Exploring AI supported Citizen Argumentation on Urban Participation Platforms

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Abstract

The paradigm shift in urban planning toward citizen participation originates from the Smart City concept, as politicians and scientists argue that citizens should be included in the design of their environment. This led to the development of urban participation platforms and was enhanced by the COVID-19 pandemic as on-site participation was unavailable. Past projects showed that urban participation platforms can reach thousands of citizens, but it became apparent that citizens' contributions vary widely and are sometimes not understandable and comprehensible which limits their value for urban projects. Therefore, we examined how an AI-based feedback system can increase citizens' argumentation on urban platforms. For this, an explorative comparison of two prototypes was conducted by applying Argumentation Theory and Mayring's qualitative content analysis to empirically analyze collected data. The findings highlight that the developed AI-based feedback system supports citizens and leads to more argumentative and comprehensible argumentations on urban participation platforms.

Keywords: Citizen Participation, Urban Planning Platforms, Argumentation Theory, Artificial Intelligence

1. Introduction

The ongoing digitization influences governments, economics, and society and changed the requirements for public service delivery, communication, and politicians (Larsson 2021; Spence 2021). Furthermore, the ongoing urbanization creates and increases new social conflicts in the domain of urban planning and design to which planning authorities and governments need to find solutions (Mohsin et al. 2019; United Nations - Department of Economics and Social Affairs - Population Dynamics 2018) considering the Smart City concept.

The Smart City concept describes future cities as a highly technological, connected, and sustainable with a focus on inclusion and participation to develop citizen-oriented solutions and environments that promote and contribute to society, social cohesion, and quality of life (Simonofski et al. 2017; Stratigea et al. 2015). The Smart City concept contains six dimensions in which urban planning and citizen participation can be seen as an integrated part which especially applies to the Smart Government dimension (Vasudavan and Balakrishnan 2019). To implement the Smart City concept and enable citizen participation, effective governance structures are crucial (Barrutia et al. 2022) to ensure the interconnectedness and security of data, communication channels, and participatory approaches to inclusively concern the demand and requirements of the inhabitants (Singh and Singla 2021). This can affect urban construction projects, social projects, and the development or adaptation of laws and public service delivery (Stelzle et al. 2017). Many cities are already using urban platforms to participate thousands of citizens (Royo et al. 2020; Smith and Martín 2021) and this development was enhanced by the COVID-19 pandemic as on-site participation was not available and e.g. healthcare requirements changed (Pantić et al. 2021).

Past projects have already examined urban participation platforms and are highlighting the benefits (Smith and Martín 2021). However, it is becoming apparent that discussions on urban participation platforms proceed differently compared to on-site participation, as arguments are often conducted asynchronously and anonymously due to the time and location independencies. In addition, textual contributions are often quite short and not comprehensible which aggravates the analysis by architects and urban planners to consider and create public value (Atreja et al. 2018; Haveri and Anttiroiko 2021). Therefore, it endorsed supporting citizens on urban platforms to create comprehensible and more argumentative contributions with intelligent solutions. In the domain of digital service delivery and help desks, intelligent solutions like chatbots are already explored to e.g. inform or answer questions (Collins et

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al. 2021; Lee 2020). In the field of urban planning and urban platforms, the use of AI is hardly explored which can be explained by the recent dissemination of urban platforms. Many cities are still developing, testing, and incorporating urban platforms into their administrative processes by adjusting and implementing new and changing existing regulations (Anttiroiko 2016; Frenken and Fuenfschilling 2021). However, past projects have examined approaches to summarize and classify contributions to support planning authorities and architects (Lieven et al. 2021; Nicolas et al. 2021) or to inform citizens about projects of possible interest (Arana-Catania et al. 2021). Some research was conducted about how to support citizens in the process of contribution (Borchers et al. 2022) and less about if these approaches are successfully supporting citizens. Therefore, we examined how an AI-based solution can support citizens with the following research question (RQ).

RQ: How can AI-based feedback system increase citizens' argumentation on urban participation platforms?

