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Visualization for Citizen Participation: User Perceptions on a Mainstreamed Online Participatory Tool and Its Usefulness for Climate Change Planning

Erik Glaas *[ID], **Mattias Hjerpe**[ID], **Martin Karlson and Tina-Simone Neset**[ID]

Department of Thematic Studies—Environmental Change, Centre for Climate Science and Policy Research, Linköping University, SE-581 83 Linköping, Sweden; mattias.hjerpe@liu.se (M.H.); martin.karlson@liu.se (M.K.); tina.neset@liu.se (T.-S.N.)

* Correspondence: erik.glaas@liu.se; Tel.: +46-11-363183

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Abstract: Citizen participation is obligated in municipal planning but is often criticized because of its inadequate implementation. To increase the usefulness of citizen participation and the involvement of underrepresented groups, online participatory tools (OPTs) have attracted attention, in particular, on topics related to climate change. Although many OPTs have been developed and are becoming more widely used, assessments of their usefulness in real-world planning remain scarce. This study aimed to disentangle prospects and pitfalls of this still novel way of practicing citizen dialogue. Specifically, we apply criteria derived from related literatures to assess a mainstreamed OPT in Norrköping, Sweden. The CityPlanner™ tool was discussed with citizens and planners using focus group methodology and semi-structured individual interviews. Moreover, citizen contributions in four applications of the OPT were analyzed. The results reveal that the biggest challenges for citizen dialogues on planning in general and on climate change, in particular, appear not mainly rooted in the technical functions of the OPT. Rather, problems lie in (i) the lack of municipal strategy for citizen participation and in applying OPTs, (ii) a disparagement in citizens' abilities to contribute to forming robust and sustainable cities, and (iii) in diverging views about the role of citizen contributions. This is reflected in how the OPT is used. While the examined OPT shows potential, the results indicate that visualized contexts for planning might be too scant to be entirely meaningful, and it lacks mechanisms for feedback. Not using the full potential of the OPT makes citizens less engaged and risks to adversely affect learning and citizens' contributions to solving complex issues.

Keywords: climate change; citizen participation; online participatory tools; planning; visualization

1. Introduction

Ideally, citizen involvement in planning can strengthen local democracy by involving marginalized groups, enhance learning, improve planning by clarifying the context, wishes and ideas for local development, and increase the chance of implementation of plan proposals by aligning it with citizens' perspectives [1,2]. However, conventional practices on and methods for citizen participation are described as often excluding, inadequate, ill-timed and instrumental [3,4]. This makes it hard to engage groups beyond "the usual suspects" and to get useful feedback on issues at hand [5]. It further impairs local democracy and hampers the use of citizens' creativity [6].

To spur citizens to engage in urban planning and decision-making, particularly on issues related to climate change, Online Participatory Tools (OPTs) are an often stressed panacea for citizen inclusion, which has gained interest by, e.g., policy-makers and scientists during the last decade [7,8]. The basic idea behind OPTs is to "support citizens' access to spatial information online and thereby informed

participation in decision-making" [9: 304]. The OPT notion can refer both to tools that are explicitly intended to support citizen engagement in planning, such as MySideWalk and CityPlanner™, but also to social network sites intended for other ends [7]. Focusing on different forms of engagement, OPTs have been applied in a broad spectrum of planning processes using different types of interfaces. Related explicitly to participatory planning on climate change, so-called "public dialogue apps" have been introduced. Nevertheless, although deemed promising, their impacts in planning have yet been modest [9].

Indeed, how to develop OPTs that spur engagement at the same time as providing qualitative contributions to practical planning issues is far from straightforward. Previous research has often focused on technical developments without sufficient attention given to users' perceptions on their design and applicability [10]. Moreover, tool prototypes and single-case tests have often been targeted rather than widely adopted applications [11]. Thus, despite the vast amount of applications available, their effectiveness for spurring on-ground planning is not clear [8] and hurdles remain for their uptake in planning [12]. When drawing from experiences from several cases, tested OPTs showcase potential to increase the amount and quality of citizen contributions, but also weaknesses related to lacking abilities to provide feedback on collected contributions and their use in planning [13]. Assessments from the eyes of users, i.e., citizens and planners, can add valuable knowledge about the applicability, benefits and challenges of OPTs. Such knowledge can make it easier for planners to decide what applications to use and reveal how they can be further developed [7].

In Sweden, many large and medium-sized municipalities have started to apply OPTs. These efforts are part of a trend to digitalize municipal data using 3D representations of cities, to which a citizen participation module generally has been attached. This module has often been utilized in comprehensive and detailed planning situations where citizen inputs are deemed particularly important. The most widely applied OPT for planning in Sweden is called CityPlanner™ (https://cityplanneronline.com), used by several big and mid-sized municipalities.

The aim of this study was to analyze how CityPlanner™ is perceived by citizens and planners as a medium for participatory intervention. Building on criteria through which the *accessibility*, *utility* and *results* of OPTs can be assessed, and applying these in a delimited case, we intend to detangle some of the pitfalls and prospects of this novel way of practicing citizen dialogues online, their suitability to generate citizen contributions on climate-related planning, and how the targeted application can be improved. Empirically, focus groups with citizens and individual qualitative interviews with municipal planners were held in Norrköping, Sweden. Moreover, citizen contributions on four applications of the OPT in Norrköping have been analyzed, specifically focusing on how contributions address climate change adaptation and mitigation. These are issues where citizen inputs are considered particularly important to incorporate [14,15]. The following research questions (RQs) have guided the study:

1. *Accessibility*: To what extent and how is the CityPlanner™ tool applied in planning, and communicated to citizens?
2. *Utility*: What are the perceived prospects and pitfalls of the CityPlanner™ tool in mediating citizen contributions and debate?
3. *Results*: What contributions on climate change adaptation and mitigation do citizens add in the OPT, and how could these contributions support planning?

2. Theoretical Point of Departure-Criteria for Assessing Online Participatory Tools

To overcome some of the challenges associated with citizen participation and to make participation easier to implement and use for local planners, various types of digital tools and systems for citizen involvement have been developed. Overlapping in content, such tools have been labelled e.g., Planning Support Systems [16], Geo-questionnaires [17], Public Participatory GIS [18] and Public Dialogue Apps [9]. In this study, we use the term Online Participatory Tools (OPTs) [7] for digital applications for citizen involvement in planning based on geographic visualization but include insights from all research strands above. Many local governments are in an experimental phase to digitalize municipal

data, planning processes and citizen participation using tools such as the municipality targeted in this study, where strategic efforts for developing participatory processes are not yet in place [8,13]. However, while the development and employment of OPTs are virtually exploding, research on their implications for local planning and citizen participation lag behind [12].

