this by implementing content categorization using predefined categories and subcategories and a personalization feature.

However, the concept of personalization did not receive widespread support. It was believed that focusing solely on topics of personal interest might discourage users from exploring new areas of interest. Additionally, some participants emphasized the interconnectedness of various climate-related topics, stressing the importance of maintaining a comprehensive understanding of how everything is connected. Therefore, personalized content may not be an appropriate solution for such a system.

In addition, the results revealed that several participants expressed skepticism regarding categorizing content into categories, as climate-related topics often overlap and can be associated with multiple categories. Furthermore, determining the appropriate category for content can be challenging, both during the publishing process and when searching for relevant material. As a result, we propose using tags as a means of categorization, as shown in figure 6.1, since content can be associated with multiple tags, and they offer an effective way to filter content.

DP1 | **Enhanced Content Categorization and Filtering Through Tags**
The system should incorporate tags to categorize and label content, enabling seamless connection to specific domains and themes. These tags should facilitate easy search and filtering capabilities, empowering citizens to discover and engage with content that aligns with their interests.

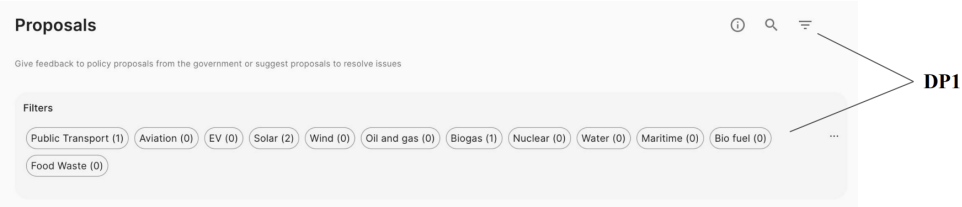


Figure 6.1.: DP1: Enhanced Content Categorization and Filtering Through Tags

The importance of making an impact was clearly emphasized during the user testing sessions, aligning with previous work [16], [49]. To foster a sense of real impact, it is essential for the government to actively utilize the system and consider the input provided by citizens in shaping their policies. Consequently, the system should effectively communicate this engagement. To address this we designed an "approved" tag to indicate which proposals are being approved. While this was appreciated by some participants, there was a suggestion to take it a step further, visually representing the progress stage of each proposal. After the second iteration of user testing, we responded to this feedback by adding a "Seen by Government" label and an "In Consultation" label, as shown in figure 6.2. The additional labels for visualizing government engagement did generally receive positive feedback in the final demonstration.

Overall, visualizing the government's engagement is crucial in conveying to citizen users that their contributions have been acknowledged and are being taken seriously. This not only serves as a motivational factor but also enhances communication from the government to the citizens. Therefore, we propose the following principle:

DP2 | **Transparent and Responsive Government Engagement**
The system should provide clear evidence of the government's active engagement and ensure transparency in its policy considerations. It should communicate that the government takes into account the content produced by citizens.

In the testing phase with government officials, the importance of collecting input in a format that is meaningful and easy to analyze was pointed out. This was especially relevant for policy on a higher level. Additionally, several young citizen participants stated that they were not interested in posting policy proposals or engaging in discussions directly themselves. However, they showed a preference for engaging and expressing their opinions through simplified actions such as polls and up-votes. The implementation of features addressing the need for low-threshold participation is shown in figure 6.3 and figure 6.4.

To address these findings, we propose including features that facilitate the collection of opinions in a quantitative format. Allowing users to participate through simple interac-

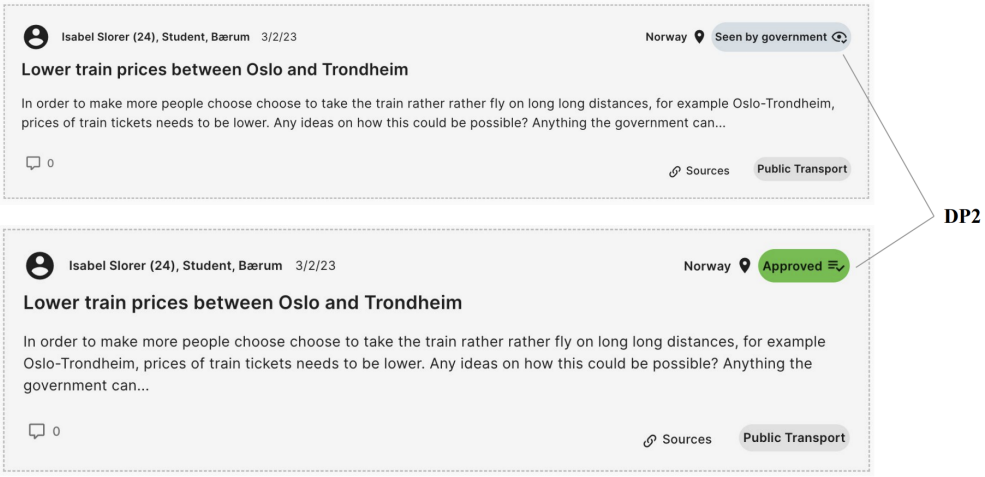


Figure 6.2.: DP2: Transparent and Responsive Government Engagement

tions like polls not only lowers the barrier to engagement but also enables government officials to analyze the data more efficiently. This approach ensures that the input gathered is accessible and valuable for policymakers, avoiding large amounts of data that are troublesome to analyze. Therefore, we propose:

DP3 | **Quantitative Opinion Collection Through Low-Threshold Interaction**
The system should offer features that lower the barrier to engagement, ensuring easy and accessible interaction for citizens. At the same time, it should collect citizens' opinions in a way that can be easily analyzed by government officials.

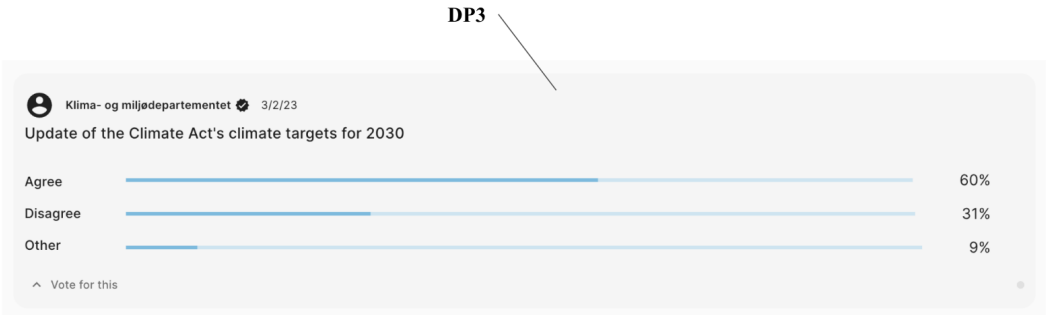


Figure 6.3.: DP3: Quantitative Opinion Collection Through Low-Threshold Interaction

From various perspectives, it was deemed crucial to enable users to link their proposals or discussions to the specific source it is based on. Furthermore, providing access to these sources empowers users to delve deeper into the underlying knowledge foundation and

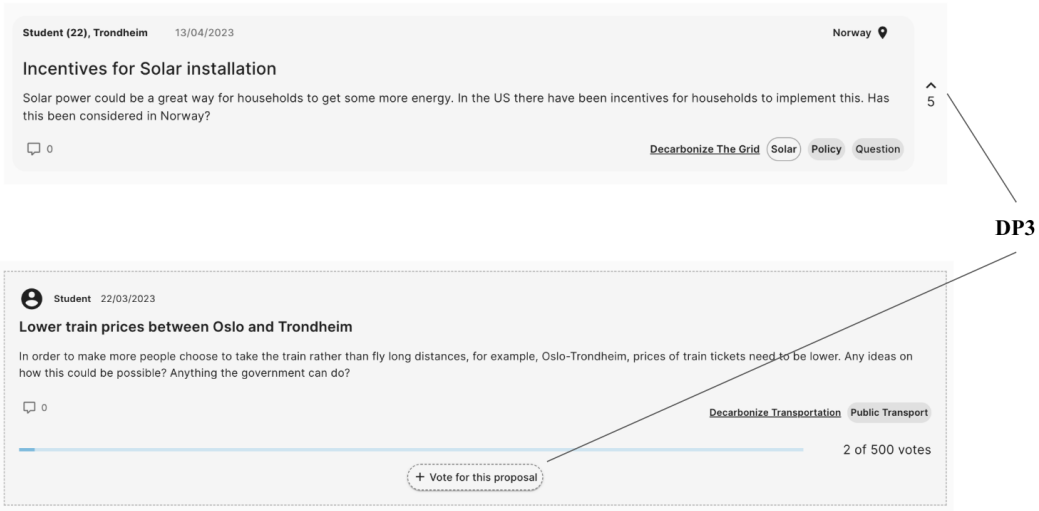


Figure 6.4.: DP3: Quantitative Opinion Collection Through Low-Threshold Interaction

develop a comprehensive understanding of the subject.

To address this, the initial implementation included an input field where users could paste a link to the relevant source. However, during user testing, participants emphasized the need to link to multiple sources. Suggestions that came up were the option to link related discussions to proposals, considering that discussions may lead to new proposals, as well as linking reports, news articles, and other relevant sources. In response, we redesigned the input field in the second iteration to allow for multiple sources. The updated implementation is shown in figure 6.5 and figure 6.6. This enhancement received positive feedback during the final demonstration. Thus, we propose:

DP4 | **Source Linkage for a Comprehensive Knowledge Foundation**
The system should enable all user-generated content to be linked to relevant sources on which they are based, allowing others to understand the underlying knowledge.