To answer the RQ an explorative comparison of two prototypes and two focus groups was conducted. In this paper, we describe our findings including the theoretical foundation (section 2), the research approach (section 3), the development of the prototypes (section 4), the evaluation (section 5), and the findings (section 6), which are finally discussed in section 7 including limitations and future work.

2. Theoretical Foundation

Due to urbanization and the development of Smart Cities, participation approaches are increasingly applied in urban planning to include citizens, as they have to live with the project's results, as politicians and scientists argue (Müller-Seitz et al. 2016). This led to the Citizen Design Science Model by Mueller et al. (2017), who combined existing approaches into a three-dimensional model to describe areas and interrelationships in urban participation and design.

2.1. Citizen Design Science

Citizen Design Science combines the three dimensions of Citizens Science, Citizen Design, and Design Science and can be used as a toolkit to enable citizen participation in urban planning (Mueller et al. 2017). Each dimension is a combination of two of the areas of citizens, design, and science as these are crucial and induce each other (Torrecilla 2019).

Citizen Science describes how citizens' requirements, needs, and ideas can be elicited in urban planning considering existing frameworks (Nicolas et al. 2021), the urban projects' conditions, and the participation methods (Mueller et al. 2017; Prestopnik and Crowston 2011). This includes on-site/analog and/or digital participation and methods like interviews, workshops, surveys, etc. (Stelzle and Noennig 2017). The scientific literature describes the advantages and disadvantages of the participation approaches, as, for example, digital approaches require a certain IT affinity of the participants. On the other side, they are more time-independent and not limited by space as on-site approaches which are therefore often only temporal and limited concerning the number of participants (Smith and Martín 2021). An overview of Citizen participation methods is provided by Stelzle and Noennig (2017) in the paper *A Database for Participation Methods in Urban Development*.

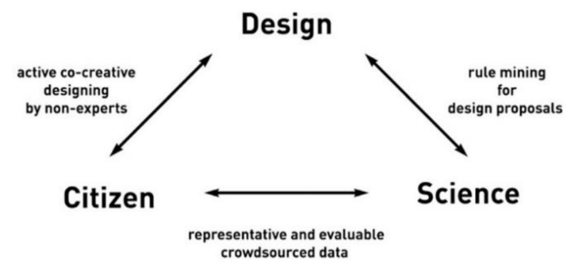

Figure 1. Citizens Design Science Model

Citizen Design determines how citizens actively contribute to the design of an urban project's vision, e.g. future buildings or parks (Mueller et al. 2017). This can be conducted differently, and the format is affected, by the determined approach (Citizen Science). The contribution of design can be textual and/or visual and was explored in past projects in which participants described parks, buildings, or entire districts on paper, digital whiteboards, mobile and/or stationary devices textually or in 2D or 3D maps (Lieven 2017; Lv et al. 2016).

Design Science describes the process of affiliating design requirements from citizen contributions (Mueller et al. 2017) to support architects and planners to design the project's objective e.g. a park or community place (Altrock 2022). Past projects showed, that transferring the contributions into a specified project's objective is more advanced than anticipated and that the meta-requirements of the urban projects and the technical participation approach and analysis of data should be determined before participation, to ensure the feasibility (Repette et al. 2021). These concerns file formats (e.g. Excel, JSON, CSV) in which the contributions are documented and specifications of how collected data should be analyzed, including manual or automatic processes (Cai 2021). Especially for automated approaches, the file format is crucial as visual contributions e.g. 2D (e.g. JPEG or PNG) or 3D maps (e.g. in Unity) are difficult to analyze as these models are stored as vector graphs or individual file formats (Hofmann et al. 2020; Rzeszewski and Orylski 2021).