Several ways to assess citizen participation through OPTs and their like have been presented in the literature, highlighting somewhat kindred criteria. In the following, we compile assessment criteria divided into three overlapping themes, focusing on the accessibility, utility and results of OPTs (for an overview of used criteria, see Table S1 in the Electronic Supplementary Materials).

2.1. Accessibility of OPTs for Partcipatory Planning

Accessibility is an essential part when applying OPTs since they aim to provide wider access to information, and thereby support informed participation in planning [9]. However, more is needed than making an OPT available online to encourage public participation [7]. To assess accessibility, thus, we use three criteria to illuminate different aspects of their outreach.

Information provision refers to the availability of information about the tool itself and about the planning process targeted [8], but also to what extent citizens make sense of the tool and of the issues raised in the planning process [7].

Audiencing is used to assess to what extent those citizens that are most effected by a plan or decision, or are usually underrepresented in open planning dialogs, are particularly targeted in the OPT deliberation [19]. For example, including citizens that are affected by climate risks is recognized when planning climate adaptation measures since they are likely to benefit from measures and experience it physically [14]. Previous research has concluded that OPTs have a potential for engaging more diverse citizen groups [7,8,20].

Relevance concerns to what extent the questions and/or issues raised make sense for citizens. OPT usage should arguably consider the capacities and needs of citizens in order to become more "inclusive, just, and communicative" [7,21]. Here, many OPTs lack a description of the problems targeted, which can obstruct its perceived relevance [9]. Whether or not citizens think that their voice will be heard also affects their perceived relevance. A potential lack of trust is here affected by citizens' general experience of participation [22] and of OPT-supported planning in particular [7].

2.2. Utility of OPTs for Citizen Interaction

We define utility as the functional capability of an OPT to fulfill the intended objectives of the participatory process, focusing on its communicative value and its user friendliness [23,24].

The *Empowerment* capacity of an OPT is assessed by evaluating its ability to educate or inform participants about an issue or planning context [25], which is important to increase the relevance of citizen contributions and debate [8]. *Engagement* relates to the capacity of an OPT to engage or incentivize participation; i.e., if and how citizens feel that the visualized contents and the forum for expressing their views and initiate debate in the OPT encourage their participation in planning [7].

Another important communicative aspect concerns mechanisms for *feedback* from planners to citizens. This can include mechanisms for compiling citizen contributions, showcasing how they have been analyzed, and presenting how contributions are used in concrete planning proposals [7,9].

User friendliness of an OPT is assessed by two criteria: *Functional clarity* and *technical availability*. *Functional clarity* refers to if the main functions used by participants for exploring the online content and for providing input on the planning process is perceived as clear by citizens. This also includes mechanisms for dialog among citizens on contemporary planning [7].

Technical availability relates to the ability of an OPT to allow users with various experiences in digital media to participate; i.e., if an OPT are perceived as easy to use. Ideally, OPTs should prevent technological lockout to enable a broad range of citizens to participate [17] to avoid over-represent internet-savvy groups which could constrain equal representation [20,26]. For example, OPTs risk favoring young people who are more frequent users of online tools in general, over elderly people.

2.3. Potential of the OPT to Generate Useful Contributions to Climate Mitigation and Adaptation Planning

An acknowledged benefit of OPTs is their ability to generate more informed citizen dialogs on so called "wicked" and emotive issues such as climate change, for which OPTs often have been applied [9]. Here, citizen inputs can provide planners with different types of local knowledge and ideas, which can be used in different stages of planning.

The first type of results based on citizen contributions can be descriptions of how inhabitants use different areas of a city, including local and historical knowledge [11]. Providing a *context* for planning, such contributions can ensure the legitimacy of planning processes, and that plan proposals do not interfere with citizens' values of urban spaces [8]. Citizen inputs can also intercept experiences of e.g., climate impacts, or knowledge of why people take the car instead of the bike.

The second type of results are descriptions of *needs* and desired futures which is important for planners to relate to [11]. In the context of climate adaptation, expressed needs and desired futures can also be used to support the prioritization of investments to protect against climate impacts [14].

The third type of results which can be generated by citizen contributions are concrete *solutions* for improvements to handle current or future risks or challenges [13], which can help identifying advantages and disadvantages of various alternatives [11].

3. Materials and Methods

This section first describes the analyzed OPT CityPlanner™ and how it commonly has been used in urban planning in Sweden. This is followed by a description of the case municipality Norrköping. Lastly, we describe the methods applied in this study and the resulting empirical material.

3.1. CityPlanner™

The CityPlanner™ software (Figure 1) was developed by the Swedish software company Agency9 and based on 3D visual representations of cities. A citizen dialogue module has been designed as an add-on, enabling urban planners to pose questions to citizens on contemporary planning issues. Citizens provide their contributions through a map interface. The design of the citizen dialogue module was intended to involve citizens at an early stage of planning in order to crowd-source ideas for urban development, gather contextual knowledge from residents, and present key considerations and important questions for in the planning process [13].

Figure 1. Graphical interface of Cityplanner™ as applied in Norrköping.

CityPlanner™ has been used in planning by several Swedish municipalities, ranging from detailed small-scale development projects to large-scale comprehensive planning, but also to a lesser extent, by municipalities in, e.g., Denmark, Finland and Norway. When applied in planning, the OPT has showcased to result in a larger number of inputs than conventional planning processes, with a fair gender and age balance [13].

3.2. Norrköping Municipality and Its Planning Context

Norrköping is a mid-sized Swedish municipality located on the south east coast with a population of approximately 140,000 inhabitants. Currently, population increase is causing urban densification and expansion. The city is exposed to fluvial floods stemming from high water levels in the Baltic Sea and the river Motala Ström, and pluvial floods due to the densification, low-lying areas and deficient capacity of the urban stormwater system [27]. For climate change mitigation, the municipal response has hitherto primarily concerned the municipality's internal emissions and measures targeting to low-carbon energy supply [28]. Guiding planning principles in the comprehensive plan include climate resilience, movability, attractiveness, and preserving its history and industrial legacy. In terms of citizen participation, the possibilities for citizens to participate in planning are emphasized and encouraged politically [13].

3.3. Methods and Empirical Material

Tree main methods were used in this study; focus group interviews with citizens, individual semi-structured interviews with planners, and thematic analyses of citizen contributions via CityPlanner™ in four different applications.

