J. Nguyen

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Serious gaming to support the adoption of sustainable drainage solutions

MSc Thesis – Supplementary Material

TU Delft

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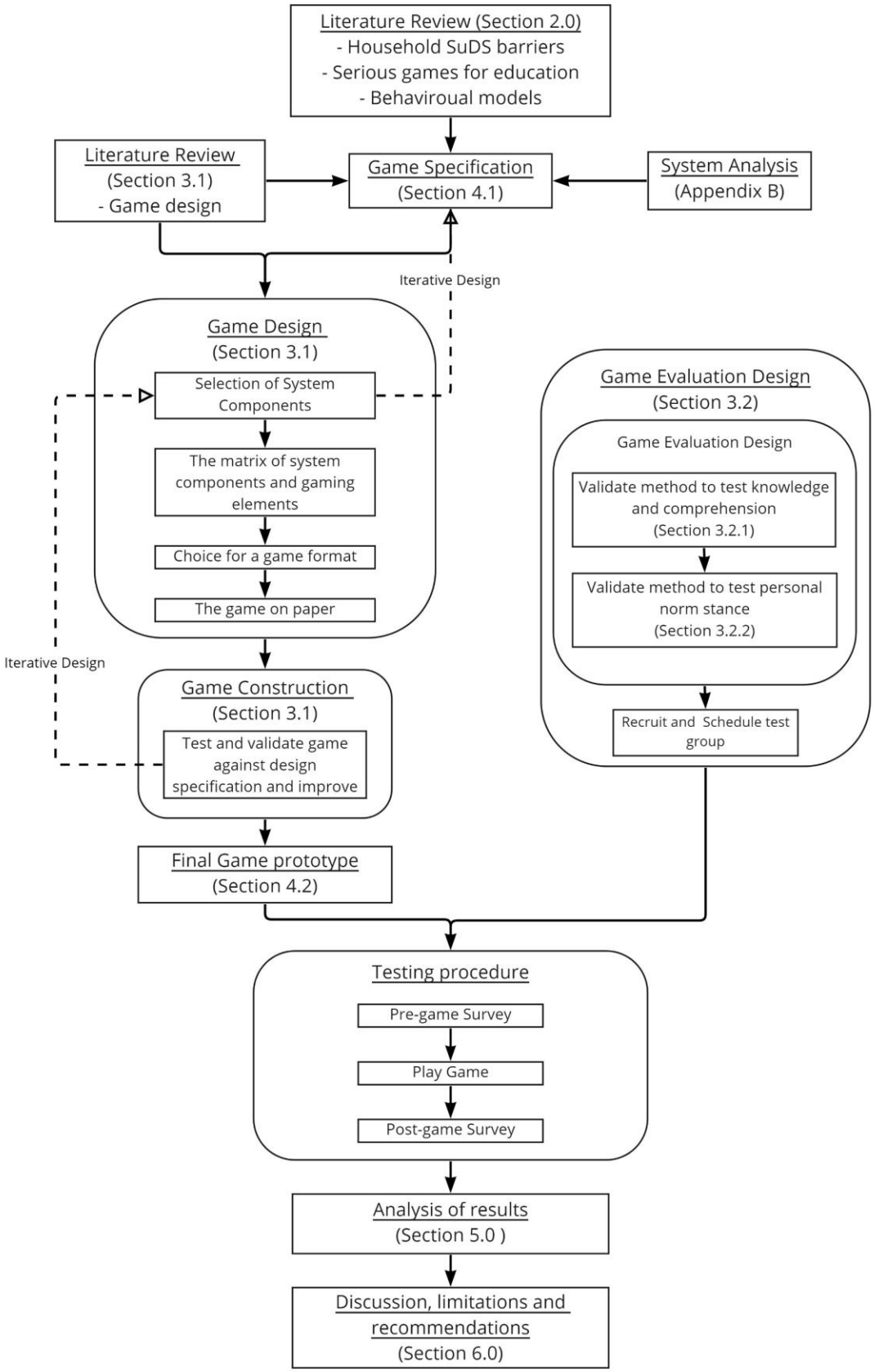
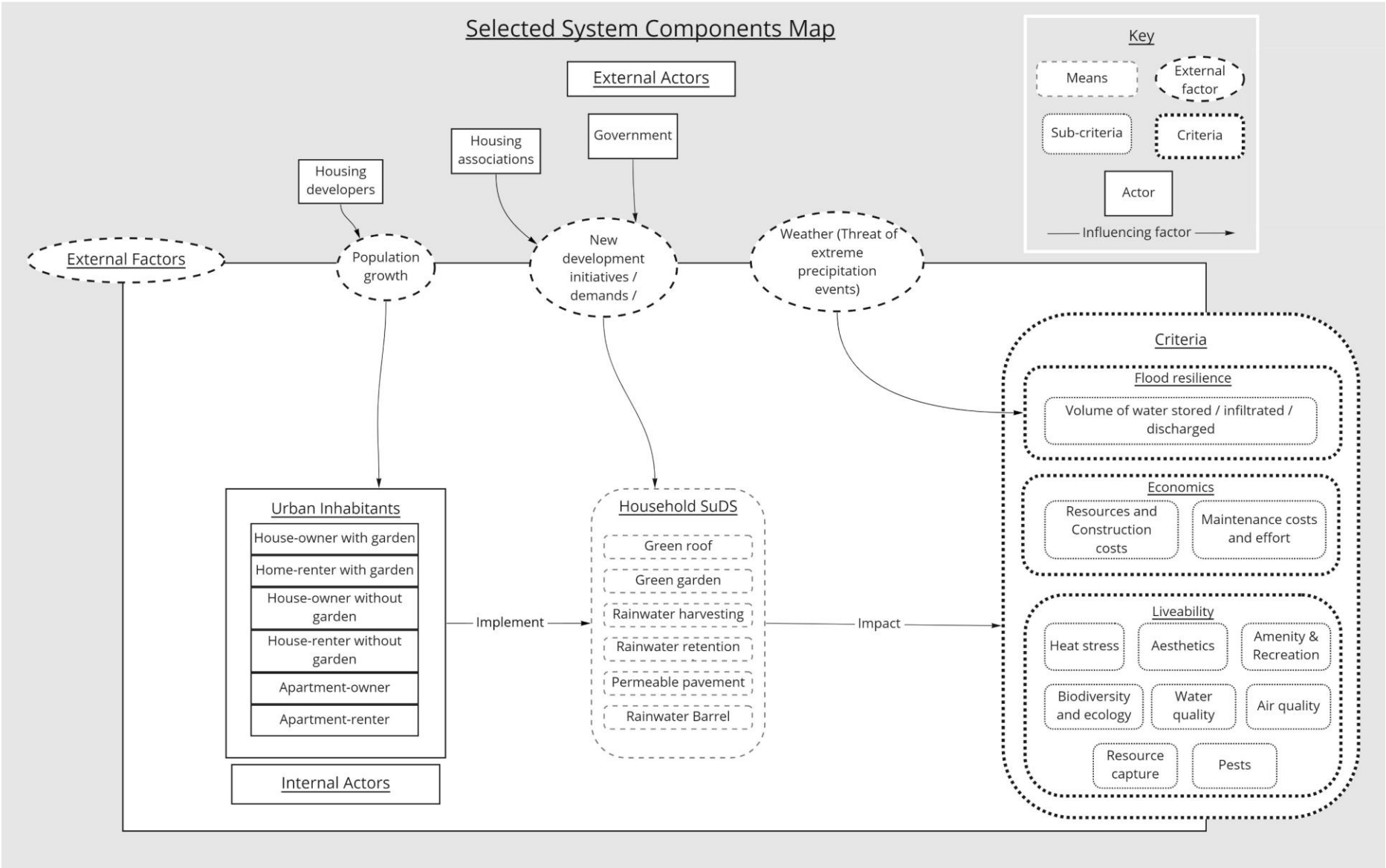
Supplementary Material A - Methodology Diagram



Supplementary Material B - System components map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Housing associations
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New development initiatives / demands /
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Criteria
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Resource capture
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Rainwater retention
Permeable pavement
Rainwater Barrel
Impact

Supplementary Material C - Pre and Post game Surveys

Pre-Game Survey

Start of Block: Introduction

Welcome! Thank you for participating in a test of a serious game. As part of the study you will be presented with the same survey before and after the game. The survey should take approximately 15 minutes. The data will be used for a MSc thesis study on using serious games to overcome barriers for the use of sustainable drainage solutions.
This is the pre-survey. Please answer honestly and to the best of your ability.
If you have any issues or questions about this survey, you can contact me on j.nguyen@student.tudelft.nl. If you prefer to fill this survey out on paper, please let me know and I will provide you with a paper copy at the game session.
Thank you for your time!
Jessica Nguyen

End of Block: Introduction

Start of Block: Demographics

What are the last 3 digits of your phone number?