2.2. Urban Participation Platforms

Urban participation platforms enable digital citizen participation and are comparable to social media platforms. They are removing time and space limitations and many cities such as Madrid (Royo et al. 2020), Barcelona (Smith and Martín 2021), Hamburg (Lieven 2017), Dresden (Jannack et al. 2020), etc. are utilizing them. Past projects in Spain, have shown, that it is possible to carry out urban participation projects with thousands of citizens. Furthermore, they upgraded urban platforms to an incorporated part of the public administration by implementing functionalities for citizens to submit applications for example new urban projects, change laws, regulations, and public services, and thus can proactively influence the governments' activity (Royo et al. 2020). During the COVID-19 pandemic, urban platforms were of high relevance to communicate and participate with citizens as urban requirements concerning public health have changed and increased as on-site approaches were unavailable (Sharifi and Khavarian-Garmsir 2020). However, past participation projects have shown that citizen contributions e.g. in discussions, forums, and surveys are not always helpful if they are not comprehensible and/or reasonable (Barrutia et al. 2022; Simonofski et al. 2017). In textual contributions, this often applies as the contributions are quite short, and sometimes only contain bullet points or keywords with less argumentation which would enable architects and designers to understand what and why citizens have certain requirements, ideas, and visions (Poorazizi et al. 2015). This also applies to 2D and 3D models as they often only contain the final contribution, and an extensive argument that would explain and show the development and intermediate steps is missing (Repette et al. 2021). Therefore, it is important to find solutions to support citizens to contribute comprehensible contributions to lay a transparent, and reasonable basement for urban projects and to support subsequent processes and design science (Krätzig and Warren-Kretzschmar 2014).

2.3. Argumentation Theory

Argumentations were systematically studied by the British philosopher Toulmin (1922-2009) in the mid-19th century. He focused on spoken words in English and developed the Argumentation Theory in 1958, which describes the process and properties of argumentation (Smiley 1958).

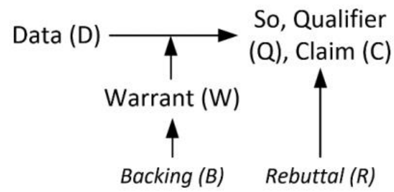

Figure 2. Toulmin Argumentation Theory

Toulmin's Argumentation Theory defines that discussions consist of the components of Data, Warrant, and Claim to be approved as an argumentation (Verheij 2005) (cf. Figure 2). Data describes facts about a certain topic. The warrant represents the derivation from data or facts to a claim. The Claim itself is an assertion or statement. In addition, Toulmin describes the Backing, Rebuttal, and Qualifier. The Backing supports the warrant as it contains further information (Lewiński and Mohammed 2016). The rebuttal constrains the Claim, and the Qualifier is described as an exception. Backing, Rebuttal, and Qualifier are not mandatory for an argument but can increase its quality and reasoning.

An example of argumentation is provided with the following sentence, "Harry was born in Bermuda (D). A man born in Bermuda will generally be a British subject (W). On account of the following statutes and other legal provisions (B). So, presumably (Q), unless his parents were aliens (R) Harry is a British subject (C)" (Lewiński and Mohammed 2016).

Argumentation Theory describes sufficient arguments as coherent and reasoned (Eemeren 1995). In the domain of citizen participation on urban platforms, this can be used as a reference to estimate and encourage citizens to submit comprehensible and transparent contributions to support Design Science (Kusumastuti et al. 2022), as argumentations (contributions) that are not comprehensible and incomplete might only be considered to a limited extent. This should be prevented in crowd-based and participatory approaches (Poorazizi et al. 2015). In on-site participation, argumentation is enabled via face-to-face discussions which are often moderated by professionals. On urban platforms, this is hardly possible as the communication can be asynchronous and depending on the number of participants and discussions, not viable with human moderators (Khan et al. 2017).

3. Research Approach

To examine how argumentation on digital platforms can be supported with AI, we conducted an explorative comparison of two prototypes. For this, we synthesized the existing knowledge in the domains of urban planning, Citizen Design Science, urban participation platforms, Argumentation Theory, and AI-based response systems e.g. by Lieven (2017) and Atreja et al. (2018) applied the following research design.

3.1. Explorative Design

Due to the lack of results in the area of AI-based feedback systems to support citizens on urban participatory platforms, we decided to follow an empirical approach, to enable an extensive elicitation of qualitative data and an in-depth discussion and analysis (Berger et al. 2018; Tremblay et al. 2010). To collect data and compare citizens' contributions, two groups of different participants who are conducting the same task on two different prototypes as shown in Figure 3, are analyzed.