Based on recommendations from two government officials, it was advised that the artifact should offer convenient access to the knowledge base relied upon when formulating policies. This accessibility would enable citizens to comprehend the underlying knowledge foundation while providing feedback on policy proposals. Typically, this knowledge base consists of extensive reports, and it is essential to present it in a format that is easily understandable by citizens. In response to this feedback, we implemented a dedicated tab labeled "knowledge foundation" on the policy page to test this concept. The user testing with citizens yielded positive responses, highlighting the significance of this feature. However, several found the extra tab beside policy proposals somewhat confusing. In the

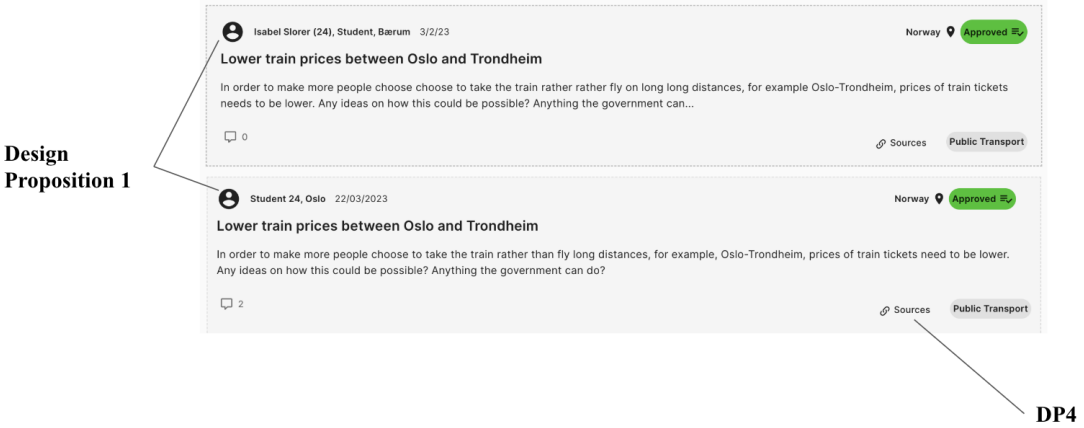


Figure 6.5.: Design Proposition 1: Contextual Anonymity and Secure Authentication and DP4: Source Linkage for a Comprehensive Knowledge Foundation

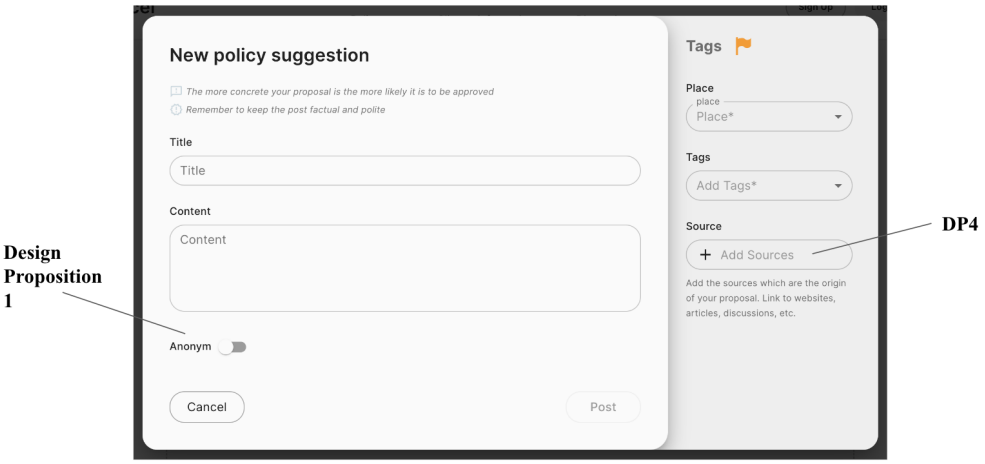


Figure 6.6.: Design Proposition 1: Contextual Anonymity and Secure Authentication and DP4: Source Linkage for a Comprehensive Knowledge Foundation

second iteration, we moved the knowledge foundation page to the same tab as climate status and implemented easy access to it through a "pop-up" and a link attached to the policy proposal it is associated with, as shown in figure 6.7. Overall, the concept of knowledge foundation received positive responses in the final demonstration of the design principles, with all participants stating that they believe they would use the feature. By allowing citizens to gain a deeper understanding of the underlying knowledge behind government proposals, this feature can both increase confidence to participate and enhance the overall quality of the participation. Hence, we suggest the following

principle:

DP5 | **Accessible Knowledge Foundation for Informed Feedback**
The system should provide citizens with easy access to the knowledge foundation that informs government officials' policies. This information should be presented in a way that is easily understood, empowering citizens to provide meaningful feedback.

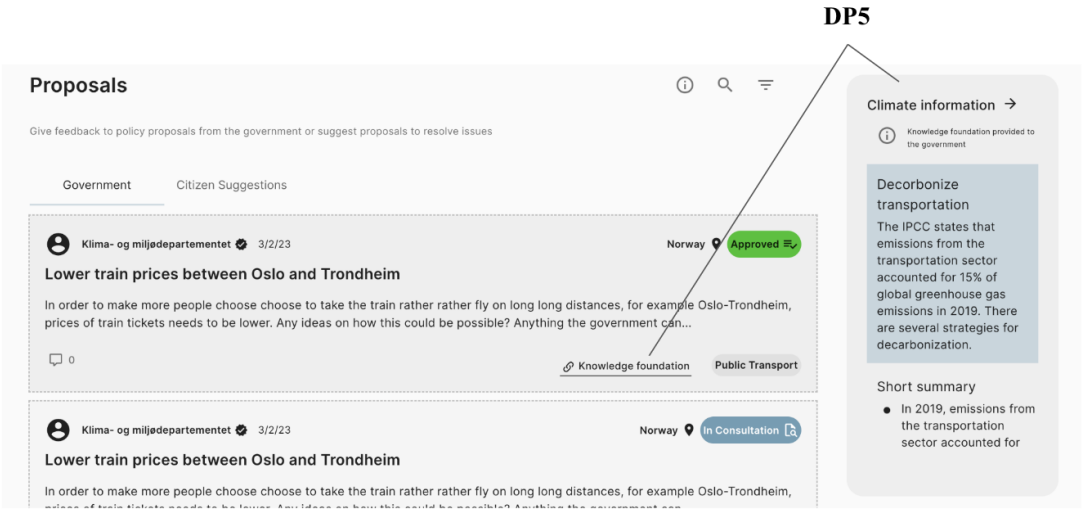


Figure 6.7.: DP5: Accessible Knowledge Foundation for Informed Feedback

Table 6.2 provides an overview of the five design principles.

6.3.4. Design Propositions

In addition to the proposed design principles, we suggest the three following design propositions. As with the design principles, these reflect insights gained through the thesis, but were either not fully implemented, or need more testing and stronger results from an evaluation to be presented as design principles.

During the user testing phase, diverse opinions were raised regarding the topic of anonymity, highlighting the dilemma of maintaining trust while maintaining a low threshold for engagement. Initially, the testing focused solely on anonymity with context. However, further feedback indicated the need for additional context and the inclusion of the option not to remain anonymous. As a response to this, a button to "toggle" anonymity was implemented, which enabled the user to choose between displaying their full name or only showcasing what was considered to be sufficiently helpful contextual information such as age, place of residence, and/or occupation. By offering optional

Table 6.2.: List of Design Principles

ID	Design Principles
DP1	**Enhanced Content Categorization and Filtering Through Tags** - The system should incorporate tags to categorize and label content, enabling seamless connection to specific domains and themes. These tags should facilitate easy search and filtering capabilities, empowering citizens to discover and engage with content that aligns with their interests.
DP2	**Transparent and Responsive Government Engagement** - The system should provide clear evidence of the government's active engagement and ensure transparency in its policy considerations. It should communicate that the government takes into account the content produced by citizens.
DP3	**Quantitative Opinion Collection Through Low-Threshold Interaction** - The system should offer features that lower the barrier to engagement, ensuring easy and accessible interaction for citizens. At the same time, it should collect citizens' opinions in a way that can be easily analyzed by government officials.
DP4	**Source Linkage for a Comprehensive Knowledge Foundation** - The system should enable all user-generated content to be linked to relevant sources on which they are based, allowing others to understand the underlying knowledge.
DP5	**Accessible Knowledge Foundation for Informed Feedback** - The system should provide citizens with easy access to the knowledge foundation that informs government officials' policies. This information should be presented in a way that is easily understood, empowering citizens to provide meaningful feedback.

anonymity, the system is intended to meet the needs of individuals who prefer to maintain their privacy, as well as those who choose to disclose their identities to enhance credibility. Furthermore, displaying relevant contextual information can provide valuable background and perspective to users' posts and opinions. This contextual information helps readers understand the content in a meaningful context. Secure authentication methods, such as electronic IDs with a high level of security, like 'minID' or 'bankID' in Norway [73], [74], ensure the integrity of user identities and prevent the creation of fake accounts.

The aim of this proposition is to promote transparency, build trust, and enhance overall credibility while maintaining a low threshold for engagement. In the final demonstration, participants did not propose any alternative ideas for anonymity. However, some participants highlighted potential negative side effects associated with flexible and contextual anonymity. These concerns included the risk of not staying anonymous if the contextual information reveals too much of your identity, for instance in a smaller community, as well as the potential for imbalanced dynamics in discussions where some users are anonymous while others are not. Therefore, further testing and evaluation of this idea is recommended. However, based on the findings suggesting that this approach may be preferable to the alternatives of full anonymity or no anonymity at all, we propose the following:

Design Proposition 1	**Contextual Anonymity and Secure Authentication** The system should offer flexible anonymity options while ensuring that a sufficient level of contextual information is always visible. A robust and secure authentication system should be in place to ensure the integrity of users' identities.