_____

What is your age?

_____

How would you describe your housing status?

- ○ I am a home owner / mortgage holder
- ○ I am a renter (private or social housing agreement)
- ○ I am a free lodger / live without any formal tenancy agreement. (e.g. living with parents)
- ○ I prefer not to say
- ○ Other (Please describe) _____

Page Break

What is the highest education qualification you have completed? You may select multiple if you are unsure which qualification is the highest

- [ ] VMBO diploma, pathway BB
- [ ] MBO diploma level 1
- [ ] VMBO diploma, pathway KB, GL or T
- [ ] MBO diploma level 2
- [ ] MBO diploma level 3
- [ ] MBO diploma level 4
- [ ] HAVO diploma
- [ ] VWO diploma
- [ ] Associate degree
- [ ] Bachelor degree (HBO or WO)
- [ ] Master degree (HBO or WO)
- [ ] Doctorate
- [ ] PhD
- [ ] Any other, please state here

_____

Page Break

Have you heard of these household sustainable drainage solutions before?

	I have never heard of this and I don't know what it is	I have heard of this but I don't know what it is	I have heard of this and i know what it is	I know what this is and I have/had one
Rain collection barrel	○	○	○	○
Permeable / porous pavement	○	○	○	○
Green roof	○	○	○	○
Vegetated garden	○	○	○	○
Garden pond	○	○	○	○

End of Block: Demographics

Start of Block: Section 1 - Self-reporting

In this question you will be presented with some statements that describe awareness and understanding level on the given topics. Please mark on the scale below how well you agree/disagree with each statement.

		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
S.1	I understand how rainfall leads to flooding in cities	○	○	○	○	○
S.2	I understand how urbanisation can contribute to flooding	○	○	○	○	○
S.3	I understand how climate change influences the likelihood of flooding	○	○	○	○	○
S.4	I perceive urgency to act to protect against pluvial flooding.	○	○	○	○	○
S.5	I am aware of the consequences of not taking additional measures against flooding	○	○	○	○	○
S.6	I understand what SuDS (Sustainable Drainage Systems) are	○	○	○	○	○
S.7	I understand how SuDS influence flooding	○	○	○	○	○
S.8	I am aware of many SuDS that could be implemented by private households	○	○	○	○	○

S.9	I am aware of the benefits and impacts of SuDS	○	○	○	○	○
S.10	I have an active role to play in taking action against flooding in cities	○	○	○	○	○

End of Block: Section 1 - Self-reporting

Start of Block: Section 2.1 - Knowledge acquisition 1

K.1 What is ‘pluvial flooding’? please describe or state 'I don't know'

_____

K.2 Underground sewer systems are often considered not prepared for future demands. Which factors contribute to this? (you may select multiple options)

- ☐ They don't work as well in rising temperatures
- ☐ Poor maintenance and ageing sewer systems
- ☐ Climate change and urbanisation means the current sewers are not large enough for future demands.
- ☐ I don't know

K.3 How is climate change expected to affect weather in The Netherlands?

- ○ More frequent intense rainstorms, and longer, warmer dry spells.
- ○ Higher temperatures overall but no change to rain patterns
- ○ A shift to a warmer, drier climate
- ○ I don’t know

End of Block: Section 2.1 - Knowledge acquisition 1

Start of Block: Section 2.2 - Knowledge acquisition 2

K.4 In which ways do SuDS (Sustainable drainage solutions) affect water flows in an urban environment? please describe or state 'I don't know'

_____

K.5 Can you think of any other positive or negative effects SuDS can have other than their influence on water flows?

End of Block: Section 2.2 - Knowledge acquisition 2

Start of Block: Section 3 - Comprehension

C.1 In which order would you rank the influence urbanisation has on the risk of pluvial flooding? Rank from highest influence, to lowest influence.

1. More urbanisation means more water use, therefore more wastewater that fills the sewers. This means the sewers are full, so cant hold anymore rainwater. Therefore, flooding is more likely.
2. More people increases paved surface cover which prevents natural absorption of rainwater into the ground. This means sewers have more rainwater to drain than if the ground was not paved. Therefore, flooding is more likely.
3. More people means more litter which clogs the sewers, therefore creating flooding in rainstorms.

C.2 How does infiltration of rainwater affect pluvial flooding?

- ○ Ground absorption makes the ground stay wetter for longer, so increases pluvial flooding
- ○ Ground absorption reduces rainwater that drains into the sewers, so flooding is less likely.
- ○ Ground absorption does not affect pluvial flooding
- ○ I don't know

C.3 Why is pluvial flooding a concern compared to river or coastal flooding?

- ○ Damage from pluvial floods are more life-threatening.
- ○ Pluvial floods are more frequent, so the sum of damage is comparable to river or coastal flooding.
- ○ Pluvial floods last longer
- ○ I don’t know

End of Block: Section 3 - Comprehension

Start of Block: Section 4 - Self-reporting personal norm

In this question you will be given some statements that describe attitudes towards household SuDS. Please mark on the scale below how well you agree/disagree with each statement.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
P.1 I feel a moral obligation to adopt SuDS wherever I can	○	○	○	○	○
P.2 I am considering getting a household SuDS in my home	○	○	○	○	○
P.3 I will accept neighbours SuDS	○	○	○	○	○
P.4 I will invest into increasing adoption of SuDS where I live (e.g. convince family member / neighbours / landlord).	○	○	○	○	○

End of Block: Section 4 - Self-reporting personal norm

Post-Game Survey

Start of Block: Introduction

Welcome! Thank you for participating in a test of a serious game. As part of the study you will be presented with the same survey before and after the game. The survey should take approximately 15 minutes. The data will be used for a MSc thesis study on using serious games to overcome barriers for the use of sustainable drainage solutions.
This is the post-survey. Please answer honestly and to the best of your ability.
If you have any issues or questions about this survey, you can contact me on j.nguyen@student.tudelft.nl. If you prefer to fill this survey out on paper, please let me know and I will provide you with a paper copy at the game session.
Thank you for your time!
Jessica Nguyen

End of Block: Introduction

Start of Block: Identifier

What are the last 3 digits of your phone number?

_____

End of Block: Identifier

Start of Block: Section 1 - Self-reporting

In this question you will be presented with some statements that describe awareness and understanding level on the given topics. Please mark on the scale below how well you agree/disagree with each statement.

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S.4	I perceive urgency to act to protect against pluvial flooding.	○	○	○	○	○
S.5	I am aware of the consequences of not taking additional measures against flooding	○	○	○	○	○
S.6	I understand what SuDS (Sustainable Drainage Systems) are	○	○	○	○	○
S.7	I understand how SuDS influence flooding	○	○	○	○	○
S.8	I am aware of many SuDS that could be implemented by private households	○	○	○	○	○

S.9	I am aware of the benefits and impacts of SuDS	○	○	○	○	○
S.10	I have an active role to play in taking action against flooding in cities	○	○	○	○	○

End of Block: Section 1 - Self-reporting

Start of Block: Section 2.1 - Knowledge acquisition 1

K.1 What is ‘pluvial flooding’?

_____

K.2 Underground sewer systems are often considered not prepared for future demands. Which factors contribute to this? (you may select multiple options)

- ☐ They don't work as well in rising temperatures
- ☐ Poor maintenance and ageing sewer systems
- ☐ Climate change and urbanisation means the current sewers are not large enough for future demands.
- ☐ I don't know

K.3 How is climate change expected to affect weather in The Netherlands?

- ○ More frequent intense rainstorms, and longer, warmer dry spells.
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- ○ I don’t know

End of Block: Section 2.1 - Knowledge acquisition 1

Start of Block: Section 2.2 - Knowledge acquisition 2

K.4 In which ways do SuDS (Sustainable drainage solutions) affect water flows in an urban environment? please describe or state 'I don't know'

_____

K.5 Can you think of any other positive or negative effects SuDS can have other than their influence on water flows?

End of Block: Section 2.2 - Knowledge acquisition 2

Start of Block: Section 3 - Comprehension

C.1 In which order would you rank the influence urbanisation has on the risk of pluvial flooding? Rank from highest influence, to lowest influence.