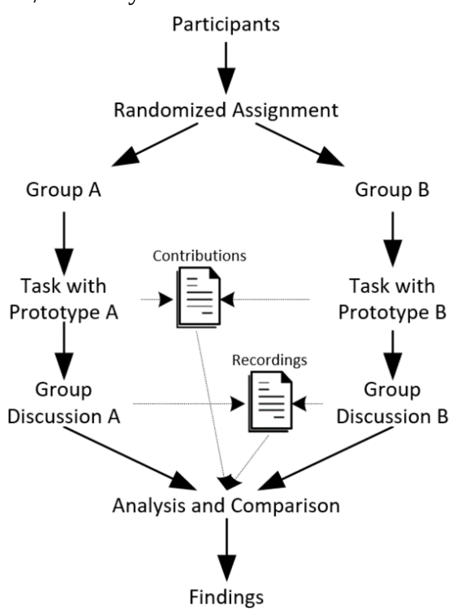

Figure 3. Explorative Design

All participants are randomly assigned to group A or group B by using a web-based program, to prevent arrangements under the participants (Dennis and Valacich 2001). In addition, both groups should contain the same or similar number of participants to prevent data biases (Levy and J. Ellis 2011). After the assignment, both groups receive the same description of a fictional urban project which is comparable to a real urban project containing information about the projects idea, location, and further specifics to define its scope and the objective of the participation (Repette et al. 2021; Stelzle et al. 2017). The prototypes of the groups vary. Both are representing the same part of an urban platform including the mentioned descriptions and guiding criteria, but only prototype A contains an implemented AI-based feedback system as we want to examine its influence on the contributions (cf. Figure 3). The feedback is a response to the contribution and is intended to increase the interaction between the human and the machine to simulate a content-related exchange. The task of the participants is to participate and contribute their requirements, ideas, and visions as conducted on urban platforms. For this, the participants have up to 20 minutes.

During the processing of the task, all submitted contributions are stored by the prototypes. After the processing of the task, each group discusses the use of the prototype concerning the AI-based feedback system (group A) and a theoretical application (group B) by using guiding questions to examine additional functions, alternative designs, and further feedback systems. Both discussions are recorded to enable a systematic evaluation and analysis in which prototype B is used as a baseline, as it represents the existing participation on urban platforms, while prototype A serves as an extension, to explore the impact and influences of the AI-based feedback system.

3.2. Analysis of the Data

The stored participants' contributions and recorded data are systematically analyzed by applying the structured content analysis after Mayring (Mayring and Fenzl 2014). The contributions are examined deductively concerning the components of Argumentation Theory (Lewiński and Mohammed 2016), as described in section 2.3, by marking all related paragraphs which enables a systematic comparison of the contributions of both groups.

Furthermore, the group discussions are analyzed by applying Maying's summarization as a deductive-inductive approach to reduce the discussion to key statements (Mayring 2014) and to examine the use and perception of the AI system, as well as further adaptions. The deductive categories are specifying the participants' perceptions and are:

1. Impact of (the) feedback on argumentation
2. Perception of the feedback
3. Design of the prototype

Both systematic content analyses are conducted by using the application MAXQDA which is developed and widely used for quantitative analysis with e.g. text, spoken language, and/or videos, and supports systematic comparisons and visualizations of data (Rädiker and Kuckartz 2019).

4. Development

Both prototypes were developed as web applications using XHTML for the front-end and Java for the middle-end to implement the AI-based feedback system and to store all submitted contributions with the session ID and time in a CSV file to enable the evaluation of the contributions over time.