Six focus group interviews were conducted to gauge how citizens perceive their participation in planning, the functionality of CityPlanner™ through test sessions of the tool, and citizen involvement in climate-related planning. Two focus group interviews were conducted with residents in a central, flood-prone city district, Lagerlunda (FG1, FG2). Residents from this district were invited since they are particularly exposed to climate risks and since several new detail plans are being developed in adjacent districts. Three focus group interviews were held with students in the ages 15-16 years from a centrally located secondary school (FG3-FG5). The high school students were invited since they "are traditionally an under-represented demographic when it comes to participating in urban planning and decision-making" [29] and thus a key group to involve. Moreover, students are dependent on efficient and safe biking and walking infrastructure, presented as a prioritized climate change mitigation action in Norrköping. One focus group interview was held with elderly citizens from a local compound of the pensioners' national association and university students (FG6). Elderly people are frequently described as relatively unfamiliar with using online tools, which motivated the joint assessments of the tool for citizen groups with different technical literacies. All focus group interviews lasted between one and a half to two hours and were recorded and transcribed.

Ten semi-structured interviews were held with officials at the municipal planning department, including a wide range of professions: city architect, comprehensive planner, 3D architect, city development coordinator, communicator, detailed development planner, water planner, climate risk coordinator, climate adaptation coordinator, and traffic planner. This allowed for different perspectives and experiences on online tools, citizen participation, and planning for climate and environmental change. The interviews lasted between 45 and 90 minutes and were recorded and transcribed.

Additionally, citizen contributions on four applications of CityPlanner™ in Norrköping were collected and analyzed using compilations of inputs and access logs provided by the municipality. The *Urban Vision* application aimed at collecting ideas for urban development in a part of the city center, generating 165 contributions. *The Garden City Hageby* application aimed at collecting ideas for development of a city district 2 km from the city center with a focus on new development and utilization of green space, generating 155 contributions. The *Sociotope Application* aimed to crowdsource the use of urban parks and nature, generating 106 contributions. Climate and environmental issues

were not asked for explicitly in either of these three applications. *The Future Mobility Application* aimed at collecting information about the general traffic situation in the urban parts of Norrköping, generating 45 contributions. Climate and environmental issues were not asked for explicitly, but implicitly due to the topic at hand.

To examine whether a citizen contribution via the OPT considered climate change issues, all 471 analyzed contributions were categorized regarding explicit references to e.g., reduced traffic emissions, improved public transport, biking or pedestrian routes and reducing climate risks.

4. Results

The empirical material above has been combined to assess the accessibility, utility and results of the OPT CityPlanner™. For *accessibility*, transcripts from individual interviews and focus groups were used to analyze how CityPlanner™ is perceived as a medium for participatory intervention and how available it was perceived to be. This includes how the OPT has been implemented in planning processes in Norrköping, how familiar and informed planners and citizens are with the OPT, and how the interviewees perceive the relevance of the OPT for citizen participation. For *utility*, foremost focus group interview transcripts but also, to some extent, individual interview transcripts were used to analyze the utility of the tool in terms of creating opportunities for learning and increased engagement for citizen interaction. This material was also used to assess the general usability of CityPlanner™, including its ability to stimulate debate between citizens and to provide feedback from planners to citizens. For *results*, compilations of citizen contributions and transcripts were used to analyze to what extent and how citizen contributions relate to climate change topics, and how these inputs could inform related municipal planning.

4.1. Accessibility of CityPlanner™ in Municipal Planning

Generally, the interviews with planners reveal that during the last years the municipality has tested a variety of activities intended to spur citizen interaction in planning by using, e.g., smaller public hearings, neighborhood consultations and CityPlanner™. As highlighted by several respondents, the focus has been on engaging more people to participate in debates about the future attractive city by using digital media for communication about, e.g., new city districts, parks and recreation, utilizing the municipality owned Visualization Center (visualiseringscenter.se) and setting up a new website for urban regeneration called "Next: Norrköping". CityPlanner™ has been applied in a number of planning processes, but according to respondents, its use was dependent on time, competence and interest by individual planners responsible for these planning processes, which has made the OPT sporadically used for different types and in different stages of the processes.

4.1.1. Information Provision

Several of the interviewed planners expressed the need for an organizational routine on how and when to use CityPlanner™ to be able to develop the general competence of using it in planning, as argued by a communicator: "I think it should be obligatory to send plans to the planning office to include in the tool, that material is most often available, but that routine is missing today."

Making citizens more familiar with the OPT is viewed to facilitate citizen engagement in planning. CityPlanner™ is here seen promising since it could facilitate more regular and continuous dialogues. From their current experience, however, planners considered it difficult to communicate to citizens how the tool is used in the municipality and how citizens can comment on recurrent planning. Consequently, the content in planning is seen communicated but not how citizens can contribute. For example, citizens can subscribe to newsletters about planning in the city, but less information is available about how people can participate, particularly through CityPlanner™.

Building on the focus group interviews, citizens requested more accessible information on planning in general, and on CityPlanner™ in particular. At current, citizens find the information fragmented and hard to find, as the following quotes illustrate: "I think that it is hard to find it. I looked at both the

municipality's website and on CityPlanner's but I didn't find it" (FG5); "Put it on their homepage, send info about where to look" (FG1).

The lack of accessibility is described here as one of the reasons why citizens do not engage in planning at present.

4.1.2. Audiencing

Planners are aware that several social groups, such as younger and elderly and women with foreign heritage, are underrepresented in the standard planning processes. The use of OPTs has, according to the planners, facilitated reaching some of these underrepresented groups: "All of a sudden we reached parents of small kids, mostly women, to a much higher degree than before. They had a lot of opinions. But for many of them, it is hard to come to a meeting at 18:00. You don´t have the time and strength or you don´t want to prioritize that. But many entered at 20:00, 21:00 on the web".

Focus group participants, however, consider it as a general problem that the municipality not sufficiently target citizen groups with the highest stakes, such as residents in areas surrounding a detail plan. This was exemplified in one of the focus group discussions with residents in Lagerlunda who argued that they had not been explicitly asked to comment on a nearby detail plan, despite the fact that it will impact them a lot, not least during the construction time.

4.1.3. Relevance

For citizens, relevance is a key aspect for participating in planning, in particular related to two issues. First, citizens emphasize that the municipality should provide a convincing case that their views will be heard, which was referred to as one barrier for engagement at present, as one focus group participant stated: "Surely I can provide comments and make my voice heard, but if I do not *know* what will happen with that view, then it probably does not matter" (FG6).