Based on user testing involving government officials and young citizens, it became apparent that even though establishing a common understanding of the climate situation was deemed important, graphs displaying solely the level of CO2 in the atmosphere lacked meaningful impact. To effectively engage citizen users, climate information should be presented in a relatable and meaningful manner. One approach to achieve this can be showcasing different scenarios, goals, and the necessary actions required to accomplish them, as mentioned during the testing phase.

Since this feature was only partially implemented it cannot be confidently presented as a design principle. However, the user feedback from evaluations indicated the advantages of this feature. Therefore, we propose the following design proposition as it will require more testing and revising before potentially becoming a principle:

Design Proposition 2	**Meaningful and Relatable Climate Information Display** The system should present climate information in a way that is personally meaningful and relatable to citizens, in order to inspire and enhance their motivation.

During the first round of interviews with government officials, it was recognized that government officials working with national and local climate policy have distinct needs and considerations due to their different roles. This understanding was included as a requirement for the artifact and implemented through the use of "geo-tags" for each proposal and post. Subsequently, during user testing with government officials, these distinct needs once again became evident. Government officials involved in local politics expressed positivity towards discussions and direct feedback on ongoing processes and proposals, while government officials in national policy emphasized the importance of easily analyzable data and expressed skepticism towards discussions in text format regarding citizen input.

The differentiation between locations and levels also received positive responses during user testing with young citizens. One participant noted that different policy levels may interest different individuals. In terms of themes and topics for engagement, some participants showed a greater interest in large-scale national policies, while others were more focused on issues that directly affected them personally. Another idea that emerged during testing was the possibility of observing the initiatives taken by other municipalities. This would enable municipalities to have a greater influence on each other and facilitate the visibility of successful initiatives across different locations. As the need for distinguishing between levels of politics was consistently evident throughout the testing, but only partially implemented, we propose the following:

Design Proposition 3:	**Clear Distinction Between National and Local Governance Levels** The system should establish a clear differentiation between national climate policies and local climate policies, recognizing their distinct needs and political considerations.

Table 6.3.: List of Design Principles

ID	Design Propositions
Design Proposition 1	**Contextual Anonymity and Secure Authentication** - The system should offer flexible anonymity options while ensuring that a sufficient level of contextual information is always visible. A robust and secure authentication system should be in place to ensure the integrity of users' identities.
Design Proposition 2	**Meaningful and Relatable Climate Information Display** - The system should present climate information in a way that is personally meaningful and relatable to citizens, in order to inspire and enhance their motivation.
Design Proposition 3	**Clear Distinction Between National and Local Governance Levels** - The system should establish a clear differentiation between national climate policies and local climate policies, recognizing their distinct needs and political considerations.

7. Discussion

This chapter discusses the results of the study, how it addresses the research questions, the implications of the study for practitioners and researchers, and the limitations to it.

The aim of this study was to make climate policy more accessible, transparent, and appealing for young people to engage and participate in through the use of e-participation. In addition, we aimed to design the artifact to make it easier for government officials to reach out and gather citizens' opinions' on climate policy. To achieve these goals the research questions RQ1 and RQ2 were formulated. The research questions were addressed through the development of an artifact, resulting in five design principles and three design propositions serving as guidelines and propositions for future practitioners and researchers.

Section 7.1 discusses the results related to research question 1. Section 7.2 discusses the results to research question 2. Section 7.3 presents the research implications and practical implications of the thesis. Section 7.4 describes the limitations of the research study. Section 7.5 presents the experiences from using No-Code to develop an artifact. Section 7.6 describes general reflections from the research study.

7.1. Research Question 1 - Participation and Engagement

RQ1 | How can an e-participation system for the net-zero transition facilitate participation and engagement among young citizens?

Our findings indicate that several factors are vital to facilitate participation and engagement among young citizens in an e-participation system for the net-zero transition. Our answer to this question includes the five design principles and the three design propositions.

DP1: Enhanced Content Categorization and Filtering Through Tags address the need to effectively find relevant content to engage in. Efficient and effective use of an e-participation system was deemed as important according to Pietilä et al. [16], and our results confirm this. While the concept of tags has been evaluated through demonstration and received positive feedback, further research should assess its effectiveness when dealing with a large amount of data in an e-participation solution. Additionally, we believe it to

be worthwhile to explore the possibility of allowing users to follow specific content and individuals. However, this feature would make the system slightly more personalized, and we believe it is important to be cautious in avoiding excessive personalization, as this received skepticism in this study.

The design principle *DP2: Transparent and Responsive Government Engagement* addresses the need for users to perceive their impact and stay updated on government engagement. This was viewed as critical for willingness to participate, as emphasized by all interviewees belonging to the group of young citizens. Various approaches could have been employed to incorporate this design principle into the artifact. While the implementation of labels to communicate the government's actions generally received positive responses in the demonstration, alternative visualizations should be explored to either replace or complement the current approach. For instance, one participant in the user testing suggested a "kanban" board to visualize status. However, due to limited time and convenience, only the extra labels were implemented in the artifact. Furthermore, it was highlighted that the effectiveness of this feature relies on active utilization by the government to have a positive impact on citizen engagement. In the absence of government involvement, it may have adverse consequences, which is an important aspect to take into consideration.

The design principle *DP3: Quantitative Opinion Collection Through Low-Threshold Interaction* lowers the threshold for participation, by making participating more accessible and user-friendly to young citizens. There are multiple approaches available for implementing this concept. Due to time constraints, we focused solely on implementing polls, votes, and up-votes on discussions. While the concept of low-threshold interaction through "clicking" rather than writing text was popular among young citizens, we cannot determine the optimal implementation of these features. We recommend conducting further research to explore alternative ideas and approaches for implementing this design principle, and testing it in a real-life scenario to investigate usage in practice and potential side-effects.

DP4: Source Linkage for a Comprehensive Knowledge Foundation aims to help users understand the origins of the presented content. Considering that several participants primarily viewed the artifact as an information source, we considered source linkage as a crucial feature for content verification based on external information. However, we are aware that this demands additional mechanisms to ensure the verification of provided sources to prevent the spread of misinformation. Moreover, during the final demonstration, it was consistently emphasized that the linking of sources should remain optional to accommodate the sharing of content based solely on opinions and experiences. To promote the use of sources, it was suggested that content not based on sources could be clearly visualized. This possibility could be explored further in future research.

The design principle *DP5: Accessible Knowledge Foundation for Informed Feedback* aims to provide citizens with a better understanding of the knowledge base relied upon by government officials when proposing and implementing new policies. We believe this feature has the potential to empower citizens to participate while improving the quality of

their feedback. During the final demonstration, all participants expressed the importance of this feature and indicated their willingness to use it. However, it is challenging to determine to what extent it would actually be utilized by citizens in practice. We believe that presenting the knowledge foundation in a way that is user-friendly and easy to grasp is crucial for promoting its usage. Further research should explore effective methods of efficiently integrating this feature into the system to ensure that it provides value to citizens.

Design Proposition 1: Contextual Anonymity and Secure Authentication addresses the need for establishing trust in the system and the content generated, which was considered critical for willingness to use the system. Additionally, it aims to maintain a low barrier to engagement through flexible anonymity. While flexibility of anonymity with contextual information was considered a suitable option compared to full anonymity or no anonymity, potential side effects were also acknowledged. Hence, it is essential to conduct further research through real-life studies to explore potential side effects and evaluate its effectiveness in practical settings.

Design Proposition 2: Meaningful and Relatable Climate Information Display aim to facilitate better comprehension of the climate situation and place it in context. Our findings suggest that climate information needs to be meaningful and relatable to serve as a motivating factor for user engagement. This could include tracking progress towards net-zero goals or presenting various climate scenarios based on progress. While this research does not delve into the specifics of which information should be included or how it should be visualized, further investigation is necessary to determine the most effective approaches.

Design Proposition 3: Clear Distinction Between National and Local Governance Levels facilitates user engagement in local or national policy based on personal interest. As this distinction was not fully implemented in the artifact, other than a simple location label, further research should explore methods for achieving a clearer distinction between the national and local levels. This would enable users to more effectively navigate and participate in policy discussions and initiatives that align with their specific interests and concerns.

7.2. Research Question 2 - Meaningful Input

RQ2 | How can an e-participation system for the net-zero transition facilitate meaningful citizen input to government officials?

To facilitate meaningful input from citizens to government officials, we suggest three of the proposed design principles and propositions to be useful.

The design principle *DP5: Quantitative Opinion Collection through Low-Threshold*

Interaction aims to address the need for gathering citizen feedback in a format that is easily analyzable. As discussed in the previous section (section 7.1), there are various approaches and features that could effectively fulfill this objective. Polls, voting, and up-votes received positive feedback during user testing from all government officials. However, it is important to determine the most appropriate features for specific cases or explore alternative methods that may be more suitable. For example, structured surveys have been mentioned in previous literature as a valuable feature that we did not test in this study.

DP5: Accessible Knowledge Foundation for Informed Feedback aims to enhance the quality of feedback from citizens on government proposals by offering convenient access to the underlying knowledge foundation. This feature intends to establish a common ground of knowledge, fostering improved communication and collaboration between the government and citizens. While this feature was highly regarded by numerous young citizen participants, its actual usage and impact on the quality of feedback and content have not been evaluated. Further testing is necessary to determine the extent to which it fulfills its intended aim and contributes to more meaningful and well-informed feedback.