4.1. Design of the Prototypes

The front ends were developed concerning existing urban platforms and recent research (Borchers et al. 2022) but do only contain a minimum of the functionalities to focalize the impact of the AI-based feedback system. The contributions are text-based, as it often applies in urban platforms, and are entered in a text field (Steiniger et al. 2016). Prototype A evaluates the participants' contribution by including the six categories *Public Services and Safety*, *Mobility and Accessibility*, *Living and Social Networks*, *Education and Labor Market*, *Recreational Areas and Green Spaces*, and *Economy and Innovations* (Vasudavan and Balakrishnan 2019). Categories or further suggestions are commonly part of urban project description, to inform participants about possibilities, provide orientation, and clarify the scope of the participation (Repette et al. 2021; Stelzle and Noennig 2017). Figure 4 shows the graphical user interface of prototype A including an exemplary participant contribution. The participants of group A can experience the AI-based feedback system by using the *Analyze contribution* button and can incorporate the feedback into their contributions but are not forced to do so. Therefore, the feedback is not estimated continuously, but immediately whenever a participant requires it. The further buttons can be used at any time to save the contribution, as a minimum length is not required, or to delete it (Ertiö 2015).

Prototype B for group B is designed similarly to prototype A but does not contain the AI-based feedback system. Therefore, column *Results of the analysis*, the description below the table, and the A*nalyze contribution* button (cf. Figure 4) are missing. The categories of column *Criteria* remain, as this provides orientation and the differences between the prototypes should be as minor as possible to focus on the impact and influence of the AI-based feedback system.

Above the input field of both prototypes, the descriptions of the task and fictive urban project are placed. All contributions were stored in a CSV file including the timestamp and session ID whenever a button was used.

4.2. AI-based Feedback System

To estimate if a citizen contribution is considering the criteria sufficiently we are using the machine learning model Global Vectors for Word Representations (GloVe) from Stanford University (Penningtin et al. 2019). Therefore, all textual inputs are converted into word embeddings e.g., word