Providing examples of proposals that have been realized or a description of how inputs are used in principle is thus considered of great importance yet seen as often lacking. Secondly, relevance also relates to the questions posed in OPT applications. The four analyzed applications in Norrköping resulted in 471 citizen contributions, well above what was obtained through conventional processes on similar topics [13]. Most of the contributions were voicing a critical concern (see Section 4.3.2.) and proposing something to address, indicating that the question posed in the OPT were considered relevant to spur debate. This was for example showcased in one of the focus groups discussing pedestrian crossings when responding to the question in the OPT asking how transportation in the city can be improved: "I think that clarity is key. Children often learn that these white lines mean a pedestrian crossing. I used to work at a childcare center, so I draw upon my experience from there. There are too few pedestrian crossings that are clearly marked in Norrköping" (FG6).

The discussion above contained references to several places lacking pedestrian crossings and described how that contributes to a feeling of being unsafe and making it harder to walk in the city. Similar discussions with school children elaborated on biking in the city, seen as unsafe when biking on streets that become narrow due to parked cars, and as a source of unsafety for pedestrians due to narrow sidewalks and unclear separation of biking and walking.

4.2. Usability of the Tool for Citizens and Planners

The application of CityPlanner™ in the four plan processes in Norrköping, and the interviews held with citizen groups and planners, has provided a valuable testbed for investigating different aspects of the usability of the OPT. As seen below, using the OPT is generally perceived as straight forward, but according to the participating citizens, the municipality does not apply the OPT in a way that utilizes its full potential. Although generating more debate among a wider array of citizens in general, more efforts are seen to be needed to make these debates better linked to future planning and to show how citizen contributions inform planning.

4.2.1. Empowerment and Engagement

When used online, CityPlanner™ can allow citizens to explore the plan process at hand and submit contributions, which are displayed through the graphical interface. Citizens can also comment on, like or dislike contributions from other citizens. While citizens use the latter function to some extent through the online application, the analyzed contributions in the four applications of CityPlanner™ rarely seem to address a more general debate on planning (see Section 4.3). In the focus group discussions, however—when CityPlanner™ served as a means for face-to-face discussions—citizens frequently reacted on other citizens' contributions and provided inputs on how planning better can address, e.g., public transportation, city development and climate related risks. Several citizens argued that this is due to the more interactive forum for debate provided by the face-to-face meetings, but also to the lack of contextual information from the municipality in the online application the OPT, which became tangible first during the focus group discussions. In the tested application of CityPlanner™, the municipality provided very little data and information in the application to explain the planning context and the key challenges at hand. Having less information from the municipality to react to, several participants argued, limits their ability to contribute to concrete planning. Participants, however, saw the potential of the OPT to generate such context for citizen dialogs, as, e.g., presented during one of the focus group discussions: "It [CityPlanner] can make plans easier to grasp" (FG4).

Nevertheless, despite the lack of visualized contexts for planning, the geographic digital presentation of the current city (in 3D) still seems to have spurred reasoning about both the current situation and potential improvements. However, Google Street View used in combination with CityPlanner™ during the focus group discussions seem to have provided a sufficient overview of the current city, which was voiced by citizens. As argued, this questions the expensive use of 3D visualizations when not utilized to also provide the desired context for planning.

In contrast, planners generally emphasized the power of the detailed 3D geographic visualization of the current city as an avenue to constructive citizen dialogues, as argued by one of the planners: "It [CityPlanner in 3D] makes it easier to grasp future changes in the physical environment resulting from the implementation of development plans."

However, planners also acknowledge that more information as base for citizen dialogues via the OPT would be preferable to better spur online dialogues: "To demand easy drawings/sketches from the builders and discuss that with citizens in the tool before the decision is taken would be a productive way for discussions".

In terms of engagement, the sheer volume of contributions provided through the OPT, and the discussions held with citizens, signals that the OPT appears to engage a wider audience. The general response to CityPlanner™ was positive by focus group participants and several participants highlighted the potential to engage groups whose opinions would otherwise have been unheard in conventional venues. Specifically, the ability to provide individual contributions anonymously without having to expose opinions to a larger audience was seen as particularly important.

4.2.2. Functional Clarity and Technical Availability

Even though the focus groups included a broad range of citizens spanning from schoolchildren to elderly people, no concerns were expressed regarding difficulties to understand or use the functions included in the OPT. User friendliness, as assessed, related to mechanisms for exploration and providing contributions was generally considered high, as one of the more senior participants concluded: "We are far from data experts, but we are very much able to use the tool and thereby provide input to the planning process." (FG6).

Another indication of the high user friendliness is the fact that the focus group discussions almost exclusively focused on the intended planning issues without being interrupted by technical misunderstandings or problems related to the main functionalities.

As a consequence, the discussions about clarity and technical availability during the focus group interviews did not focus mainly on the current usability of CityPlanner™, but rather on the lack

of mechanisms for providing better contributions to ongoing planning. To use the full potential of the tool, focus group participants requested mechanisms to take a more active role in the planning by, e.g., dissect and comment on different initial suggestions for what a plan should include to have something more concrete to discuss, as presented during one of the focus group discussions: "The municipality should develop a few ideas to select from" (FG1).

The possibility to include concrete planning ideas, as requested by citizens, is possible in CityPlanner™ and has been included in other municipalities. Consequently, the reasons why this has not been done in Norrköping seem rooted in unclear routines for how to use citizen proposals in planning (see Section 4.1) rather than in deficient mechanisms in the tool.

4.2.3. Feedback

The communicative aspects of CityPlanner™ were considered particularly important, both regarding the tool functionality and for ensuring a sustained engagement. Many participants stressed the importance of mechanisms for receiving feedback on their contributions. Such mechanisms should arguably compile and show citizen contributions, as well as visualizing overall patterns. As one participant put it: "I think citizens should have a clear role in the planning of infrastructure. However, it is important that the input can be filtered to reduce noise." (FG3).

In addition to compiling citizen contributions and describing how it has been used in concrete plan proposals, seen as a key development need of the OPT, one concrete suggestion was also to include a mechanism for providing location specific feedback targeting, e.g., a city district. Such a mechanism could, for example, target neighborhoods or areas with a clear connection to a specific plan, and thereby, invite particular citizens with high stakes to participate. The absence of such directed involvement was seen to reduce the engagement at current.