1. More people means more water use, therefore more wastewater that fills the sewers. This means the sewers are full, so cant hold anymore rainwater. Therefore, flooding is more likely.
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End of Block: Section 3 - Comprehension

Start of Block: Section 4 - Self-reporting personal norm

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P.3 I will accept neighbours SuDS	○	○	○	○	○
P.4 I will invest into increasing adoption of SuDS where I live (e.g. convince family member / neighbours / landlord).	○	○	○	○	○

End of Block: Section 4 - Self-reporting personal norm

Start of Block: Block 7

The following question is designed to provide feedback on the serious game experience. The following statements describe feelings on aspects of the gameplay. Please mark on the scale below how well you agree/disagree with each statement.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
G.1 The game was fun	○	○	○	○	○
G.2 The game was engaging	○	○	○	○	○
G.3 The game was difficult to follow	○	○	○	○	○
G.4 The game was realistic	○	○	○	○	○
G.5 I learnt a lot in this game	○	○	○	○	○
G.6 It was easy to win the game	○	○	○	○	○
G.7 The game rules were clear	○	○	○	○	○

End of Block: Block 7

Start of Block: Plenary

G.8 What have you learnt from this game that has surprised you?

_____

G.9 Do you have suggestions on how the game could be improved? (please describe)

_____

End of Block: Plenary

Supplementary Material D - Detailed game design specification

Background

What themes and problem behaviours does the serious game addresses and its context?

The game addresses the issue of lack of public awareness of SuDS. The context of the problem is explained in section 1.0 which expresses the need to overcome the barriers of SuDS adoption to enhance flood resilience in a future that is projected to make reliance of centralised drainage systems increasingly vulnerable from growing urbanisation, and threats of more extreme storm events.

Which of these themes and problems should the serious game focus on?

The serious game will focus on imparting knowledge on household SuDS functions and why there is an urgency to implement them in the context of climate change and urbanisation. These knowledge gaps are outlined by learning objectives 1.1 and 1.2.

Why is a serious game considered an intervention to educate on household SuDS?

The intervention is to educate on the topic of household SuDS. Section 2.2 details the power and effectiveness of using simulation gaming to educate on complex system interactions by facilitating interaction, experimentation, graceful failure and social engagement. These feature alongside the entertainment aspect of games which can evoke a positive mood in the players, making them more receptive to the messages conveyed through the game and therefore enhance learning and knowledge acquisition.

What is the target audience for the game?

It is important to acknowledge the fact the public is not a homogeneous group. The public is made up of different demographics who display different attitudes and behaviours and face differing issues, agendas and powers. There are varying powers and accessibilities of different inhabitant groups. For example, there are homeowners and renters who have different powers to implement SuDS. Those who have private gardens, which is an opportunity for a wider range of SuDS measures against those who do not have a garden. Then those who live in houses can make decisions more independently, than those who live in apartment blocks who may need to collaborate with neighbours to implement SuDS. The target audience will incorporate all urban inhabitants, but with acknowledgement of these differences.

What image of reality must be transferred by the serious game?

The serious game should simulate realistic actions and reactions about the function and impact of implementing SuDS in the urban environment. This means that the image of reality conveyed through the game should contain all factors that are relevant to the implementation of household SuDS, such as volume of water storage, impact on quality of living, and economics as well as the effects of climate change. All relevant actors should also be represented in the game. The image of reality conveyed through the game is represented with a systems components map shown in Supplementary Material B with all means, actors, external factors and criteria that contribute to a full understanding of the consequences of SuDS.

What is the problem statement, against which the serious game will be evaluated, once designed and implemented?

SuDS are an approach to water management that has strong drivers in an increasingly urbanised world, as a strategy for better flood and climate change resilience, environmental sensitivity and improved urban amenity. The objectives of SuDS are recognised however, SuDS face barriers in being widely and systematically adopted despite established technology. A contributing factor that hinders SuDS adoption is the lack of public awareness of household SuDS. Strategies proposed to address educating citizens of SuDS to recommend active and engaging forms of education.

Who are the main actors in the context of the problem? What are the interests, objectives, constraints and resources of the main actors?

The main actors that will feature in the game as playable roles are the groups of urban inhabitants: house-owner with garden, house-renter with garden, house-owner without a garden, house-renter without a garden, apartment owner and apartment renter. These demographic distinctions are chosen as they have different access and powers that influence the pathways to adopt private household SuDS.

<u>Objectives of the serious game</u>

What are the purposes of the serious game?

To educate on the topic of private household SuDS to support its adoption by urban inhabitants. The learning objectives contained in Table 1 set out the educational topics that should be conveyed through the game.

Will there be other tools or means being deployed in combination with the serious game?

The serious game will be introduced with an introductory explanation by the game facilitator that sets the scene of the game setting and the structure/rules of the game. The explanation should introduce the roles, goals and physical elements of the game.

What are the specific objectives that have to be reached by means of the serious game?

The game should fulfil an appropriate balance of the three aspects of play, meaning and reality. A careful and equal balance of these 3 aspects of the game will ensure that the game is a motivating and fun experience, while still maintaining a meaningful and valid purpose.

The meaning aspect can be fulfilled by addressing the learning objectives outlined for the game shown in Table 1. The reality aspect of the game is outlined by the system components analysis contained in Supplementary Material B. The play aspect of the game can be fulfilled using motivational game mechanisms such as competition, challenge and immersion, which can be supported by feedback from the game validation session (Harteveld, et al. 2010).

Against which criteria will the serious game be evaluated?

The game will be evaluated against success in addressing the learning objectives shown in Table 1. This will be tested with a before and after survey as outlined in section3.2.1. Supplementary to that, the experience will be evaluated for its impact on the participant's personal norm stance on household SuDS, evaluated by the survey also, explained in section 3.2.2.

General considerations for the game design

In what way will the participants be involved in the serious game and how will the participants be grouped?

The participants of the game will take interactive roles within the game. The roles can be assigned randomly or by choice to each player and they will remain playing the assigned role throughout the game.

Are there specific messages or issues that have to be conveyed or emphasised through the game and how should they be addressed?

The tones and issues the game should emphasise are outlined by the game learning objectives stated in Table 1. The primary objective 1.1 states the game should educate on the effects of urbanisation and climate change on urban pluvial flood risk and the urgency for SuDS adoption.

Objective 1.2 states the game should educate on household SuDS options and their features and criteria.

Finally, it should be acknowledged that the game will ultimately be tested for its performance in education and influence on participants' personal norm stance on SuDS issues. Therefore, the game should not be biased or suggestive to favour SuDS solutions, on a basis that is not accurate to reality. It is therefore important that the game is balanced and in line with reality for the consequences of each development.

To what degree will the participants be free to choose their actions?

The participants will have access to a range of actions within the game that are tailored to their role. This means that there may not necessarily be equality in the range of actions and access between each role, but this reflects the realism of the situation and emphasises the need to co-operate. Despite that, each role should still have many actionable options to choose from. There may be limited opportunities to influence the actions of others within the game to enforce cooperative play dynamics.

Is the serious game to be 'loaded' with a predefined representation of the real-life situation?

The serious game setting or starting scenario should reflect a typical dutch or western-European urban environment at present. It should contain typical and generic features but be fictitious. This can be expressed by pre-loading the game starting scenario with typical features, of an urban neighbourhood and having criteria scores to reflect this. The game should represent features and interactions contained in the system analysis that are relevant to the aims of the game.

What aspects of reality will feature in the game as criteria that the game feedback is assessed upon?

The game criteria as outlined in the system components map contained in Supplementary Material B are the impact of SuDS on overland flood storage and quality of living. The game feedback is expressed via scoring on these criteria. High scores in both criteria simultaneously should be the winning aim of the game.

Are there any limitations concerning the time that the serious game may last?

Time limitations of the game should be mindful of effective learning engagement levels. A balance should be made between the level of engagement with the game, which tends to drop

over time. The game validation session should balance the game engagement level and gameplay time limit to ensure engagement is maintained. The gameplay time should also consider the requirement for participants to conduct pre-and-post surveys in the research study which can take 30 minutes collectively.

Elements of the serious game

Is the scenario (fully) predetermined or is there room for participants to generate it (partly)?

The starting scenario is pre-loaded into the game to reflect typical realistic settings. When the game starts, players are free (and encouraged) to adjust the scenario by adding and removing means. The players can recreate the make-up of the environment, with actions that they have access to within their role.

Should the scenario be based on specific documents?

All solutions, impact on criteria and external influences should be factually correct and backed with literature. This information can be derived from outcomes of the thesis study such as the system analysis, or literature reviews on SuDS, and further literature research where necessary. Useful resources are: (Wansleeben 2016, susdrain n.d., Krijnen 2020, Amsterdam Rainproof 2022).

Are there special desires concerning the portability, reproducibility and storage of the materials of the serious game?