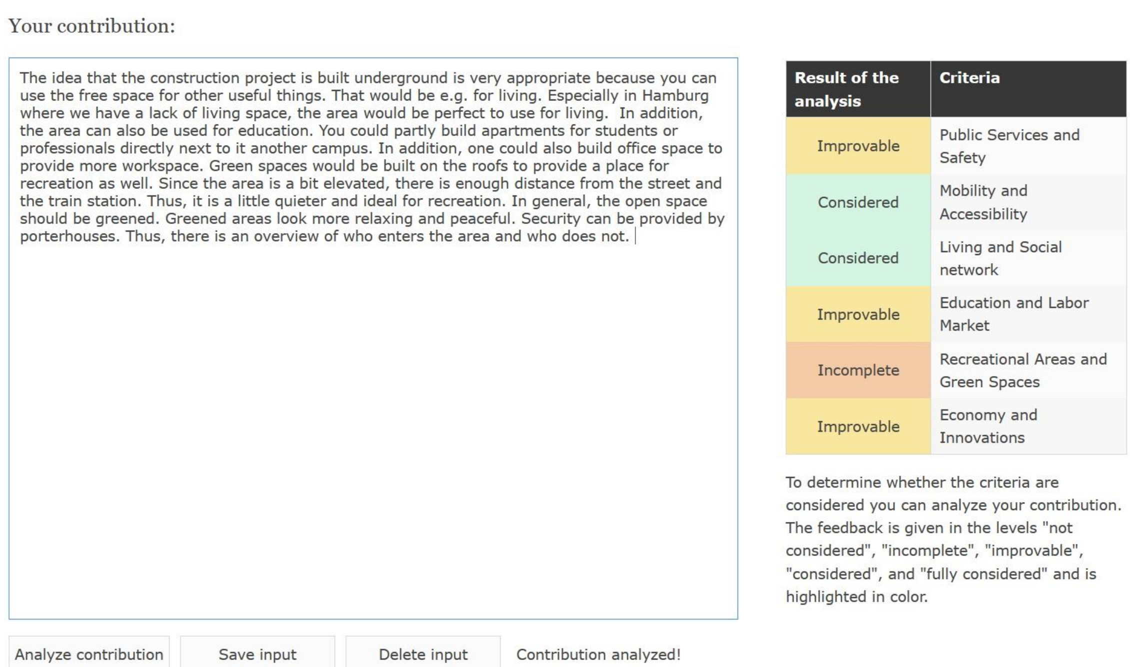

Figure 4. Graphical User Interface of Prototype A

vectors, and then compared by an algorithm to six reference sentences that can be easily replaced and of which each is representing the content of one of the six criteria. The comparison is conducted using the cosine similarity and the length of the contribution to estimate, which category was considered to which degree (Lieven et al. 2021). The feedback for each category can be *not considered*, *incomplete*, *improvable*, *considered*, or *fully considered*. An extensive argumentation on the content of a category is therefore classified as *fully considered* as it is addressing the prescribed content and is of sufficient length. The five-stepped feedback was chosen, as it is intuitive and comparable to the widely known Likert scale (Hartley 2014). In addition, this approach supports, that participants do not reach the middle or highest feedback with their first contribution, as it would be possible with a three-stepped scale which could shorten or end the participation as the participant already reached the highest feedback. We suppose that the participant will be encouraged by the feedback to submit more argumentative and comprehensible contributions and that this approach is more intuitive than implementing a feedback system that responds with the elements of the Argumentation Theory, as most participants would not be familiar with it.

5. Evaluation

The exploration (cf. Figure 3) was conducted with a total of 16 participants who were asked if they possess a basic or higher level of media capabilities and can operate a laptop with a keyboard without further support. All participants approve that, as required as we wanted to ensure that the results were not affected by a lack of media capabilities.

All participants were between the ages of 18 and 22 and they were randomly divided into two groups of eight participants. The average age in group A was 19,625 (male=6, female=1, divers=1) and in group B 19,75 (male=7, female=1). All participants were from Germany, and we cannot exclude cultural differences due to a lack of diversity which also applies to the age. We consider this to be acceptable since the focus is on the perception and the influence of the AI-based feedback concerning the argumentation, and possible hypotheses which can be verified later with e.g. quantitative experiments.

Each participant received an equal convertible device to conduct the task, as described in section 3. Research Approach The prototypes for the participants in each group were already opened in a web browser. All participants had 5 minutes to read the task and to ask questions for clarification, which was not required. Afterward, all participants had up to 20 minutes to conduct the task and submit their contributions to the fictitious urban project. Afterward, each group discussed their prototype in terms of functionalities and perceptions of the AI system (group A) or a possible feedback functionality (group B) and further supporting elements. The group discussions were moderated by the authors using guiding questions.

We planned 45 minutes for the discussion and required 47 minutes in group A and 40 minutes in group B. The audio was recorded in both groups, transcribed, and analyzed by the authors together with the stored participants' contributions by using MAXQDA. In total, we marked 294 paraphrases according to Mayrings' qualitative content analysis (Mayring 2014). Of these, 56 markers are allocated to the group discussions and 238 to the participants' contributions.

6. Findings

The discussion of the prototypes reveals that the opinions of the participants diverge and that the predefined feedback categories can be double-edged. The left side of Figure 5 represents group A and the right-side group B. The numbers indicate the amount of deductively marked paraphrases and are summed up in the hierarchies above (Mayring 2014).

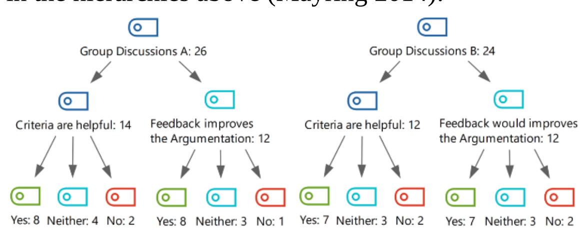

Figure 5: Comparison of Group Discussions

The discussion of whether the *criteria are helpful* was in terms of marked phrases similar, but in terms of content quite diverse. Both groups described the criteria guide as the participants immediately have some thoughts about them in mind which most of the participants also included in their contributions. In addition, both groups mentioned (A n=4, B n =2), that the criteria are imprecise and thus it is necessary to think about them and to assume what the urban projects responsible had in mind (Stelzle et al. 2017). This promotes argumentation and supports the development of ideas as the criteria are interpreted individually which can support the diversity of the contributions, as citizens consider them from their life perspectives (Caliskan 2012). However, two participants in group A and four in group B mentioned, which was marked with neither, that as the criteria are defined imprecisely, they are not supportive, but as they can be ignored also do not affect the citizen negatively. Furthermore, two participants in group A and two in group B described the criteria as not helpful as they are too unprecise, can confuse participants, and are influencing and pushing the participants in a certain direction, which enables manipulation and could lead to the rejection of the urban project and participatory approaches (Arana-Catania et al. 2021).