Design Proposition 3: Clear Distinction Between National and Local Governance Levels suggests the importance of establishing a clear differentiation between the national and municipal levels to address the varying needs of citizen input based on the level of governance. As this differentiation was not completely incorporated into the solution, further research should consider which inputs are most valuable for national and local governance respectively.

7.3. Implications

7.3.1. Research Implications

Over the last decade, Sustainable Human-Computer Interaction (HCI) literature has called for researchers to design systems that move beyond the individual, support structural changes, and aim at having an impact at scale [7], [8]. This study responds to these calls by connecting the research area of E-participation to Sustainable HCI (SHCI). We consider this a novel contribution in itself, as we have not been able to identify any previous research within SHCI doing this. As e-participation has the goal of facilitating transparent, balanced, and enhanced democratic processes [10], we considered this a natural direction to go in as a response to previous SHCI literature, and will encourage SHCI researchers to further explore the intersection of these two research areas.

Furthermore, many of the needs and success factors mentioned in previous e-participation literature are reinforced through our research findings. The study *Understanding the Youth's User Needs for Inclusive eParticipation* [16] presented ten needs for an e-participation system that is inclusive to young people, which were categorized into *trust and safety*,*motivation to participate*, *integration into governmental processes*, and

efficient and effective use. Several of these needs were confirmed in this study, including trust in the system, a personally interesting topic, an adequate number of users, having a real impact, search features, and material available to read up on. Most of these needs were addressed by the proposed design principles, extending the results of the study by verifying them through the evaluation of an artifact.

Interestingly, our findings challenged the need for anonymity identified in the previous study [16]. The context of this thesis, such as the focus on climate policy, may explain the differences between our findings and their results regarding anonymity. Some participants in our research did not see the point of anonymity, highlighting the potential benefits of not being anonymous and emphasizing the value of contextual information. In response, we suggested an alternative approach that combines flexible anonymity with sufficient context, aiming to meet the needs for both anonymity and the benefits associated with non-anonymity. Although this alternative may also bring potential side effects, it was considered the best alternative throughout the study, and introduces a novel approach to the dilemma of anonymity which should be investigated further, as mentioned in section 7.1.

Moreover, our findings confirmed several of the success factors highlighted in the prior studies: *Success Factors in Designing eParticipation Initiatives* [49] and *Decide Madrid: A Critical Analysis of an Award-Winning e-Participation Initiative* [50]. The involvement of citizens in the design process, receiving continuous feedback, and creating an appealing yet user-friendly system were identified as crucial aspects of the design process [49]. Furthermore, ensuring transparency, government responsiveness, and accountability were recognized as important factors and were addressed through the implementation of DP2. The importance of providing clear and understandable content and offering convenience through a one-stop solution did also come up in this thesis [49]. Additionally, our findings echoed the significance of pursuing quality contributions as emphasized by government officials [50]. Integration with the policy-making process and the opportunity to influence decision-making for proposals were also identified as essential for fostering engagement [50].

This research study also goes beyond existing e-participation studies by validating many of the identified needs and success factors in the context of climate policy. Furthermore, our study brings novelty by proposing the use of low-threshold interaction as a means to reduce barriers to engagement and provide easily analyzable input formats for government officials. We also explored a novel approach to simplifying engagement in relevant topics by prototyping a "personalization" feature. Although this feature did not receive widespread support from the young citizen participants, there was a request for the opportunity to follow specific themes and individuals, indicating the potential for further exploration. While we do not dismiss the possibility that personalization can be a valuable feature, we recommend conducting careful testing to consider all potential side effects associated with its implementation in further research.

Furthermore, our study introduces a novel approach to the field of e-participation by

adopting a design science research strategy. Unlike previous studies that primarily evaluated existing solutions, our research aimed to create an innovative solution tailored to the specific context of climate policy and the engagement of young citizens. However, we believe that many of our findings hold broader relevance and can serve as valuable guidelines for e-participation research in general. By extending beyond the scope of existing solutions, our study contributes fresh perspectives and insights to the field.

7.3.2. Practical Implications

Since this thesis resulted in the development of a method artifact rather than an instantiation, its direct impact on the stakeholder group of young citizens is limited. However, investigating their needs for this type of platform may result in an increased focus on meeting their needs in future research and potential instantiations.

For government officials, it is essential to have research that contributes to an understanding of how an e-participation platform for climate politics can achieve success. This research provides recommendations through the design principles that can serve as valuable guidance for future government initiatives that wish to utilize e-participation to shape future climate policy. Although the research performed focused on accommodating the different governance levels in Norway, the findings could also benefit the development of e-participation platforms created for international collaborations, such as the European Union.

The design principles resulting from this thesis have an impact on e-participation software designers and developers by providing knowledge of important considerations when designing systems that aim to engage young people.

For practitioners who plan to use no-code to develop a prototype, either in research or industry, this thesis offers valuable lessons and insights from our experiences that could be considered, elaborated in section 7.5. Previous literature in the research field of no-code has not addressed methods and recommendations on the use of no-code to design, develop, and test a prototype artifact.

7.4. Limitations

Evaluating the artifact through semi-structured interviews aligned well with the research scope and objectives defined for the thesis and offered numerous advantages. Nevertheless, it is important to acknowledge the limitations of this method. Firstly, achieving consistency and objectivity can be challenging considering the effect of the context and the researchers [20]. In addition, considering that interviews are artificial, they can be misleading, as interviewees may not always align their actions in the real world with what they say they do. Moreover, the participant sample from the citizen user stakeholder group primarily consisted of students we knew from NTNU, due to convenience. Hence, the results may have been biased toward a more positive outcome. Additionally, the

sample was not representative of a diverse range of young citizens, making it difficult to generalize the findings.

During the design and development phase, user feedback was collected to some extent using the *walk-trough* method with each other, our supervisors, and other master's students. Still, this should have been conducted earlier and more frequently and involved users from the relevant stakeholder groups, as user involvement during this phase is important to ensure that the artifact fulfills user needs [51].

To expedite the testing process due to the limited time frame, we ended up partially implementing many of the features we were evaluating, focusing on simulating the experience rather than providing full functionality. This approach enabled us to evaluate the artifact based on young citizens' perceptions of the concept itself, but not evaluating the concept in practice. While this approach was efficient and useful to rapidly iterate through the develop, demonstrate, and evaluate cycles [52] in order to formulate design principles, it is important to acknowledge that the results may have been influenced by the partial implementation of some of the features. As a result, we were not able to test how the system would genuinely be utilized by young citizens in a real-life scenario. Testing the system in a real-life situation by, for instance, conducting action research could provide other results or discover potential side effects that haven't been addressed through this study. Hence, more research is needed to further test the design principles' effectiveness in solving the identified problem in real-life situations.

Furthermore, our access to government officials was limited. While we are satisfied with the inclusion of government officials from various levels and departments, it would have been ideal to involve a representative from Stortinget as well, considering their role in shaping the policies that Regjeringen implements [75]. Although we were able to get in touch with several representatives of the Energy and Environment Committee at Stortinget, all representatives were busy and unable to participate in the study. Moreover, we were not able to involve government officials in the final demonstration of the implemented design principles due to time constraints, something which would have been ideal.

7.5. Experiences From Using No-Code

During the creation of the artifact, we gained valuable experience utilizing the no-code tool Appfarm [76] for designing and developing a prototype. Appfarm was originally chosen as the development tool since it allowed us to develop an artifact rapidly compared to traditional coding. Initially, we focused on implementing features with functional capabilities. However, during the development phase we realized that achieving full functionality was more time-consuming than anticipated and not essential for accomplishing our research objectives. Consequently, we shifted our approach to partially building out many of the features instead, as described in section 5.1.

Moreover, throughout the design and development phase, it proved challenging to introduce significant design changes once an initial design had been established. Even though the artifact was intended to be evaluated as a prototype, making drastic modifications during the development stage proved difficult. This might be due to the partial functionality which made it harder to make significant changes to the artifact later. In hindsight, we believe a more effective approach would have been to begin with multiple design iterations in Figma before developing the artifact with Appfarm. This would have allowed for more rapid testing and iterative learning, capturing insights more efficiently. By leveraging a more iterative approach in the early stages, the artifact could have benefited from a more informed and refined design, resulting in a better end result.

It is also important to question the necessity of using no-code in the first place in this study, considering that a significant portion of the insights and discoveries could have been achieved using tools like Figma. In research projects with an extended time frame that can conduct action research [20], we believe no-code could serve as a valuable tool to quickly develop a functional artifact that can be deployed and used in real-life situations. However, given the constraints of our available time, we were unable to undertake action research, raising the question of whether the investment in developing partial functionality with no-code was truly essential.

7.6. General Reflections

The findings of this study are derived from the specific requirements we outlined for the artifact, such as discussion forums and policy proposals. While these requirements were supported by interview findings and existing literature, it is important to acknowledge that an enhanced solution could incorporate additional valuable features. Other features, such as participatory budgeting, interactive maps, online surveys and so forth, could have potentially served a useful purpose and should be subject to testing in future research. Upon reflection, we also recognize that the proposed artifact could have placed greater emphasis on effectively communicating the current actions and plans undertaken by the government to achieve their net-zero goals. It is important to acknowledge this aspect for future research and implementation.