A physical board game will be the format for the game. As part of the method of the study, the game will be tested with numerous test groups, mostly in university study rooms or communal spaces. This means that for ease of use, the game should be portable to the extent that I can carry the game around on public transport on my own and set up promptly. It is also ideal that the game does not produce any waste to reduce clean-up efforts. There is no intent for the game to be reproduced.

Use of the serious game

Are there wishes and/or restrictions for the setting in which the serious game will be tested?

Ideally, the game will take place in a room free from any distractions with all players attending in real life along with the game facilitator. However, there should be a contingency plan for contact-free testing of the game, should there be social distancing restrictions.

Are there wishes and/or restrictions concerning activities that immediately precede the serious game?

A pre-survey as part of the game evaluation method should be table by all participants within 48hours before the game session. In the game session, the setting/scenario of the game should be set in a short pre-game introduction to get everyone familiar with the game setting, problem and goal. Before commencing the game, there should be no suggestive indication that the game aims to get the players to favour SuDS in the game, and this also applies to information given in recruitment and the pre-game survey also.

Are there wishes and/or restrictions concerning activities that immediately follow the serious game?

The post-game survey should be conducted by all participants within 48hours after the game session, to reduce external factors influencing the survey.

Supplementary Material E – Game paraphernalia

The elements of the game are physically represented by paraphernalia that supports the gameplay. The paraphernalia comprises:

- *Game board [Figure 5]:* The game board spatially represents the town and its land use comprising roads, parks, a school, shops, and different housing types. The board also contains score meters for flood reduction and liveability and keeps track of the game timeline where the 9 years from 2022 to 2030 are shown. The board also provides informational content for the game such as the outcomes of the landlord and neighbour/housing association dice roll check. The sewer is also visually represented on the board and explains the process and outcomes of a flood event.
- *Role cards [Figure 6]:* Six different roles each have a role card that describes the role, means they have access to, checks the requirements to implement the means, and income and maintenance information.
- *Means cards [Figure 7]:* Eight means feature in the game, each with description cards explaining what the item is, and its scoring impacts
- *Means blocks[*Figure E. 2*]:* Small (laminated paper) blocks of each implementable item that can be placed on the board to represent a purchase.
- *Action cards[*Figure E. 1*]:* A card that outlines players' actions and end-of-round actions for convenience
- *Weather event dice[*Figure E. 2*]:* Three six-sided dice with faces representing weather events. Dice associated with the later years of the game contain faces with more extreme drought and rain multipliers
- *Weather event card [Figure 8]:* A card explaining the outcomes of each weather event for convenience
- *Rain dice[*Figure E. 2*]:* A ten-sided dice to represent a chance roll for rain. This dice plus 10, times any weather event multiplier yields the number of rain cubes that 'fall in Sudsbury'.
- *Landlord dice[*Figure E. 2*]:* A six-sided dice with faces representing landlord blocking, accepting and financially supporting a SuDS
- *Neighbour/housing association concern dice [*Figure E. 2*]:* A six-sided dice with faces representing the chance of a concern, or not.

- *Justify cards [*Figure E. 2*]:* Drawn to represent a neighbour/housing association concern. Contains a question and answer on the topic of SuDS where the player must fill in the answer with the correct word to '*convince'* the neighbour/housing association member to accept the SuDS.
- *Tokens[*Figure E. 2*]:* Colour-coded tokens specific to each role, represent liveability points obtained from item implementation. Similarly, blue water cube tokens can be collected in the same way to represent flood reduction contributions. For both, 3 of each of these tokens can be exchanged for a (larger) counter to mark the score on either the flood reduction or liveability meter.
- *Flood and survive counters[*Figure E. 2*]:* Counters will be placed on the timeline to track the current year. Purple counters represent years survived with no flooding, blue flood counters represent years where a flood has occurred. The number of flood counters is restricted and dependent on number of players, (3 for 4 players, 2 for 5-6 players).
- *Play money:* Money to represent the financial aspects of the game such as buying, income and maintenance.
- *Erasable pen:* For each player to update maintenance costs throughout the game.

How the game paraphernalia is arranged and used in the starting set-up of the game is shown in Figure E. 3.

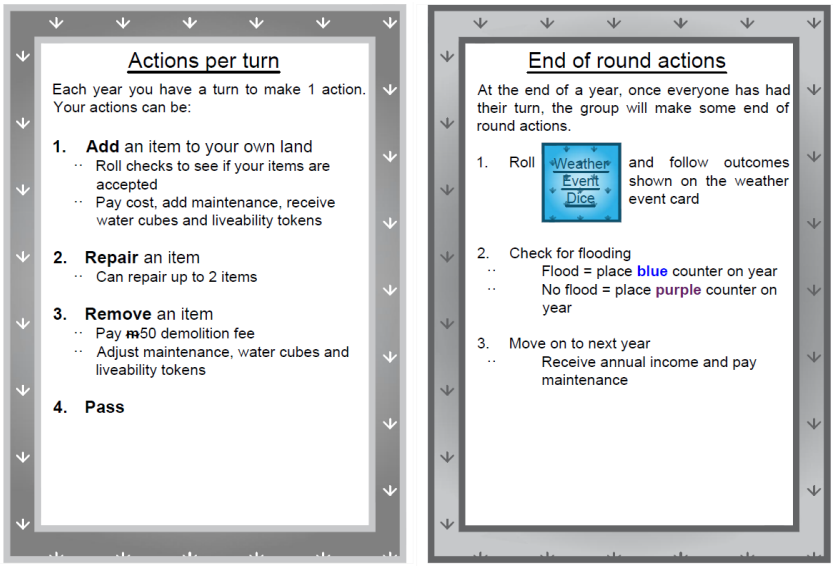

Figure E. 1 - Action card to describe turn and end of round actions

Figure E. 2 - Sudbury additional paraphernalia described from the top right, going clockwise: Weather event dice, Rain dice, means blocks, Landlord dice, Neighbour/housing association concern dice, Flood and survive counters, Tokens, Justify cards.

Figure E. 3 - Sudsbury starting game set-up

Supplementary Material F - Results of game evaluation survey (Pre and post surveys)