The discussion in group A, if the *AI-based feedback is improving the contributions* exhibits, that at the beginning of conducting the task many participants were critical about the feedback system, but as the usage is quite easy and intuitive, have tested it. For this, some participants duplicated text or copied the urban projects and task description, to evaluate how the feedback changed, and the AI model estimates the criteria, as far as possible. Most of the participants in group A tried to reach the highest response and considered this a challenge, as they were curious about what had to be submitted to reach the highest feedback. This encouraged the participants to submit and analyze many contributions. On the other hand, if the feedback is perceived as a challenge, participants may only submit desired content to reach a high response without concerning what they really need and require as citizens and how they can be affected positively or negatively by the urban project. Less participants agreed on that, but all participants confirmed, that it is mandatory to be able to submit contributions at any time independently of the feedback to ensure, that everybody can participate. In addition, this also enables citizens to express their disinterest in certain topics by not considering them. In group A three participants think, that the feedback improves their contributions, two answered neither, and three do not think, that the feedback positively influenced their contributions. The discussion in group B was similar, and two participants answered with yes, three with neither, and three with no (cf. Figure 7). The participants in group B also describe, that it is important that contributions can be submitted at any time without concerning the feedback, as this otherwise would exclude citizens with fewer requirements and ideas. Furthermore, the feedback should be automated to receive it immediately and group B agreed, that manual feedback by experts would not be sufficient, as they argue that this approach would be too costly and is increasing responding time which could end the participation, as many citizens are not willing to wait (Krätzig and Warren-Kretzschmar 2014).

The analysis and visualization of the participant contribution of both groups by applying the elements of Argumentation Theory are shown in Figure 6. In the contributions of group A, 163 phrases were marked, and in group B 75. The average length of a contribution in group A is 217,5 and the total amount of words is 1.740 (71,14 %). In group B the average length is 88,25 and the total amount of words is 706 (28,86 %).

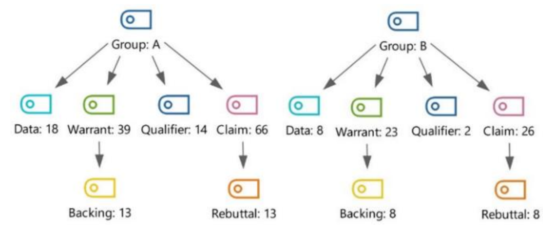

Figure 6: Comparison of Participants' Contributions

The comparison of the participants' contributions concerning Argumentation Theory (cf. section 2.3) highlights, that the quality of argumentation in group A is higher than in group B as, the participants submitted more comprehensible contributions with further Data, Warrants Qualifier, and Claims. However, the documentation of Data is still quite low which can be explained, as the participant were non-experts in urban planning and design and therefore are not aware of e.g. studies and would have a higher effort to search, read and mention them in their contributions (Münster et al. 2017).