Additionally, there are many aspects to the artifact that may have impacted the results, which we were not able to focus on in the study. One such aspect is visual aesthetics. We chose a clean, minimalistic, and neutral style for the artifact in order to not let the visual design take the focus from the features themselves. Feedback from participants on this varied, one found the colors slightly boring, but most participants appreciated the minimalistic and seriousness perceiving it as enhancing trust in the system. Hence, our findings indicate that maintaining a simple and clean design can be advantageous for such a system.

Moreover, several concerns and uncertainties relevant to e-participation tools in general came up during the study. The significance of content moderation to mitigate the presence

of trolls was consistently emphasized during the testing phase. However, addressing this issue was not considered within the scope of our study, as we focused on exploring factors that were more context-specific. Nonetheless, content moderation remains a crucial aspect for all solutions involving user-generated content, including e-participation systems, which is important to keep in mind in future research.

Furthermore, the question of who would run and own such a system is a key consideration. The young citizen participants expressed diverse perspectives and opinions regarding a fully government-run system. While many believed it to be a favorable idea that could enhance trust, it is crucial to acknowledge that the study's results may be influenced by its context in Norway. Norwegians, as noted by one participant, tend to have greater trust in the government compared to other countries [77]. It is important to recognize potential risks, such as governments exploiting such a system to portray themselves favorably if similar systems are used in other countries. Additionally, participants pointed out that they did not have much faith in the government being able to implement and maintain such a system. Our study does not provide definitive answers to these questions as they lie beyond its scope. Nevertheless, it is essential to remain mindful of these risks and considerations in further research and practical implementation.

8. Conclusion and Future Work

This chapter concludes the thesis by summarizing the thesis' main contributions and findings, other relevant contributions, and presents suggestions for future work.

8.1. Contributions

This thesis held several goals. Overall, it was motivated to address the powerlessness experienced by many young people in the matter of climate change and reaching the net-zero target. To approach this wicked problem, the study aimed to gain insights on how to design effective e-participation systems that make climate policy more accessible, transparent, and appealing for young people to engage and participate in, while providing meaningful input to government officials. This aim was formulated into the following research questions.

RQ1 | How can an e-participation system for the net-zero transition facilitate participation and engagement among young citizens?

RQ2 | How can an e-participation system for the net-zero transition facilitate meaningful citizen input to government officials?

The master's thesis applied the design science research methodology to design, develop, demonstrate, and evaluate an artifact in iterative cycles. The outcome of the process has resulted in five design principles and three design propositions, which address the research questions. These principles and propositions are intended to offer valuable guidance for future researchers and practitioners involved in the design of e-participation systems, either focusing on promoting participation from young citizens, the context of climate policy, or both. While the principles derived from this specific context, we believe that several of them hold broader relevance and can also be beneficial for e-participation systems generally.

Our research findings indicate that many of the design recommendations from existing e-participation literature are significant in the context of climate policy. These recommendations encompass important aspects such as content structure, active government

involvement, and the availability of accessible knowledge resources. Furthermore, our findings highlight the value of including features that facilitate quantitative collection of opinions, such as polls, up-votes, and votes. Such features not only enhance participation among young citizens but also provide government officials with easily analyzable data. Moreover, our study contributes new insights regarding anonymity, suggesting a flexible approach with contextual information. We propose the integration of meaningful and relatable climate information within the system to enhance the motivation to participate, as well as a clear distinction between national and local governance.

The study makes a significant contribution to the field of Sustainable Human-Computer Interaction (HCI) by connecting it with E-participation, addressing the call to design for system changes in society. Many e-participation initiatives often fail due to inadequate fulfillment of stakeholders' needs, and there seems to be little design science research in the field of e-participation. Hence, we believe that the bridging of Sustainable HCI and E-participation holds great value, as it can lead to the development of improved and more user-centered e-participation systems in the future, supporting a sustainable development of society.

Furthermore, this study presents an innovative approach to the design and development phase of design science research by leveraging a no-code tool for constructing the artifact. Existing literature in the field of no-code appears to have little research on the utilization of no-code tools for designing, developing, and testing method artifacts in research projects. As a result, we consider this contribution to be novel within the area of no-code research and valuable for future design science researchers who seek to adopt a similar methodology.

8.2. Future Work

This research study serves as an initial step for researchers and practitioners interested in developing E-participation systems that specifically target climate policy and aim to enhance participation among young individuals. It provides high-level principles and propositions, valuable to guide the design process. However, to achieve the best possible outcomes, further research should delve deeper into the optimal implementation of these principles and propositions, exploring their practical application in greater detail. Additionally, future research can explore the inclusion of other features that were not covered in this study, such as interactive maps, structured surveys, and participatory budgeting. Furthermore, it can place a greater emphasis on addressing important needs uncovered in this study but not directly addressed, such as improving the government's communication of climate policy and future plans more effectively, as well as visualizing the pathway to achieving net-zero in a meaningful and relatable way, while highlighting the necessary actions from society.

The study holds several limitations, such as the partial implementation of certain features and the evaluation of the artifact solely through semi-structured interviews. It is

important to note that this artificial context of evaluation may have influenced the thesis' findings, and they may not fully reflect the actual application of the envisioned system in real-world practice. To truly understand the practical implications, it would be necessary to implement these features in a real-life situation to assess their effectiveness and potential side effects. In addition, the study may be affected by its demographic context, being conducted solely in Norway with limited involvement of a diverse group of young citizens, thus potentially overlooking important perspectives and preferences. Additionally, involving more government officials from various branches can provide a more comprehensive understanding of their perspectives and requirements. Future research can address these limitations by ensuring greater involvement of government officials, a broader group of young citizen users, and exploring varied perspectives across different nations or contexts.

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Appendices

A. SIKT Consent Form

Vil du delta i forskningsprosjektet?

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke hvordan en applikasjon kan bidra til å øke engasjement og påvirkningskraft til individer for å bidra i det grønne skiftet. I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Dette forskningsprosjektet er en masteroppgave på NTNU.
Målet med prosjektet er på å teste ut nye IT-løsninger som kan bidra til mer klimavennlig atferd og at individer enklere skal kunne bidra til klimakrisen.

Hvem er ansvarlig for forskningsprosjektet?
Institutt for Datateknologi og Informatikk (IDI) på NTNU er ansvarlig for prosjektet. Veileder og hovedansvarlig for prosjektet er Ilias Pappas. Forskningsprosjektet gjennomføres av studentene Isabel Sørheim Slorer og Benedicte Kaltoft Hansen.

Hvorfor får du spørsmål om å delta?
I forskningsprosjektet ønsker vi å få innsikt og tilbakemeldinger fra personer mellom 20-80 år. Du har blitt spurt om å delta fordi du kjenner noen som jobber med dette prosjektet eller fordi du har en jobb som gjør at du vil ha verdifull innsikt.

Hva innebærer det for deg å delta?
Hvis du velger å delta i prosjektet, innebærer det at du deltar på et intervju, som vil ta deg ca. 60 minutter. Målet med intervjuet er å få mer innsikt i tanker, problemer og utfordringer. I tillegg til å få tilbakemelding på prototypen som er utviklet. Under intervjuet vil det bli tatt lydopptak og notater. Lydopptaket vil bli transkribert i ettertid.

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket. Det vil ikke være mulig å Identifisere intervjudeltagerne i den publiserte utgaven av masteroppgaven. Det er bare studentene som gjennomfører forskningsprosjektet og veileder som vil ha tilgang til dataen vi samler inn underveis i prosjektet. Transkripsjon vil bli gjennomført manuelt i ettertid.

Hva skjer med personopplysningene dine når forskningsprosjektet avsluttes?
Prosjektet vil etter planen avsluttes når masteroppgaven er fullført og godkjent, oppgaven skal etter planen levers til sensur innen 19. juni 2023. Etter prosjektslutt vil datamaterialet med dine personopplysninger anonymiseres. Lydopptak, transkripsjonen, notater og sammendrag fra intervjuet vil slettes når prosjektet avsluttes.

Hva gir oss rett til å behandle personopplysninger om deg?

Vi behandler opplysninger om deg basert på ditt samtykke.

På oppdrag fra Institutt for datateknologi og informatikk ved NTNU har Sikt – Kunnskapssektorens tjenesteleverandør vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:

- innsyn i hvilke opplysninger vi behandler om deg, og å få utlevert en kopi av opplysningene
- å få rettet opplysninger om deg som er feil eller misvisende
- å få slettet personopplysninger om deg
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger

Hvis du har spørsmål til studien, eller ønsker å vite mer om eller benytte deg av dine rettigheter, ta kontakt med:

- Benedicte Kaltoft Hansen, benedkh@stud.ntnu.no
- Isabel Sørheim Slorer, isabelss@stud.ntnu.no
- Veileder: Ilias O. Pappas, ilpappas@ntnu.no
- Vårt personvernombud: Thomas Helgesen, thomas.helgesen@ntnu.no

Hvis du har spørsmål knyttet til vurderingen som er gjort av personverntjenestene fra Sikt, kan du ta kontakt via:

- Epost: personverntjenester@sikt.no eller telefon: 73 98 40 40.

Med vennlig hilsen

Ilias O. Pappas	*Benedicte Kaltoft Hansen*	*Isabel Sørheim Slorer*
(Veileder)	(Student)	(Student)

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

☐ Å delta i intervju

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet

---

(Signert av prosjektdeltaker, dato)

B. Initial Interview Questions

The following interview questions are in Norwegian since the interviews were conducted in Norwegian.