Participant demographic data

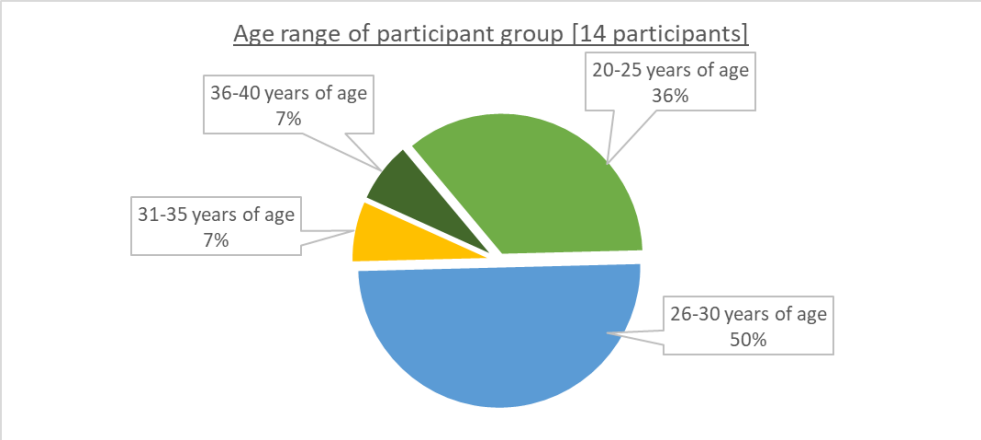

Figure F. 1 - Pie chart of demographic data of 14 participants: Age range

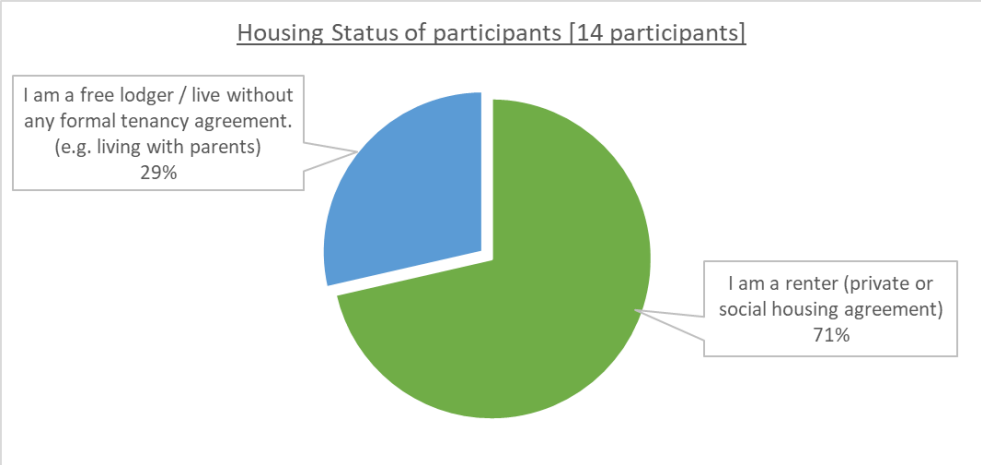

Figure F. 2 - Pie chart of demographic data of 14 participants: Housing status

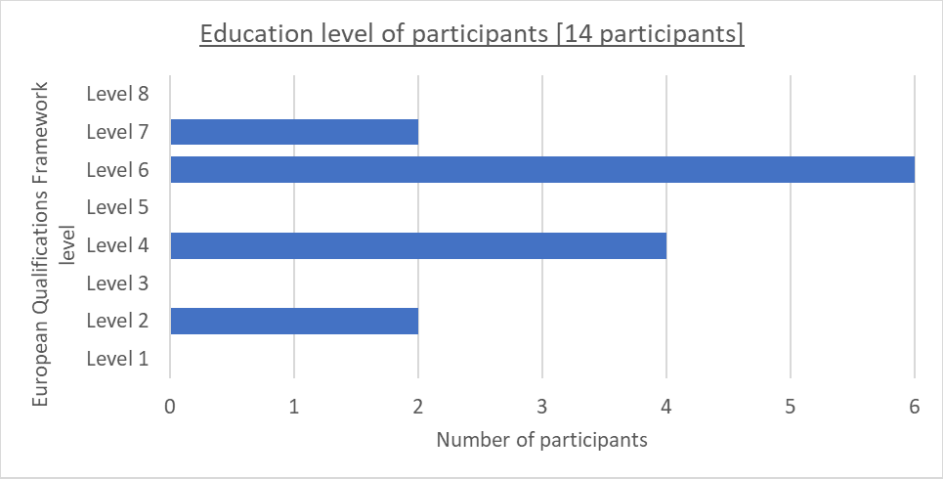

Figure F. 3 - Pie chart of demographic data of 14 participants: Education level (European qualifications framework)

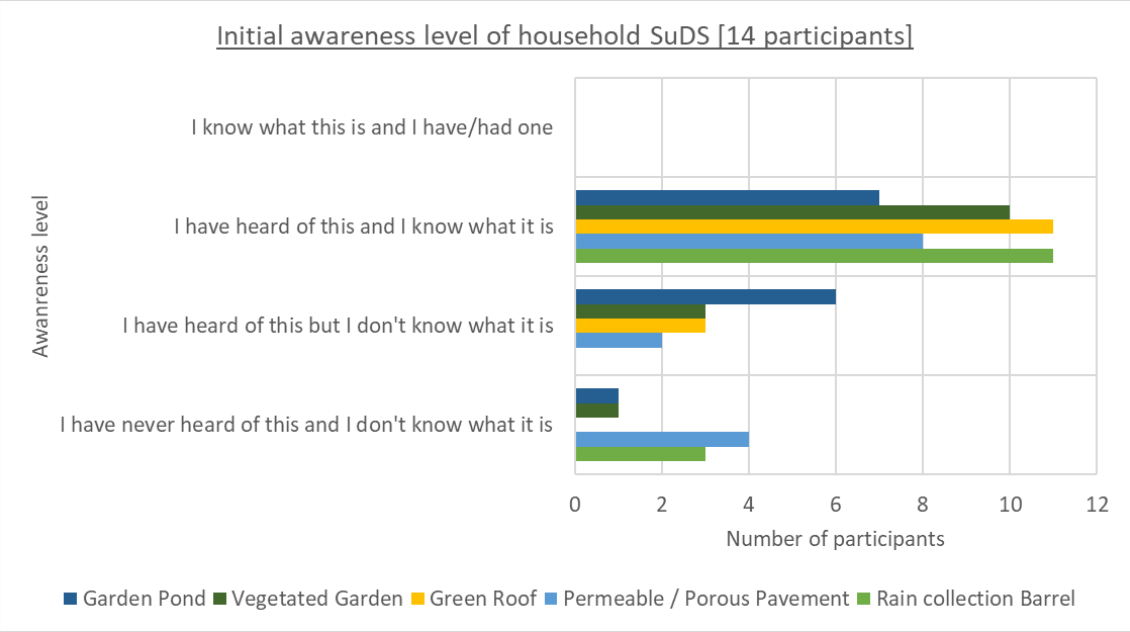

Figure F. 4 - Bar chart of demographic data of 14 participants: Initial awareness level of household SuDS

Results of self-reported knowledge and comprehension level

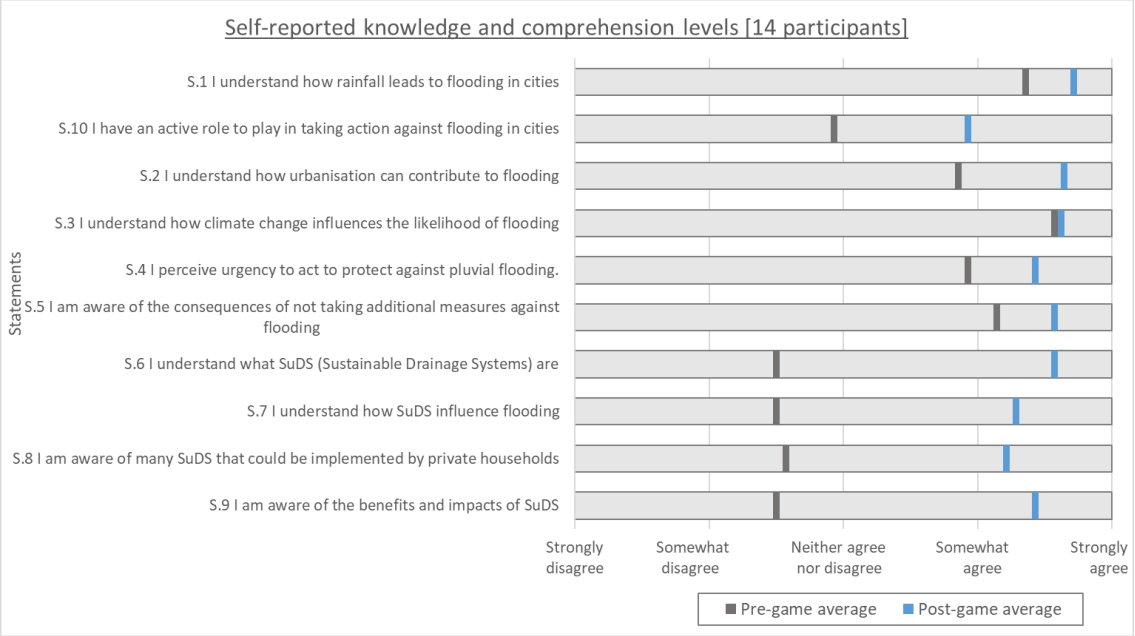

Figure F. 5 – Pre and post-game average score of 14 participants on a scale of strongly disagree to strongly agree for statements (S.1-S.9) of self-reported knowledge and comprehension levels

Results of knowledge acquisition

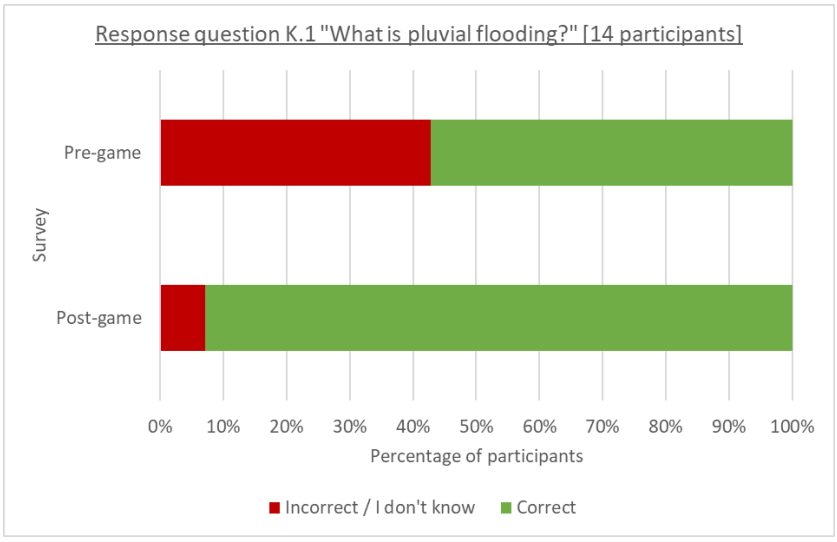

Figure F. 6 - Percentage of correct and incorrect pre and post-game responses to question K.1 'What is pluvial flooding?'