Comparably, out of all usability aspects assessed, the lack of feedback mechanisms in the OPT was the most frequently stressed obstacle for engagement by the interviewed citizens.

4.3. Potentials of Citizen Contributions to Inform Climate Related Planning

In the four analyzed applications of CityPlanner™ in Norrköping, 71 (15%) of the 471 contributions submitted concerned climate change or related environmental aspects. In the two applications focusing on general urban development, the share of climate related contributions was 10% and 16%, respectively. A notably higher share (36%) was found in the 'future mobility' application and 8% in the 'sociotope' application. The results indicate that citizens do submit contributions that relate to climate change through the OPT, even though it is not explicitly asked for, most commonly on transport and mobility.

4.3.1. Context

The analysis of citizen contributions makes it clear that many provide detailed descriptions of situations and risks which are important to address in order to plan for a more robust and sustainable city. In some cases, contributions take the perspective of the individual, but contributions also address general trends and risks which would be hard for planners to comprehend without citizen inputs, as exemplified in the following contributions: "Here you find a rich birdlife with a large colony of black-headed gulls at "the rocky islet" and many Canada geese and ducks. During bid migration periods-spring and autumn-many sea birds rest on islets of the stream" (Sociotop Application); "When it rains, there are many large puddles at this pedestrian route, from the miniature golf to the crematorium" (Sociotop Application); "Ban car traffic! A cozy square very close to the water, not very nice to take a cup of coffee or a lunch due to the car traffic" (Future Mobility Application). These examples contain descriptions of the context which planners could use. As for the first contribution, such knowledge would be hard for the planners to obtain from other sources.

Interviewed planners see an active city, social integration, more green areas, climate adaptation and sustainable transportation as key planning issues in Norrköping. Planners acknowledge that citizens are able to provide inputs that can facilitate planning on these topics, particularly knowledge

about the place where they live and how they use the city, as for example argued by two of the interviewed planners: "It is so important to involve citizens in planning due to social sustainability and because they possess important information about how they behave ... we have to know for example how people travel to understand how to build public transportation."; "It is important to get local knowledge about a place early on, which can give us better knowledge about for example important areas for recreation."

To be useful for planning, some planners argued that more general citizen dialogs should be applied on a city scale rather than specific dialogs for a detail plan since it can capture how citizens behave. In the focus group discussions, on the other hand, interviewees did not only see their role as provider of the context for planning. Rather, citizens considered themselves more important as providers of concrete ideas for improving the city and by pointing out what does not work today, which demand involvement also in detail planning.

4.3.2. Needs

Few of the analyzed contributions on climate change articulate more comprehensive goals and needs for the whole municipality, which likely is a result of the often-general questions posed. Exceptions are, for instance, proposals to protect a forest, areas close to the river and urban parks from urban expansion/densification. Rather, needs often addressed specific problems in parts of the city, and particularly the perceived poor maintenance by the municipality. Similarly, needs articulated in the focus group discussions, and which were incorporated into CityPlanner™ by focus group participants during the test sessions, often relate to a perceived lack of maintenance of parks and green space, sanding of sidewalks in winter and marking of biking lanes in the city. Focus group participants argued that the municipality does not pay sufficient attention to their articulated needs which is problematic for their participation in general: "They [the municipality] should relate current issues like maintenance with new development. It´s only one municipality for citizens" (FG1).

Moreover, citizens also highlighted general qualities that they wish that planners should maintain or improve. Such qualities voiced in the focus groups were green areas, playgrounds, safety, family-friendliness and good walking and bicycle paths. In the focus groups with elderly/students, in particular commuter parking's, car free zones/streets, pedestrian crossings, access to public transport and areas appreciated by pedestrians were discussed. Here, the ongoing planning in the municipality was seen as a way to improve public transportation and bicycling. Such needs often implicitly relate to climate change, though this is seldom articulated.

4.3.3. Solutions

This study also finds that the analyzed citizen contributions often contain detailed proposed solutions to a specific problem. Examples include the localization of commuter parking, better pedestrian and cycling routes, planting trees to reduce traffic noise, ground stability measures, sites for urban agriculture, and new public transport routes.

Although interviewed planners generally appreciate citizen contributions on planning, they expressed different attitudes to the abilities of citizens to contribute with inputs on solutions related to climate change mitigation and adaptation. The skepticism by some of the interviewed planners related to both the perceived low ability of citizens to think of the common good, and to contribute to solving complex issues. Related to the former, one planner argued that the act of balancing self-and public interest might be difficult for citizens: "I don´t think that we can demand that all view this from the public's interest. Of course I think it would be very positive if I could get feedback that were not just 'my view gets blocked', but rather relates to issues like 'this is how I think that inhabitants in Norrköping should travel' or 'it is good for children if the environments looks like this'. I mean if people took a more overarching perspective. But that is probably too much to ask for."

Related to the latter, several reasons for why it is problematic to discuss and incorporate contributions from citizens on climate change-related topics were mentioned by the interviewed

planners. Firstly, one planner expressed that citizens' views on climate change often are polarized: " … we so clearly have two sides. The ones who think we should not worry too much about climate risks and continue as we have done, and the other who almost thinks it is too late to do something" … "with these two values, we have to create an as correct picture as possible about the scenario and try to get all to work in the same direction somehow".

To be able to perform citizen dialogs on climate risks and adaptation, planners thus want to make more use of visual interfaces which could be incorporated into CityPlanner™ as basis for more informed dialogs and to raise the level of knowledge on these issues: "visualizing it [climate risks} to make it easier to understand. Like with visualizations of a 100-year rain or the pollution in the Inner Harbor area".

In the focus group discussions, climate change risks, adaptation and mitigation were frequently addressed, signaling that at least the citizens interviewed for this study do possess relevant knowledge and interest on climate risks and adaptation solutions, which contrasts the view of planners. For example, citizens clearly see the benefit of better flood protection as a solution to mitigate flood risks in exposed areas, of which interviewees had their own experiences: "In 2011, many of us had flooding in our basements, I think it was about 70-80 households who had flooding" (FG1).

Citizens further showcased clear ideas on how flood risks could be reduced, e.g.,: "We would need dams to handle cloudburst floods" (FG1); "...you can see dams as an opportunity and not only build boring dams, you could make those into something that are used" … "you could build a skate park or a water playground" (FG2).

This illustrates that citizens are also aware of the potential co-benefits of climate adaptation that urban planners seek for. The focus groups with elderly/students also discussed measures of relevance for reducing emissions from traffic, such as commuter parking, clearer prioritization of walking and biking lanes over car traffic, and reduced velocity. This, too, indicates an ability to elaborate and debate different measures, which could provide useful input to planning processes if acknowledging and building on these potentials.