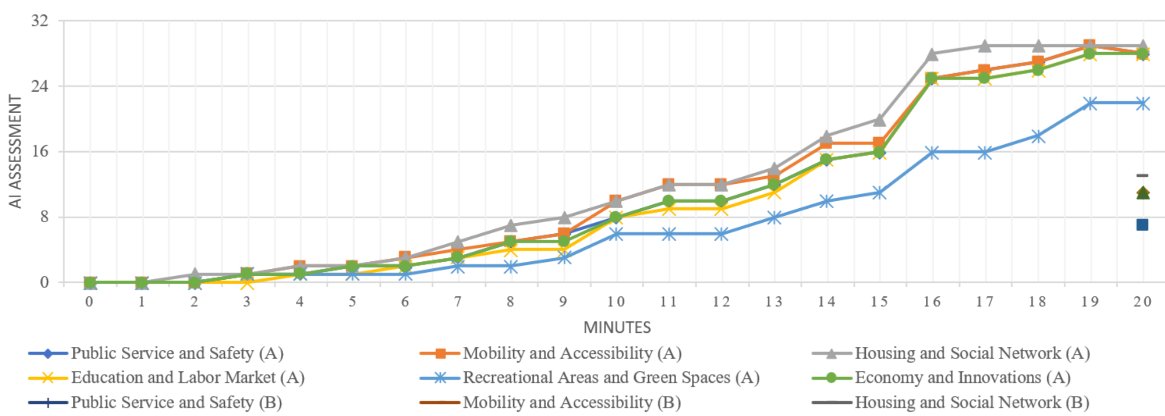

Figure 7: Development of the Argumentation in Participants' Contributions

The analysis of the development of the contribution over time is shown in Figure 7. The vertical axis *AI Assessment* shows the estimation by the implemented AI-based feedback system for each category for all participants of group A and group B. The maximum of the estimation for a category is 32, as the five-stepped scale begins with *not considered*, that is concerned with 0, up to *fully considered*, that is considered with 4, and reach, multiplied by the number of participants a maximum of 32 for each predefined category. The contributions and their estimations in group A were stored every time a participant used the analyze button (*Analyze contribution*) to get feedback. This enables the visualization of the development of contributions from group A over time. In group B, the contributions were only stored at the end of the conduction of the task when the participants submitted them. Therefore, Figure 7 shows the development of the contributions of group A and the final contributions of group B, which were evaluated afterward by the AI-based feedback system Figure 7 highlights, that the estimated feedback of the participants is overall continuously increasing, and that this development is enhancing from minute nine. This corresponds to the mentioned evaluating phase of the feedback by the participants which was described in the discussion of group A. In addition, this also applies to the continuous increase after minute nine, as most participants wanted to achieve the highest feedback for all criteria. In the group discussions, the participants were inconclusive about the influence and support of the A-based feedback. The estimated contributions of group B are shown on the left of Figure 7 and emphasize, that the feedback system had a huge impact on the participants' contributions, as the average estimation of all criteria in group A is 21,17 and in group B 10,67. This indicates, that the developed AI-based feedback is supporting the citizen to write more argumentative and comprehensible contributions. This also corresponds to the findings of Figure 6, even if the difference in argumentation is slightly and only deviates strongly considering the number of claims (cf. Figure 7).

7. Conclusion

In this paper, we examined how an AI-based feedback system can increase citizens' argumentation on urban participatory platforms. To do so, we implemented two prototypes as a representation of urban platforms and developed an AI-based feedback system corresponding to the Citizen Design Science model, Argumentation Theory, and scientific literature about urban platforms and AI (Arana-Catania et al. 2021).

The systematic comparison of the prototype with (group A) and without (group B) the AI-based feedback system indicates that the AI-based feedback system support citizens to contribute more comprehensible and argumentative contributions which are highlighted by the comparison of the contributions of both groups (cf. Figure 5). The contributions of group A are twice as long as in group B and the argumentation is increased, especially concerning the number of claims (cf. Figure 7). Therefore, we hypothesize that there is a correlation between the developed AI-based feedback and argumentation in citizens' contribution which is advocated by the feedback, and the associated content exchange and reconsideration.

Due to the quantitative approach, the limited number of participants, and the low diffusion of gender and age, we cannot determine the presumed correlation. Furthermore, alternative and better for example question-based feedback and support systems are possible which could be based on chatbots. However, our findings reinforce the impact of the implemented AI-based feedback system which now should be validated in a quantitative experiment.

With our findings, we contribute and provide initial knowledge about how AI-based feedback systems for urban planning participation should be designed to encourage citizens to contribute more argumentative and comprehensible contributions. In addition, we summarized the benefits and challenges and described the potential for manipulation through criteria (Murphy and Hands 2016).

Our findings are of relevance to AI, urban planning researchers, and urban experts like architects and planners and can be used as a baseline to develop extended and alternative systems to enhance citizen contributions on urban planning platforms in comparison to the described system.

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