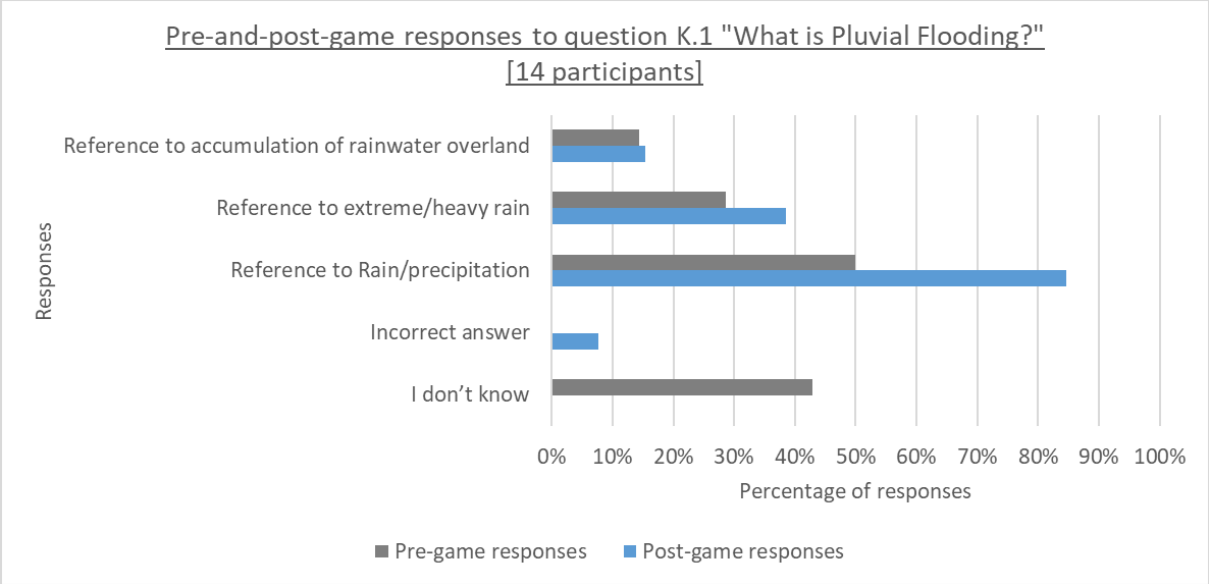

Figure F. 7 - Pre and post-game responses to open question K.1 'What is pluvial flooding?'

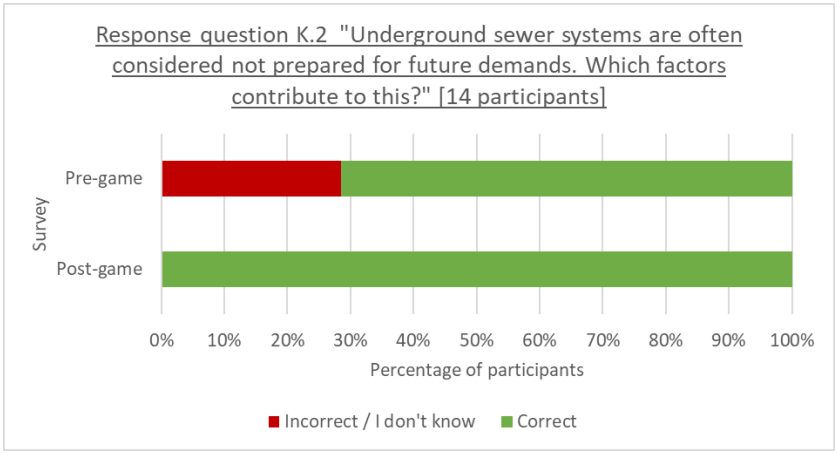

Figure F. 8 - Percentage of correct and incorrect pre and post-game responses to question K.2 "Underground sewer systems are often considered not prepared for future demands. Which factors contribute to this?"

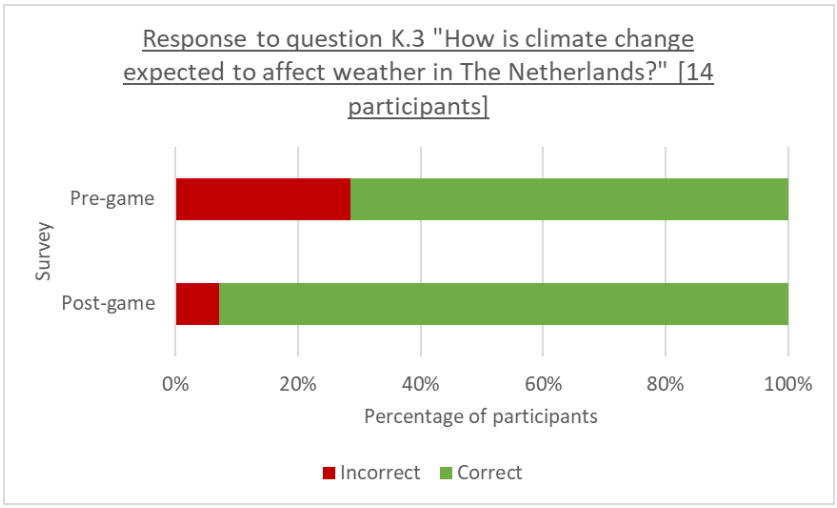

Figure F. 9 - Percentage of correct and incorrect pre and post-game responses to question K.3 “How is climate change expected to affect weather in The Netherlands?”

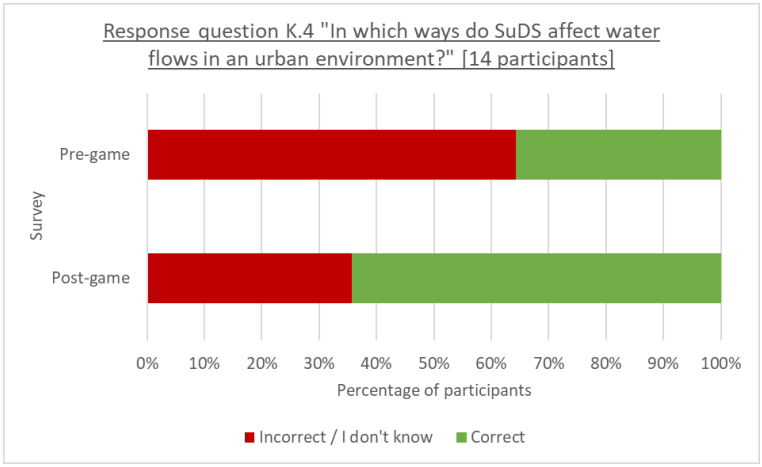

Figure F. 10 - Percentage of correct and incorrect pre and post-game responses to question K.4 “In which ways do SuDS affect water flows in an urban environment?"

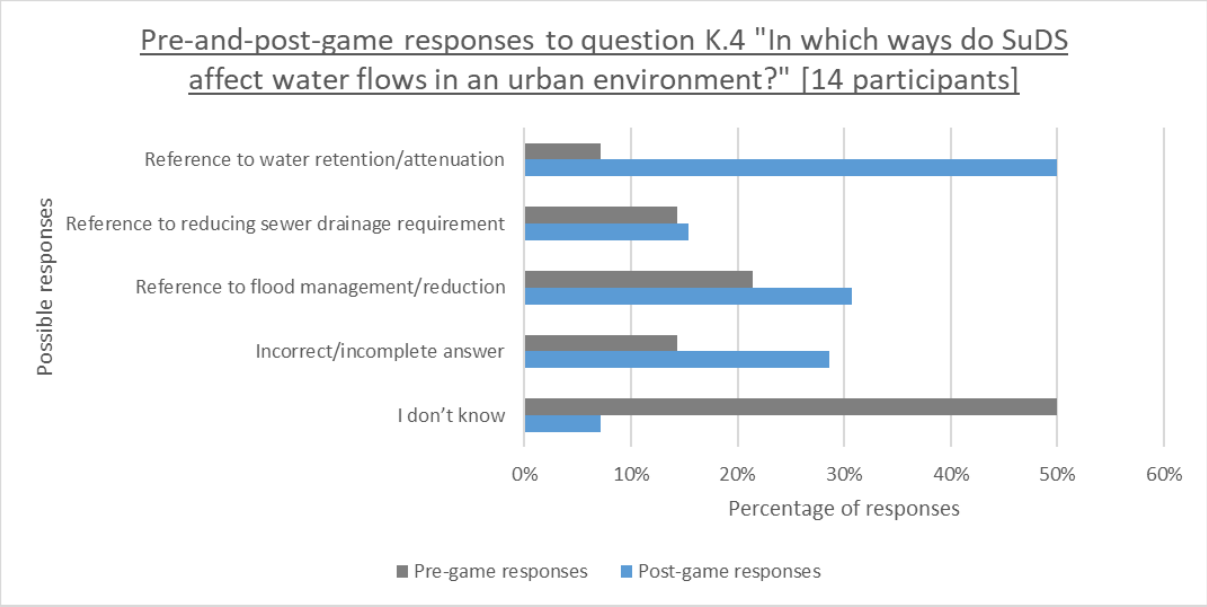

Figure F. 11 - Pre and post-game responses to question K.4 "In which ways do SuDS affect water flows in an urban environment?"