5. Discussion

Based on the results stemming from the empirical material, some general observations stand out as particularly important to discuss in relation to the posed research questions.

5.1. To What Extent and How Is the CityPlanner™ Tool Applied in Planning, and Communicated to Citizens?

Both the interviewed planners and citizens described the current use of the OPT in the municipality as problematic, which appear rooted in a lack of organizational strategy for citizen participation in planning in general, and for using OPTs in particular. Since the planning department does not yet have a policy or routine specifying what, when and how OPTs should be used, its application becomes Ad Hoc and up to each planner to decide upon. From a citizen perspective, this creates confusion and a disincentive for engagement and for familiarizing with the specific OPT. It also aggravates communication about citizen participation and the OPT for municipal planners and communicators. Our results thus support the conclusion that the mere online availability of such tools does not lead to effective participation and does not encourage people to participate by default (c.f. [10]). The use of OPTs demands collaborative learning and a distinct role in various planning processes, which must be communicated to citizens. Currently, the municipality appears to invest more in developing forms for collecting comments, than in deciding when this is of importance or how contributions should be used. Related to this, municipalities or other OPT facilitators should, in principal and/or through examples, clarify how citizen inputs are intended to be used, which appear blurred both for citizens and many planners at present.

Nevertheless, despite the unclear role and often poor information, using the OPT has generated more citizen contributions than conventional methods, and appears to reach a wider span of comment providers in terms of gender and age (c.f. [13]). However, to what extent the OPT contributes to

attracting other "hard to reach groups", such as immigrants and residents in exposed areas [5,7,19], remains unclear since the OPT lacks mechanisms for collecting such information. As argued by citizens, the municipality should be better at targeting residents in districts that are climate sensitive and located close to other planned areas, seen as key citizen groups (c.f. [14,15]). This would demand a distinct strategy of what groups/areas to reach in different types of planning processes. Here, the OPT could be used as a compliment to other forms of citizen participation to reach underrepresented groups in planning.

The CityPlanner™ tool has primarily been used to collect citizen proposals via generally formulated questions of urban development, or about topics such as green infrastructure and traffic/mobility. Though often using open questions such as "how can the city be improved", OPT-supported consultations seem to spur relevant debate. However, the interviews and focus group discussions highlight that more directed questions—linking to a specific idea of how inputs should be used—might be more engaging and could potentially provide more qualitative contributions, not least for climate change related issues. Experiences from our focus groups when using the OPT in face-to-face meetings indicate deeper debates among citizens targeting key planning issues. The results indicate that when posted online, citizens often provide input as individuals, while when used in face-to-face dialogues citizens were more likely to discuss each other's proposals (c.f. [13]).

5.2. What Are the Perceived Prospects and Pitfalls of CityPlanner™ in Mediating Citizen Contributions and Debate?

For empowerment and engagement, CityPlanner™ seems to have provided a forum for debate and interaction, judging from the intense discussions during the focus groups, but also by the amount of inputs in the assessed applications. The specific application tested in the focus groups called "Urban Vision" provides an open question where citizens are asked to share their ideas for the future city. Many detailed discussions regarding, e.g., how to improve road, walking and biking infrastructure, flood protection and how to make city districts more livable were discussed after adding these comments in the OPT. Thus, despite the minimal background information provided in the OPT, citizen´s contributions and discussions aligned with the planning at hand, not least for topics related to climate change adaptation and mitigation. Nevertheless, foremost citizens and but also planners demanded visualized contexts (e.g., climate risks to address) and planning alternatives to better inform these discussions. Potentially, these elements could further stimulate debate, improve and streamline contributions provided, and facilitate learning for citizens and planners that use the OPT. However, as discussed in the previous section, this would demand a municipal strategy for participatory planning and for using OPTs on, e.g., climate sensitive urban regeneration, which is currently lacking.

For functional clarity and technical availability, i.e., user friendliness of the OPT, the results indicate that participants find it easy to use. Focus group participants agreed that it was straight forward to add contributions and to comment on inputs from other citizens, despite their different prior knowledge of using digital tools and the internet in general, in contrast to results of earlier studies (e.g., [20,26]). However, the current use of 3D animations presents a potential obstacle, as 3D is used primarily for visualizing the current city as a point of departure for discussing future planning. The requested context and planning alternatives could here have been included to make better use of the advanced technology of the OPT. At present, 3D makes the OPT expensive to develop and heavy to load. If using 3D to, e.g., digitalize municipal data related to the planning context discussed, and letting citizens use such technology to present their suggestions (as done through CityPlanner™ in, e.g., Gothenburg and Stockholm [12]), it could facilitate realizing the full potential of the OPT as requested by citizens.

For feedback, this study finds a strong connection between feedback and citizens' willingness to use the OPT and participate in resulting discussions (c.f. [7,9]). In the focus groups, citizens requested three types of feedback based on their contributions. A first type can be coined *synthesis feedback*, where citizens request compilations of trends and patterns of provided inputs. A second type is

topic-specific feedback, where citizens request feedback on how planners/decision-makers interpret the patterns of citizen contributions and what issues/challenges these can inform. A third type can be labelled *contribution-specific feedback*, where citizens request feedback on how their own and other citizens´ contributions have been acted upon in concrete plan proposals. If jointly implemented, such feedback mechanisms could make it easier to see how citizen participation informs planning, which, in turn, would increase engagement. Potentially, it could also foster a broader discussion about the benefits and challenges of citizen participation and let that inform municipal strategies for participation. Developing such or similar feedback mechanisms thus appear central for further OPT development and application. Building on prior knowledge gained in the field of Qualitative GIS could support developing thematic coding of citizen contributions to show trends and make it easier to act on commonly articulated needs. This, however, would demand that planners increase their capacity code inputs in the OPT in relation to the planning processes at hand [30,31].

5.3. What Contributions on Climate Change Adaptation and Mitigation Did Citizens Add in the OPT, and How Could These Contributions Support Planning?