B.1. Questions From Initial Interviews With Young Citizens

Bakgrunn og introduksjon

Vi prøver å finne nye løsninger som skal kunne bidra til å løse klimaproblemene gjennom masteroppgaven vår. Og vi ønsker derfor gjennom intervjuer å finne ut mer hvilke barrierer og utfordringer folk opplever med med tanke på å kunne ha en påvirkning på det grønne skiftet? I tillegg til å høre litt om hvilke tanker og synspunkter du har på klima. Så dersom du har noen innspill eller tanker underveis på utfordringer du har, så gjerne ta det opp. Først så vil vi si at det du sier i dag blir skrevet ned, lagret og brukt som en del av masteroppgaven vår. Vi tar også lydopptak av intervjuet, men dette brukes kun av oss for å kunne skrive ned det du sier i ettertid, og dette opptaket vil ikke bli publisert. Er dette greit for deg?

1. **Fortell litt om deg selv**
    a) Navn, alder, bosted, livssituasjon
    b) Fortell litt om dine vaner
        i. Hvor ofte reiser du? Og hvilke transportmetoder bruker du når du reiser?
        ii. Hvor ofte kjøper du nye klær? Hvor ofte kjøper du ting brukt?
        iii. Hvor mange dager i uka spiser du kjøtt til middag?
2. **Hva tenker du når jeg sier "bærekraft"?**
3. **Hva tenker du når jeg sier klima-endring?**
4. **Kan du fortelle litt om ditt forhold til bærekraft og klima-endringene som er i dag?**
    a) Hva er dine tanker rundt det?
    b) Hvordan forholder du deg til det?

c) Hvis personen er engasjert: Hvorfor og hvordan engasjerer du deg? Hvor kom det fra?

d) Hvis ikke: Hvorfor engasjerer du deg ikke?

5. **Fortell om ting du gjør i dag i forhold til klima-endringene?**

   a) Hva gjør du av individuelle tiltak? Hva med karriere?

   b) Hvorfor gjør du det? Eventuelt hvorfor gjør du ikke noen tiltak?

   c) Hvor mye føler du at det har å si?

   d) Hva tenker du er de største barrierene som gjør det vanskelig å leve mer klimavennlig enn du allerede gjør?

6. **I hvor stor grad føler du at du forstår klima endringene og dagens klimasituasjon?**

   a) Hva tenker du er problemet?

   b) Hva tenker du er utfordringene som er i dag?

7. **Hvordan oppdaterer du deg på klimasituasjonen?**

   a) Hvor får du informasjon fra?

   b) Hvor tilgjengelig synes du informasjon er?

   c) Hvordan synes du den blir kommunisert? Hvor lett er den å forstå?

   d) Hvis du ønsker å finne informasjon om klima-status i Norge, som f.eks. hvor mye utslipp Norge har redusert det siste året, hvordan ville du gått fram og hvor hadde du gått for å finne denne informasjonen?

   e) Holder du deg jevnlig oppdatert på hvilke tiltak som gjøres for å bedre klimasituasjonen?

8. **Bruker du noen applikasjoner i dag som går innenfor kategoriene bærekraft eller klima?**

   a) Hvis de ikke bruker noen: Hva er grunnene til at du ikke gjør det?

   b) Bruker du noen applikasjoner for å bidra til klimasituasjonen generelt?

9. **Snakker du om klima med venner? Som for eksempel å dele tips eller nyheter med hverandre?**

   a) Hvordan prater dere om det?

   b) Hvorfor prater dere om det? Eventuelt, hvorfor prater du ikke med venner om klima?

   c) Hva snakker dere om? (Nyheter, politikk, tips etc.)

   d) Hvordan er synspunktene til vennene du prater med om klima i forhold til dine synspunkter?

10. **I hvor stor grad har du tro på at du kan være med å påvirke klimasituasjonen?**
    a) Hvorfor tror du det?
    b) Hvordan tror du at du kan påvirke?
    c) Hva tenker du om effekten av individuelle handlinger? Tror du det er "vits" å gjøre tiltak selv?
11. **Kan du fortelle litt om følelsene dine rundt den nåværende klimasituasjonen og fremtiden?**
    a) Er du optimistisk, pessimitisk, likegyldig? Og hvorfor?
    b) Er det noe du synes er frustrerende med situasjonen?
12. **Hvordan engasjerer du deg politisk?**
    a) Hva gjør du?
    b) Hvorfor gjør du det? Eventuelt, hvorfor engasjerer du deg ikke politisk?
    c) Føler du at du forstår det som foregår i politikken?
    d) Har du tillitt til politikerne?
    e) Hva tenker du om din mulighet til å påvirke politikken?
    f) Hvordan tror du politikerne har mulighet til å påvirke klima-situasjonen?
13. **Har du noen tanker om hva mer du tror at du kunne gjort for å ha en påvirkning?**
    a) Er det noe mer du ønsker å gjøre?
    b) Hvis ja: Hva er grunnen til at du ikke allerede gjør det?
    c) Hva tror du skal til for at du skulle engasjert deg mer i klima-situasjonen?
14. **Hvorfor engasjerer du deg eller hvorfor engasjerer du deg eventuelt ikke mer i klima-endringene?**
15. **Hva synes du er mest frustrerende med klima-situasjonen?**
16. **Hva tenker du skal til for at klima-krisen blir løst?**
    a) Hvem tror du at har makten til å gjøre noe?
    b) Har du troen på at klima-krisen kommer til å bli løst?
    c) Hva mener du barrierene er for å løse klima-krisen?

17. **Til slutt, er det noe du tenker på eller innspill du har som vi ikke har pratet om underveis?**

B.2. Questions From Initial Interview With the Ministry of Climate and Environment

Introduksjon og velkommen

1. "Takk for at dere ville ta deg tiden til dette, det setter vi stor pris på"
2. Introduksjon av oss selv
3. Er det greit at vi tar opptak av dette intervjuet sånn at vi kan transkribere det i ettertid?
4. Kort om bakgrunnen for prosjektet
    a) Problemet vi ønsker å løse er at mange unge er bekymret for klima, og føler at de har lite påvirkningskraft på det som skjer. Klimakrisen er et stort problem som angår alle, men samtidig er det et stort strukturelt problem. Mange føler derfor at det er lite de kan gjøre for å bidra og ender dermed med å ikke gjøre noen ting. Vi har funnet ut gjennom å egne undersøkelser at det finnes en del digitale sider for medvirkningsprosesser, men veldig få av de menneskene vi har snakket med har hørt om disse sidene. I tillegg er det ofte nye sider for ulike prosjekter, og det er dermed en utfordring for brukere at det ikke er "samlet" et sted.
    b) Målet med projektet er derfor å undersøke hvordan en teknsik løsning kan bidra til å involvere folk for å få det grønne skiftet til å gå raskere. Med fokus på hvordan en slik platform kan designes til å engaserte folk til å ville delta
5. Målet vårt med dette intervjuet er å få litt insikt i hvordan dere jobber, hva som er utfordringer, og hva en digital medvirkningsplatform trenger for å mer effektivt la folk være med å påvirke klimatiltak

Om intervjuobjektene

1. Kan dere fortelle litt om hvem dere er og hva dere jobber med i Klima- og Miljødepartementet?
    a) Vil dere fortelle litt mer om Klima- og Miljødepartementet generelt og hva dere jobber med?

Generelle spørsmål

1. Det står på nettsidene deres at dere arbeider med å "utvikle og gjennomføre egne tiltak og være pådriver overfor ulike sektormyndigheter"
    a) Hvordan gjør dere dette i dag?

   b) Hva fungerer bra med dette?

   c) Hva er utfordringer med det?

2. Det står også at dere arbeider med å "samordne regjeringens klima-og miljøpolitiske mål og sørge for resultatoppfølging av klima- og miljøpolitikken"

   a) Hvordan gjør dere dette i dag?

   b) Hva fungerer bra med dette?

   c) Hva er utfordringer med dette?

Innbyggerinvolvering

1. Hvilke måter har dere i dag for å innvolvere innbyggere på i prosessen av utvikling og gjennomføring av tiltak?

   a) Hvordan fungerer dette?

   b) Hva fungerer bra med innbyggerinnvolvering slik det gjennomføres i dag?

   c) Hva er utfordringer med innbyggerinnvolvering slik det gjennomføres i dag?

2. Har dere noen tanker om hvordan det kunne vært nyttig å få innspill av innbyggere?

   a) Hva slags type innspill?

   b) I hvilke settinger og situasjoner?

3. Har dere noen konkrete mål og kategorier som dere jobber innenfor?

B.3. Questions From Initial Interview With the Climate and Environment Department in Trondheim Municipality

Introduksjon og velkommen

1. "Takk for at du ville ta deg tiden til dette, det setter vi stor pris på"
2. Introduksjon av oss selv
3. "Er det greit at vi tar opptak av dette intervjuet sånn at vi kan transkribere det i ettertid?"
4. "Målet vårt med dette intervjuet er å få insikt i hvordan dere jobber med innbyggerinnvolvering, hva som er utfordringene med dette, og hva en digital medvirkningstjeneste for innbyggere trenger for å mer effektivt la folk være med å påvirke klimatiltak."
5. Kort om bakgrunnen for prosjektet

a) Problemet vi ønsker å løse er at mange unge er bekymret for klima, og føler at de har lite påvirkningskraft på det som skjer. Klimakrisen er et stort problem som angår alle, men samtidig er det et stort strukturelt problem. Mange føler derfor at det er lite de kan gjøre for å bidra og ender dermed med å ikke gjøre noen ting. Vi har funnet ut gjennom å egne undersøkelser at det finnes en del digitale sider for medvirkningsprosesser, men veldig få av de menneskene vi har snakket med har hørt om disse sidene. I tillegg er det ofte nye sider for ulike prosjekter, og det er dermed en utfordring for brukere at det ikke er "samlet" et sted.

b) Målet med projektet er derfor å undersøke hvordan en teknsik løsning kan bidra til å involvere folk for å få det grønne skiftet til å gå raskere. Med fokus på hvordan en slik platform kan designes til å engaserte folk til å ville delta

Om intervjuobjektet

1. Kan du fortelle litt om hvem du er og hva du jobber med i kommunen?
   a) I hvor stor grad jobber du med innbyggerinnvolvering?
   b) I hvor stor grad jobber du med klimatiltak?