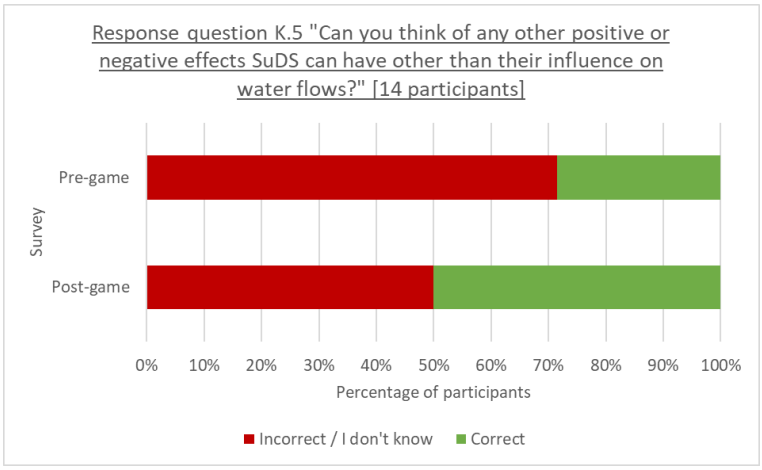

Figure F. 12 - Percentage of correct and incorrect pre and post-game responses to question K.5“Can you think of any other positive or negative effects SuDS can have other than their influence on water flows?”

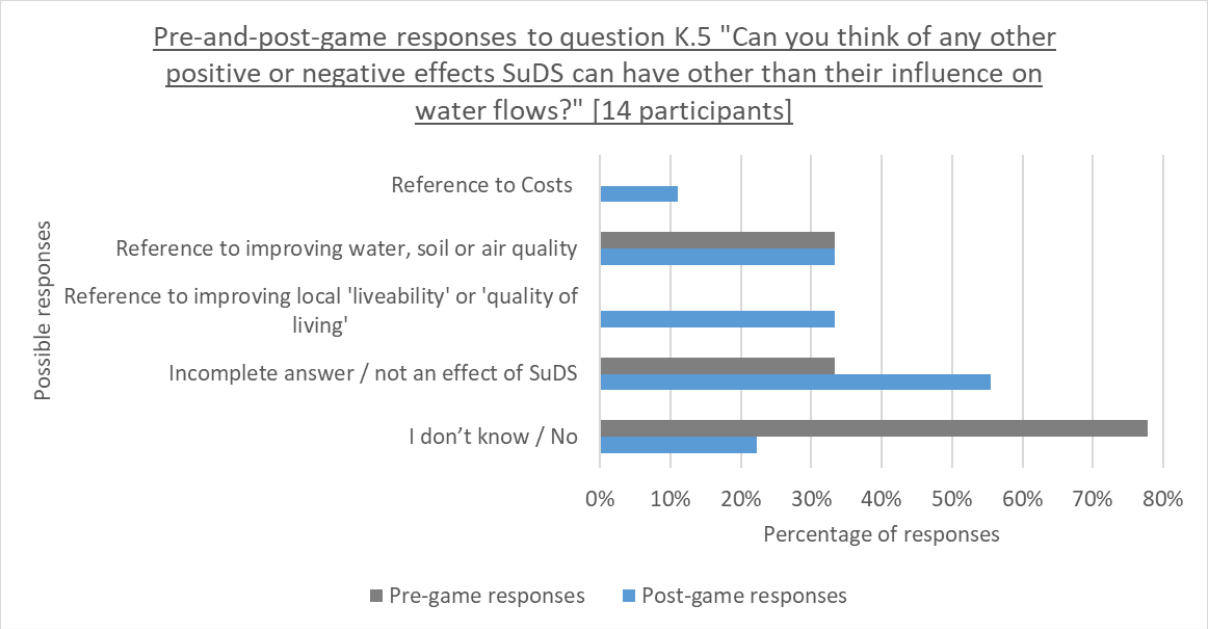

Figure F. 13 - Pre and post-game responses to question K.5 ”Can you think of any other positive or negative effects SuDS can have other than their influence on water flows?”

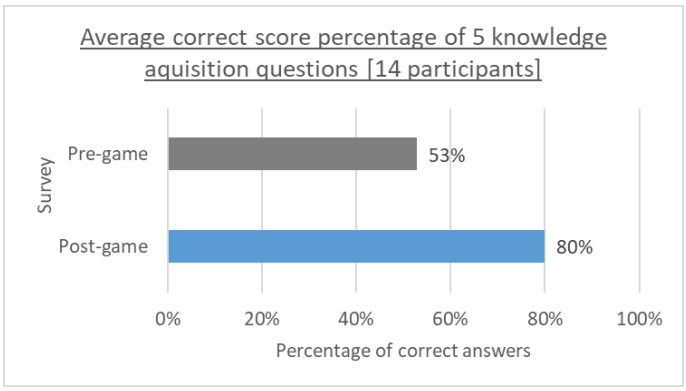

Figure F. 14 - Overall average scores of the 5 knowledge acquisition questions, pre and post-game

Results of Comprehension questions

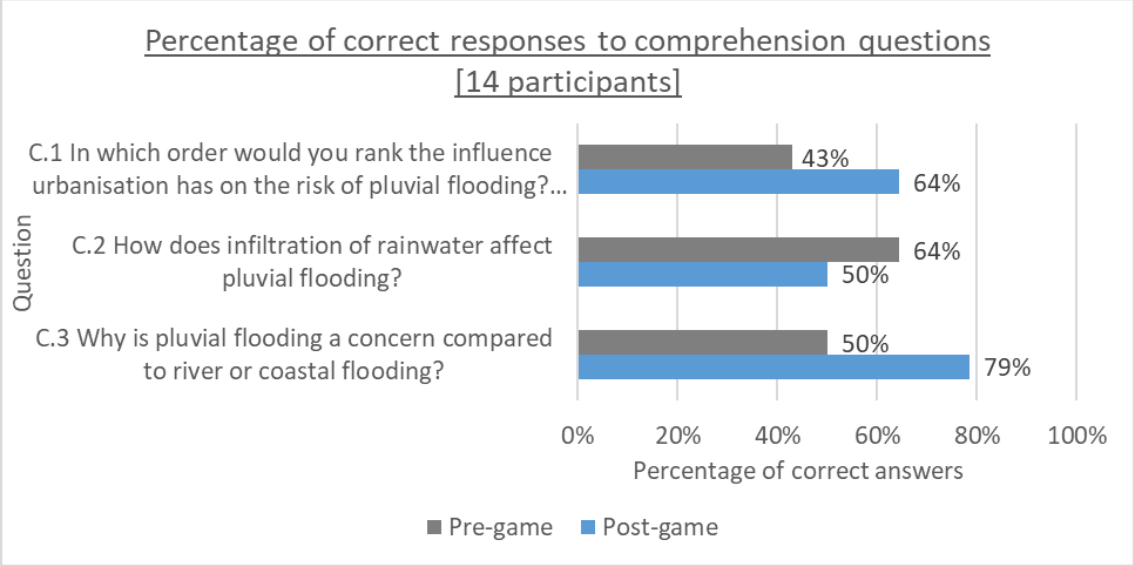

Figure F. 15 - Percentage of correct and incorrect pre and post-game responses to the questions; C.1"In which order would you rank the influence urbanisation has on the risk of pluvial flooding?", C.2 "How does infiltration of rainwater affect pluvial flooding?", C.3"Why is pluvial flooding a concern compared to river or coastal flooding?"