The analysis of citizen contributions in the OPT and in the focus group discussions showed that citizens are able to propose many relevant descriptions of, e.g., climate vulnerability and measures for adaptation and mitigation which could benefit planning. For example, citizens approached climate adaptation through their own experiences of flooded basements and demonstrated knowledge about the problems in a low-lying area as well as effective and attractive measures such as stormwater dams. Planners however showed skepticism about citizens' ability to do this (c.f. [11]), for example, due to the complexity of climate impacts and people's ability to see to the common good. Moreover, since such contributions are produced bottom-up, and it is generally unclear what decisions they are meant to inform or what challenges they should target, they seldom relate explicitly to municipal goals. This seems to make contributions hard to use for planners. The skepticism by planners further seems rooted in a low internal knowledge and lack of strategy on how to communicate about such issues, and thus how to apply OPTs for spurring climate related debates. By providing a better description of the planning context, key climate challenges and an idea for how proposals can be used [8], citizen contributions via the OPT could benefit planners by e.g., providing a gross list of concrete solutions anchored in local needs by citizens, provided at a very low cost. In accordance with conclusions by Moser and Pike [14], not using citizen contributions properly and not investing in engagement capacity appears as a missed opportunity for developing supported plans addressing climate change.

The above also reveal that planners and citizens have different perspectives on the role of citizen contributions in planning. Planners interpret comments as primarily providing a more valid representation of the context for planning, and to some extent the needs of citizens. In contrast, citizens would like to take a more active part in regenerating the city. This is mirrored in the often too general questions posed in the OPT, and the contributions provided by citizens which often provided detailed descriptions of how e.g., traffic, flood protection or maintenance could be improved. This also indicates that the various forums for citizen interaction in the municipality are not synced. Using different yet interconnected OPTs both for planning dialogues and maintenance reporting and having a clear responsibility division specifying what municipal functions that should handle different types of citizen contributions, seem beneficial as in line with conclusions by Kahila-Tani et al. [8]. This could avoid a situation where many contributions are not acted upon due to limited liability and increase the ability to intercept more types of citizen contributions through a set of OPTs. Citizen participation could consequently become more efficient for the municipality and more engaging for citizens.

6. Conclusions

This study set out to analyze how a widely adopted OPT is perceived by citizens and planners as a means for participatory planning intervention and as medium for citizen dialogue on climate change, to detangle some of the pitfalls and prospects of this still novel way of practicing citizen dialogues.

In the studied case, the most significant challenges for efficiently engaging citizens in planning in general, and on climate change-related topics in particular, appear not rooted in how users view the technical functions of the OPT. On the contrary, the tested tool was considered easy to use in general, which cut across groups with different prior knowledge of using digital tools and appeared a productive avenue for citizen dialogs. This highlights a need to direct more research focus to questions on how OPTs can be streamlined in municipal planning processes, and what capacity development is needed for this to happen. The OPT was nevertheless seen as lacking sufficient mechanisms for feedback from planners to citizens on how citizen contributions are interpreted and used, and visualized data on planning processes and challenges at hand. Not using the advanced 3D technology beyond representing the current city, for example by letting citizens react on or propose various designed plan proposals, and not integrating contextual data and information in the application of the OPT, appears to be a missed opportunity for facilitating learning about planning and the challenges at hand. How to develop sufficient feedback mechanisms in OPTs that link to planning at hand, as e.g., proposed here, stands out as an important research topic.

More importantly, however, this study finds that the use of the OPT as a means for facilitating citizen dialogue on planning is limited by currently undeveloped municipal strategies for citizen participation and for using OPTs in planning.

First, the lack of an organizational strategy for citizen participation is reflected in how the OPT is used. Currently, the OPT is used sporadically in some planning process, in different stages and is up to each individual planner to decide upon. The OPT is poorly communicated internally and to citizens. Consequently, citizens' incentive to participate is weakened and the municipality risk getting less useful contributions (c.f. [7]).

Second, the distinction between participation in future planning and on maintenance is unclear. As the OPT is currently used, citizens provide input on both, which is hard to handle due to the delimited role of municipal officials. Citizen dialogues could be made more productive if introducing a set of OPTs with complementing roles that separate inputs on planning on the one hand, and on maintenance on the other (c.f. [9]). This could make it easier for citizens to know how to contribute, and for municipal officials to act on contributions provided. However, this necessitates a strategy for OPT-mediated dialogue which is communicated to citizens and continuously followed-up, showcasing the contributions generated and how they are acted upon in concrete plan proposals.

Third, citizens' and planners' views on the role of citizens in planning diverge. Planners perceive citizens mainly as providing the context and needs for planning, for which the OPT applications predominantly have been applied. Citizens, however, see their ideas for planning as an important reason for engagement. As the OPT currently is used in planning, thus, it creates a relatively weak incentive for citizens to engage in the long run.

Fourth, while online OPTs result in more citizen input and have the potential to increase the participation of some currently underrepresented groups (c.f. [13]), it still seems to attract relatively resourceful social groups. To reach more marginalized citizens, the OPT could be embedded in face-to-face meetings. Here, too, the planning organization needs to determine their ambition and in what ways such dialogues should be carried out.

Fifth, related to generating contributions on climate change topics in planning, the municipalities appear to be missing out on good opportunities to fully use the experiences, knowledge and ideas by citizens (c.f. [14]). The analyzed citizen contributions via the OPT and in focus group discussions revealed that citizens certainly could contribute with relevant ideas for adaptation and mitigation, while planners were skeptic about this aspect. If a distinct strategy for participation on climate resilience and mitigation could be mirrored in the questions posed, in the visualized contextualized data and in

the feedback provided, the OPT showcases potentials to contribute with a forum for productive and engaging debate on climate change among and with citizens.

Based on the findings from this study, we thus propose research that focuses on how strategies that integrate OPTs in local planning could be set-up and communicated, and how visualization of the context for and results of citizen dialogues on climate change-related planning could be developed and applied.