Om hvordan de jobber i kommunen

1. Hvordan jobber dere med å utvikle og gjennomføre klimatiltak i dag?
2. Har dere noen konkrete klimamål som dere arbeider målrettet mot for å oppnå? I så fall, hvilke?
3. Hvordan blir nye tiltak, anbefalinger og liknende kommunisert ut fra kommunen til innbyggere?
   a) Har dere noen utfordringer dere opplever i denne kommunikasjonsprosessen?
4. Hvilke måter har dere i dag for å innvolvere innbyggere på i prosessen av utvikling og gjennomføring av tiltak?
   a) Hvordan fungerer det?
   b) Hva fungerer bra? Og hvilke utfordringer har dere med det?
5. Hvor stor del av innbyggerinnvolvering skjer digitalt i dag? Og hvilke erfaringer har dere med dette i forhold til andre typer innbyggerinnvolvering?
6. Hva mener du er de mest kritiske funksjonalitetene en medvirkningsplattform må ha for at dere skal få effektiv og verdifull data fra innbyggere?
7. Hva er de største barrierene for kommunen når det kommer til å ta i bruk digitale medvikrningstjenester (i forbindelse med klimaarbeid)?
8. Vet du noe om hva som har vært de største utfordringene for innbyggere når det kommer til bruk av digitale medvirknings plattformer?

9. Hva slags type innspill tror du kunne vært nyttig for dere å få fra innbyggere?
    a) Hva med innspill på saker som allerede er bestemt?
    b) Forslag på nye saker fra innbyggere?
10. Hvordan type innspill fra innbyggere gir mest verdi for dere? Hvilke erfaringer og utfordringer har dere med type diskusjonsforumer og "åpne" tekst løsninger?
11. Vi fant en NRK-artikkel om et innbygger-innvolverings prosjekt Trondheim kommune gjennomførte i 2019, som fungerte som et digitalt kart der innbyggere kunne komme med forslag og innspill til byutvikling (vise frem artikkel). Men dette kartet er ikke lenger aktivt.
    a) Hvorfor ble det avviklet?
    b) Hvordan ble det brukt? Hvilke erfaringer fikk dere med det?
    c) I hvor stor grad tok innbyggerne det i bruk?
12. Trondheim kommune gar en medvirkningsplattform kalt borgerkraft.no som for tiden er et pilot plattform
    a) Hvor lenge har den vært i bruk?
    b) Hvilke erfaringer har dere med den? Hvilke utfordringer har dere hatt med å bruke den?
    c) Hvordan jobber dere med å få innbyggere til ¨ta det i bruk og bli klar over at det finnes?
    d) Når det ut til flere ulike innbyggergrupper? Blir det brukt av et representativt utvalg?
        i. Hvilke brukergrupper er eventuelt vanskeligst å nå ut til og å få til å delta?

B.4. Questions From Initial Interview With the Local Politician

Introduksjon og velkommen

1. "Takk for at du ville ta deg tiden til dette, det setter vi stor pris på"
2. Introduksjon av oss selv
3. Er det greit at vi tar opptak av dette intervjuet sånn at vi kan transkribere det i ettertid?
4. Kort om bakgrunnen for prosjektet

   a) Problemet vi ønsker å løse er at mange unge er bekymret for klima, og føler at de har lite påvirkningskraft på det som skjer. Klimakrisen er et stort problem som angår alle, men samtidig er det et stort strukturelt problem. Mange føler derfor at det er lite de kan gjøre for å bidra og ender dermed med å ikke gjøre noen ting. Vi har funnet ut gjennom å egne undersøkelser at det finnes en del digitale sider for medvirkningsprosesser, men veldig få av de menneskene vi har snakket med har hørt om disse sidene. I tillegg er det ofte nye sider for ulike prosjekter, og det er dermed en utfordring for brukere at det ikke er "samlet" et sted.

   b) Målet med projektet er derfor å undersøke hvordan en teknsik løsning kan bidra til å involvere folk for å få det grønne skiftet til å gå raskere. Med fokus på hvordan en slik platform kan designes til å engaserte folk til å ville delta

5. Målet vårt med dette intervjuet er å få litt insikt i hvordan dere jobber, hva som er utfordringer, og hva en digital medvirkningsplatform trenger for å mer effektivt la folk være med å påvirke klimatiltak

Om intervjuobjektet

1. Kan du fortelle litt om hvem du er og hva du jobber med i forbindelse med klima og miljø (i næringslivet og i politikken)?
   a) Hvorfor gikk du inn i politikken?
2. I arbeid med klima og miljø i næringslivet; hvilke barrierer har du opplevd politisk?

Spørsmål i forbindelse med klima-politikk

1. Hvordan jobber du med utvikling og gjennomføring tiltak i dag?
2. Har du noen konkrete klimamål som dere arbeider målrettet mot for å oppnå? I så fall, hvilke?
3. Hvilke måter har du i dag for å involvere innbyggere på i prosessen av utvikling og gjennomføring av tiltak?
   a) Hvordan fungerer dette?
   b) Hva fungerer bra, og hva er utfordringer med det?
4. Har du noen tanker om hvordan det kunne vært nyttig å få innspill fra innbyggere for de som jobber med klima- og miljø politikk?
   a) Hva slags innspill?
   b) I hvilke settinger/situasjoner?
5. I arbeidet med klima og miljø-politikk; hvilke barrierer har du opplevd i forbindelse med å få til endringer?

6. Føler du at du har hatt mye mulighet til å være med å påvirke klima-og miljø politikken?

C. User Testing Questions

The following demonstration and interview questions are in Norwegian since the interviews were conducted in Norwegian.

C.1. Questions From User Testing With Government Officials

Introduksjon til demonstrasjon av prototype

1. Takk for at du ville ta deg tiden til dette, det setter vi stor pris på
2. Vi ønsker gjennom dette intervjuet å få ditt inntrykk av ideen og innspill til hva en slik type tjeneste vil trenge å ha for å bli tatt i bruk
3. Forklaring av at det er en prototype
    a) Vi vil poengtere at dette kun er en prototype. Det er flere ting som ikke fungerer optimalt enda, men poenget med prototypen er at den skal vise frem og teste et konsept.
    b) Ikke vær redd for å gi ærlige tilbakemeldinger. Det er ingen riktige eller feil svar.
    c) Mens vi holder på så vil vi veldig gjerne at du tenker høyt underveis, som å fortelle oss hvs du prøver på og hvordan du tror du kan gjøre det.
    d) Hvis du blir forvirret eller det er noe du ikke forstår, så gjerne fortell oss det ved å si det høyt. Hvis du ser noe du liker, så gjerne fortell oss det også.
4. Sende link til prototypen
5. Introduser en kontekst for bruk:
    a) La oss si at det blir bestemt av staten at det skal benyttes en digital platform som myndighetene i Norge vil bruke for bedre samarbeid og kommunikasjon med befolkningen for å nå klimamålene.
        i. Hva tenker du når du hører det?
        ii. Hva tror du kan være potensialet med dette?

iii. Hva tror du kan være risikoer?

Forside

1. Hva tenker du når du ser denne?
2. Hva forventer du at plattformen gjør?

Sign Up

1. Hva tenker du her?
    a) Er det noe som mangler av informasjon som kunne vært nyttig?
2. Hva tenker du om at man kan velge interesser for å personalisere tjenesten?

Diskusjonsforum

1. Hva tenker du om det du ser her?
2. Hva er naturlig for dere å gjøre her?
    a) Hvordan ville dere i Klima- og Miljødepartementet/i Klima- og Miljøenheten i kommunen/ som lokalpolitiker ha brukt det?
    b) Hvordan ville dere interagert med brukere her?
3. Kan du opprette en post?
    a) Hva ville dere i Klima- og Miljødepartementet/i Klima- og Miljøenheten i kommunen/ som lokalpolitiker ha skrevet her?
4. Si at du som privatperson var en bruker, hva ville du skrevet i en post som ville gi dere i Klima- og Miljødepartementet/i Klima- og Miljøenheten i kommunen/ som lokalpolitiker verdi?

Policy Proposals

1. Hva tenker du når du ser denne siden?
2. Hvordan tenker du at Klima- og Miljødepartementet/Klima- og Miljøenheten/lokalpolitikere kunne tatt i bruk dette?
3. Kan du opprette et forslag?
    a) Som Klima- og Miljødepartementet/Klima- og Miljøenheten/lokalpolitiker, hva ville du skrevet her?
4. Si at du som privatperson var en bruker, hva ville du skrevet i et forslag som ville gi dere i Klima- og Miljødepartementet/i Klima- og Miljøenheten i kommunen/ som lokalpolitiker verdi?

Climate Status

1. Hva tenker du om denne siden?

2. Tror du en slik side kan være nyttig? Hvordan kan eventuelt en slik side være nyttig?
3. Hva tror du er viktig for at en slik side kan være nyttig?
4. Hvordan tror du en slik side kunne vært brukt?