References

1. Stirling, A. Analysis, participation and power: Justification and closure in participatory multi-criteria analysis. *Land Use Policy* **2006**, *23*, 95–107. [CrossRef]
2. Stirling, A. "Opening up" and "closing down". Power, participation, and pluralism in the social appraisal of technology. *Sci. Technol. Hum. Values* **2008**, *33*, 262–294. [CrossRef]
3. Conrad, E.; Cassar, L.F.; Christie, M.; Fazey, I. Hearing but not listening? A participatory assessment of public participation in planning. *Environ. Plan. C* **2011**, *29*, 761–782. [CrossRef]
4. Parkins, J.R.; Sinclair, A.J. Patterns of elitism within participatory environmental governance. *Environ. Plan. C Gov. Policy* **2014**, *32*, 746–761. [CrossRef]
5. Stenberg, J.; Abrahamsson, H.; Benesch, H.; Berg, M.; Castell, P.; Corkhill, E.; Danielsson, S.; Fridén, A.; Styffe, R.H.; Jadelius, L.; et al. *Framtiden är Redan Här: Hur Invånare Kan Bli Medskapare i Stadens Utveckling [The Future Is Already Here: How Citizens Can Become Co-Creators of Urban Development]*; Majornas Grafiska AB: Gothenburg, Sweden, 2013.
6. Michels, A.; De Graaf, L. Examining citizen participation: Local participatory policy making and democracy. *Local Gov. Stud.* **2010**, *36*, 477–491. [CrossRef]
7. Afzalan, N.; Sanchez, T.W.; Evans-Cowley, J. Creating smarter cities: Considerations for selecting online participatory tools. *Cities* **2017**, *67*, 21–30. [CrossRef]
8. Kahila-Tani, M.; Broberg, A.; Kyttä, M.; Tyger, T. Let the citizens map—Public participation GIS as a planning support system in the Helsinki Master Plan process. *Plan. Pract. Res.* **2016**, *31*, 195–214. [CrossRef]
9. Ertiö, T.-P. Participatory Apps for Urban Planning—Space for Improvement. *Plan Pract. Res.* **2015**, *30*, 303–321.
10. Poplin, A. Playful public participation in urban planning: A case study for online serious games. *Comput. Environ. Urban Syst.* **2012**, *36*, 195–206. [CrossRef]
11. Faehnle, M.; Bäcklund, P.; Tyrväinen, L.; Niemelä, J.; Yli-Pelkonen, V. How can residents' experiences inform planning of urban green infrastructure? Case Finland. *Landsc. Urban Plan.* **2014**, *130*, 171–183. [CrossRef]
12. Babelon, I.; Ståhle, A.; Balfors, B. Toward Cyborg PPGIS: Exploring socio-technical requirements for the use of web-based PPGIS in two municipal planning cases, Stockholm region, Sweden. *J. Environ. Plan. Manag.* **2017**, *60*, 1366–1390. [CrossRef]
13. Hjerpe, M.; Glaas, E.; Storbjörk, S. Scrutinizing Online Participatory Tools for citizen involvement in planning. *Politics Gov.* **2018**, *6*, 159–169. [CrossRef]
14. Moser, C.M.; Pike, C. Community engagement on adaptation: Meeting a growing capacity need. *Urban Clim.* **2015**, *14*, 111–115. [CrossRef]

15. Juhola, S.; Goodsite, M.E.; Davis, M.; Klein, R.J.T.; Davídsdóttir, B.; Atlason, R.; Landauer, M.; Linnér, B.-O.; Neset, T.S.; Glaas, E.; et al. Adaptation decision-making in the Nordic countries: Assessing the potential for joint action. *Environ. Syst. Decis.* **2014**, *34*, 600–611. [CrossRef]

16. Russo, P.; Lanzilotti, R.; Costabile, M.F.; Pettit, C.J. Towards satisfying practitioners in using Planning Support Systems. Computers. *Environ. Urban Syst.* **2018**, *67*, 9–20. [CrossRef]

17. Czepkiewicz, M.; Jankowski, P.; Młodkowski, M. Geo-questionnaires in urban planning: Recruitment methods, participant engagement, and data quality. *Cartogr. Geogr. Inf. Sci.* **2017**, *44*, 551–567. [CrossRef]

18. Laatikainen, T.E.; Piiroinen, R.; Lehtinen, E.; Kyttä, M. PPGIS approach for defining multimodal travel thresholds: Accessibility of popular recreation environments by the water. *Appl. Geogr.* **2017**, *79*, 93–102. [CrossRef]

19. Hoch, C. Making plans: Representation and intention. *Plan. Theory* **2007**, *6*, 16–35. [CrossRef]

20. Schulz, D.; Newig, J. Assessing online consultation in participatory governance: Conceptual framework and a case study of a national sustainability related consultation platform in Germany. *Environ. Policy Gov.* **2015**, *25*, 55–69. [CrossRef]

21. Kleinhans, R.; van Ham, M.; Evans-Cowley, J. Using social media and mobile technologies to foster engagement and self-organization in participatory urban planning and neighbourhood governance. *Plan. Pract. Res.* **2015**, *30*, 237–247. [CrossRef]

22. Yli-Pelkonen, V.; Kohl, J. The role of local ecological knowledge in sustainable urban planning: Perspectives from Finland. *Sustain. Sci. Policy* **2005**, *1*, 3–14. [CrossRef]

23. Pelzer, P.; Arciniegas, G.; Geertman, S.; Lenferink, S. Planning Support Systems and Task Technology Fit: A comparative study. *Appl. Spat. Anal. Policy* **2015**, *8*, 155–175. [CrossRef]

24. Sarzynski, A. Public participation, civic capacity, and climate change adaptation in cities. *Urban Clim.* **2015**, *14*, 52–67. [CrossRef]

25. Glaas, E.; Ballantyne, A.G.; Neset, T.-S.; Linnér, B.-O. Visualization for supporting individual climate change adaptation planning: Assessment of a web-based tool. *Landsc. Urban Plan.* **2017**, *158*, 1–11. [CrossRef]

26. Seltzer, E.; Mahmoudi, D. Citizen participation, open innovation, and crowdsourcing: Challenges and opportunities for planning. *J. Plan. Lit.* **2012**, *28*, 3–18. [CrossRef]

27. Glaas, E.; Hjerpe, M.; Jonsson, R. Conditions influencing municipal strategy-making for sustainable urban water management: Assessment of three Swedish municipalities. *Water* **2018**, *10*, 1102. [CrossRef]

28. Glaas, E.; Hjerpe, M.; Storbjörk, S.; Neset, T.-S.; Bohman, A.; Muthumanickam, P.; Johansson, J. Developing transformative capacity through systematic assessments and visualization of urban climate transitions. *Ambio* **2019**, *48*, 515–528. [CrossRef]

29. Mallan, K.M.; Foth, M.; Greenaway, R.; Young, G.T. Serious playground: Using Second Life to engage high school students in urban planning. *J. Learn. Media Technol.* **2010**, *35*, 203–225. [CrossRef]

30. Garnett, R.; Kanaroglou, P. Qualitative GIS: An open framework using SpatiaLite and open source GIS. *Trans. Gis.* **2016**, *20*, 144–159. [CrossRef]

31. Jung, J.-K.; Elwood, S. Extending the qualitative capabilities of GIS: Computer-aided Qualitative GIS. *Trans. Gis.* **2010**, *14*, 63–87. [CrossRef]