Debrief - Semistrukturert intervju etter demonstrasjonen er ferdig

1. Etter å sett dette, hvilke tanker sitter du igjen med?
2. Hva likte du?
3. Hva likte du ikke?
4. Hvis du kunne ha tre ønsker for å forbedre denne, hva hadde det vært?
5. Hvordan tror du den kunne hjulpet dere i Klima-og Miljødepartementet/Klima- og Miljøenheten/som lokalpolitiker?
6. Hva tror du er de størtste risikoene som kan gjøre at en slik plattform feiler?
7. Hvordan tror du at folk vil ta i bruk denne?
8. Hvordan ønsker du at folk skal ta i bruk denne?
9. Hva tror du vil være de viktigste årsakene til at folk vil ta den i bruk?
10. Hva tror du er kritisk for at en slik plattform skal være suksessfull? (Altså både hjelpe dere og folk til å samarbeide om bedre tiltak for at det grønne skiftet skal gå raskere og at vi skal nå klimamålene)
11. Hvilke andre parter tenker du hadde vært naturlig at brukte denne fra statens side?
12. Hva tror du kan være typiske use-cases for en slik platform?
13. Var det noe du savnet her?

C.2. Questions From User Testing With Young Citizens

Velkommen

1. "Takk for at du ville ta deg tiden til dette, det setter vi stor pris på".
2. Gjerne fyll ut dette samtykkeskjema (dersom de ikke har gjort dette enda)

Om intervjuobjektet

1. Hva driver du med til vanlig? (Student, jobber, etc)
2. Hva gjør du når du ikke jobber?
3. Hva er dine tanker og ditt forhold til klimaendringene?

4. Hvordan og hvor mye engasjerer du deg i det?

Introduksjon til demonstrasjon av prototype

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2. Forklaring av at det er en prototype
    a) Vi vil poengtere at dette kun er en prototype. Det er flere ting som ikke fungerer optimalt enda, men poenget med prototypen er at den skal vise frem og teste et konsept.
    b) Ikke vær redd for å gi ærlige tilbakemeldinger. Det er ingen riktige eller feil svar.
    c) Mens vi holder på så vil vi veldig gjerne at du tenker høyt underveis, som å fortelle oss hvs du prøver på og hvordan du tror du kan gjøre det.
    d) Hvis du blir forvirret eller det er noe du ikke forstår, så gjerne fortell oss det ved å si det høyt. Hvis du ser noe du liker, så gjerne fortell oss det også.

Introduser en kontekst for bruk:

1. La oss si at det har kommet nyheter om at det nå skal benyttes en digital plattform som skal brukes for bedre å forbedre samarbeid og kommunikasjon mellom staten og befolkningen for å nå klimamålene.
    a) Hva tenker du når du hører det?
    b) Hvordan ville du avgjort at du skulle signet opp på denne og engasjert deg og tatt i bruk denne plattformen?

Forside

1. Hva tenker du når du ser denne?
2. Hva er forventningene dine til hva denne platformen gjør?
3. Hva er det neste du ville gjort her?
    a) Hva tror du at det er som gjør at du trykker/eventuelt ikke trykker “sign up” her?

Sign Up

1. Hva tenker du her?
2. Er det noe du ser her som gjør at du får lyst til registrere deg som bruker eller eventuelt ikke registrere deg?

Diskusjonsforum

1. Hva tenker du om det du ser her?

2. Hva er naturlig for deg å gjøre her?
3. Kan du opprette en diskusjonspost?
    a) Hva ville du skrevet her?
4. Hvordan føles det naturlig å interagere og engasjere med plattformen?

Policy Proposals

1. Hva tenker du når du ser denne siden?
2. Hva ville du gjort videre?
3. Kan du opprette et forslag?
    a) Hva tenker du om det du ser her?
    b) Hva ville du skrevet her?

Climate Status

1. Hva tenker du her?
2. Hva tenker du om viktigheten av en slik side på plattformen?
3. Er det noe du ville tatt i bruk?
4. Er det noe du savner?
5. Hva ville du hatt på en sånn side?

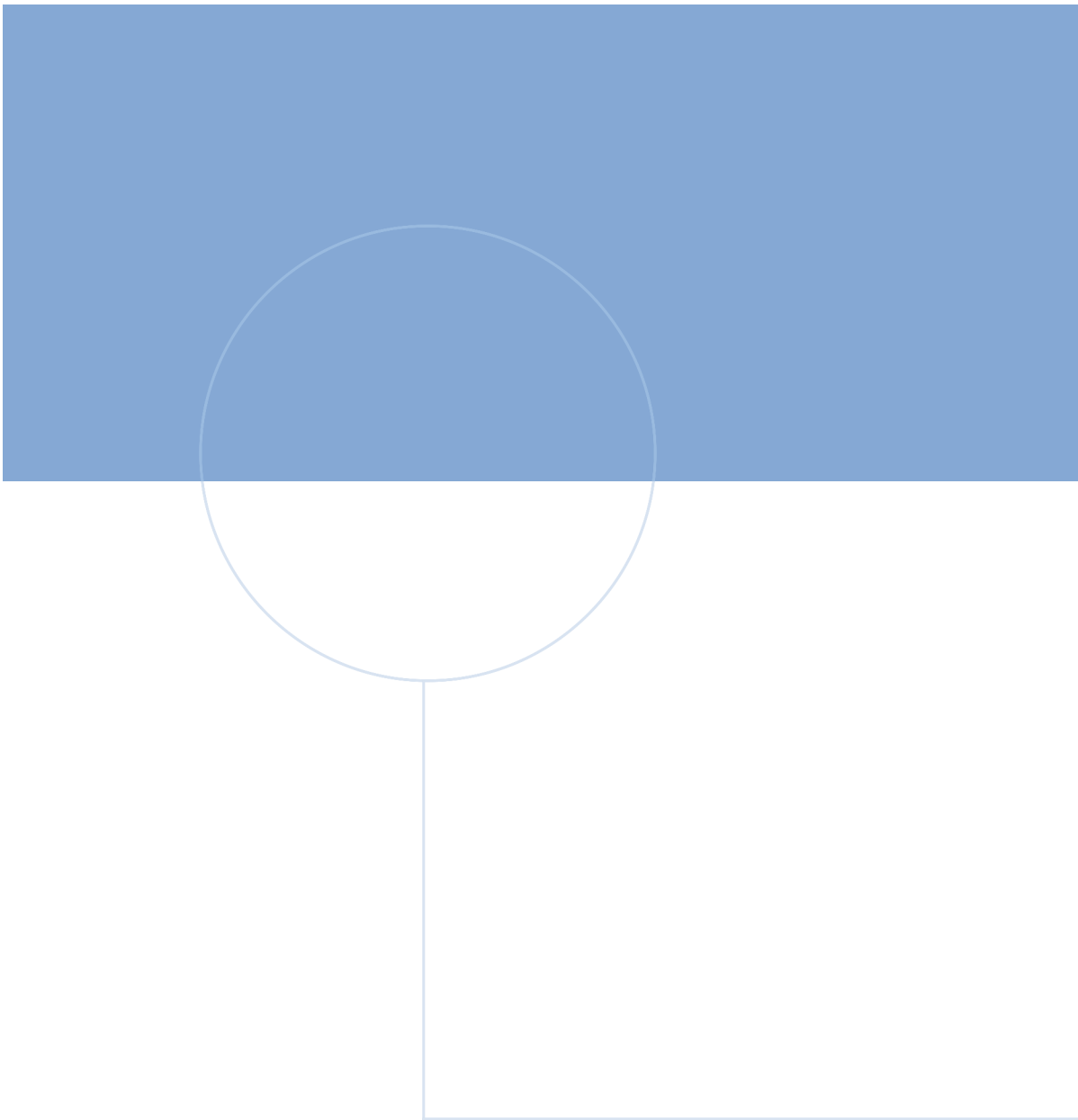
Engasjement og generelle inntrykk

1. Hvordan synes du det var å sortere ut og finne frem til ting som var relevant for deg?
    a) Hvordan tror du dette (personalisering/tilpasning) vil påvirke din bruk av plattformen?
2. Hva tenker du om anonymitet på plattformen? Altså kun å vise hva du gjør og hvor gammel du er
    a) Hvordan tror du dette ville påvirket hvordan du bruker plattformen? (delta mer eller mindre)

Debrief - Semistrukturert intervju etter demonstrasjonen er ferdig

1. Etter å sett dette, hvilke tanker sitter du igjen med?
2. Hva likte du med plattformen?
    a) Hva gjorde at du likte det?
3. Hva likte du ikke?

4. Hvordan følelse sitter du igjen med etter å ha brukt den?
    a) Hvorfor?
5. I hvor stor grad av tillit har du til plattformen? Altså at den faktisk vil hjelpe å dra ting i riktig retning
    a) Hvorfor/hvorfor ikke?
6. Hvordan tror du at du hadde tatt i bruk en slik plattform?
7. I hvilke saker og situasjoner ville du deltatt? Hva ville du engasjert deg i?
8. Hva tror du er mulige barrierer for at du ville engasjert deg?
9. Hva ved denne plattformen følte du ga deg mest?
10. Var det noe du savnet med plattformen?
11. Hva tror du skal til for at du hadde tatt i bruk en slik plattform?
12. Hvis du kunne hatt tre ønsker for å forbedre denne, hva ville det vært?
13. Er dette noe du hadde hatt lyst til å bruke?
    a) Hvorfor? Eventuelt, hvorfor ikke?
14. Hvordan ville du beskrevet denne løsningen til en venn?
15. Hva tenker du om at det er staten driver en slik platform?



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