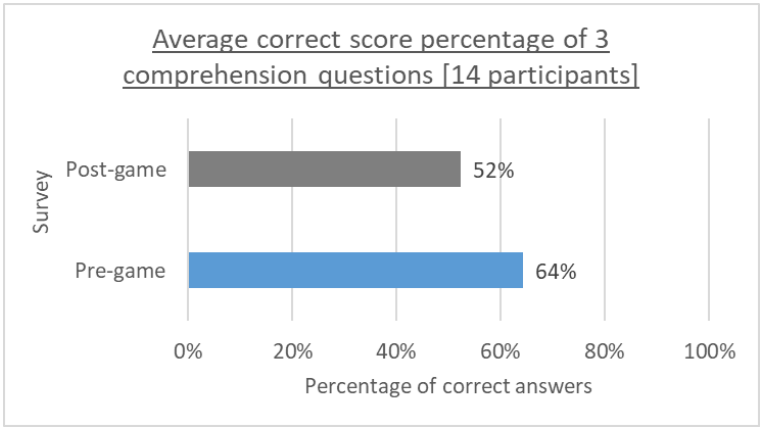

Figure F. 16 - Overall average scores of the 3 comprehension questions, pre and post-game

Results of self-reported personal norm

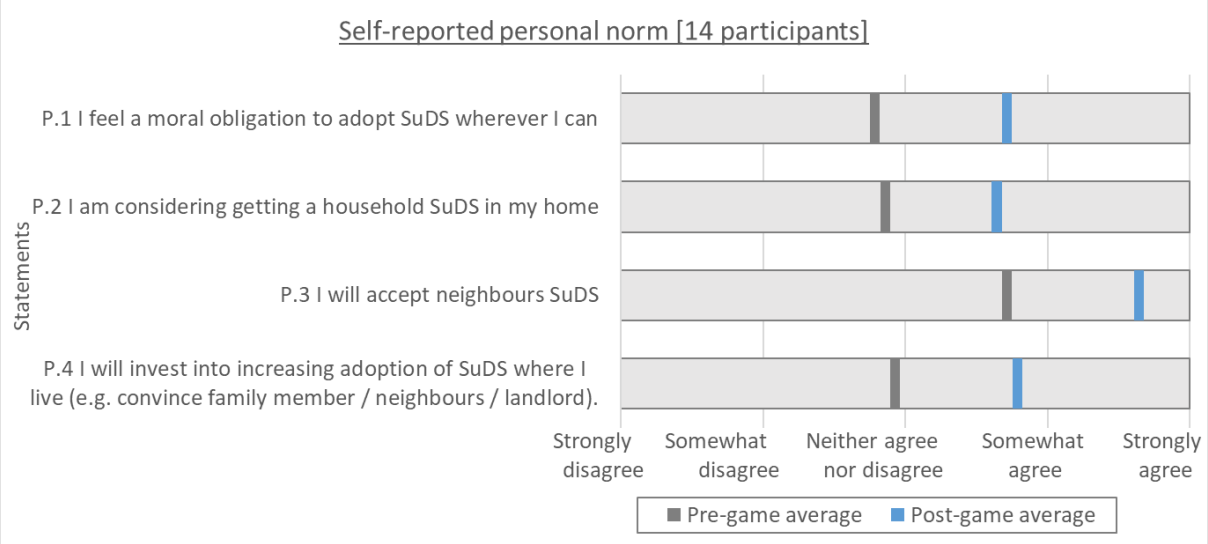

Figure F. 17 - Pre and post-game average score of 14 participants on a scale of strongly disagree to strongly agree for statements P.1-P.4 of personal norm attitudes towards household SuDS

Overall results

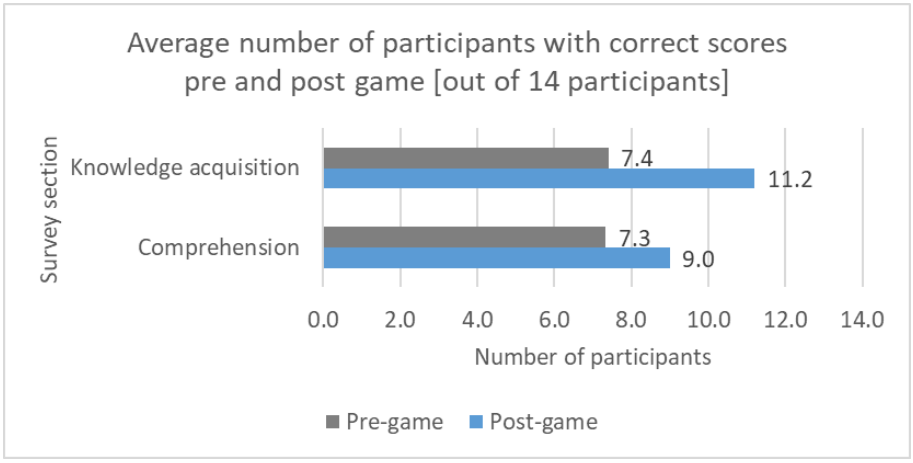

Figure F. 18 - Summary of results for the survey sections; knowledge acquisition and comprehension

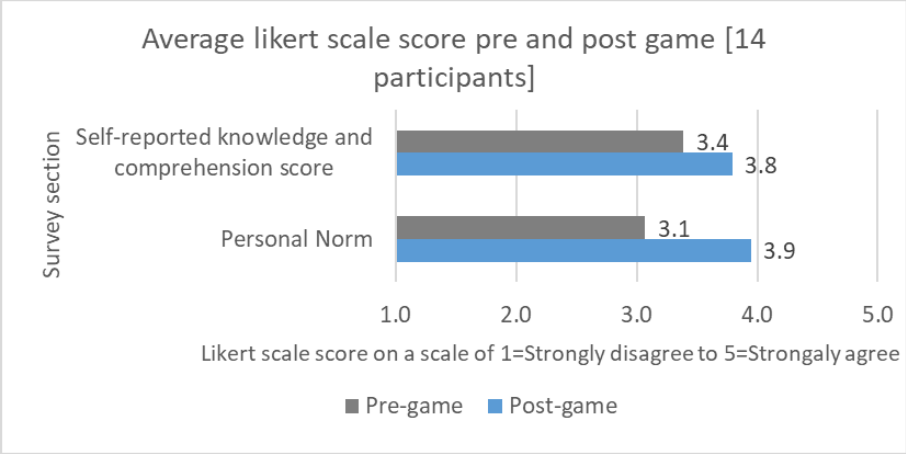

Figure F. 19 - Summary of results for the survey sections; personal norm and self-reported knowledge and comprehension

Gameplay experience feedback

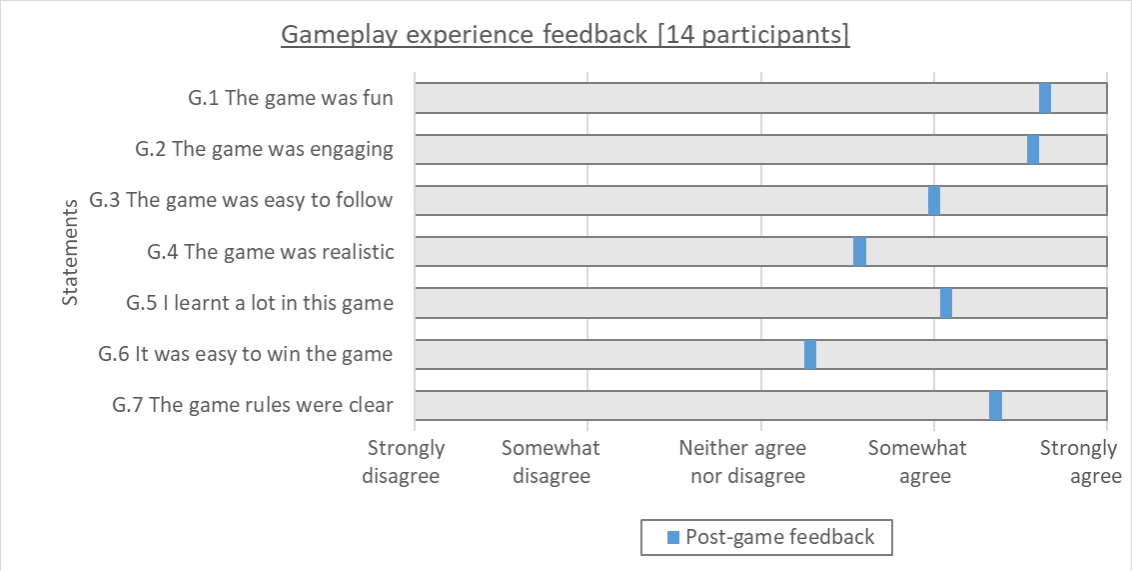

Figure F. 20 - Pre and post-game average score of 14 participants on a scale of strongly disagree to strongly agree for statements G1-G7 of gameplay experience

Responses to question G.8 "What have you learnt from this game that has surprised you?"
How fast you could get
How to plan for suds
*The meaning of provida*l *flooding*
Everything about the theme, because i didn't know anything.
Possibilities to maintain flood management or to support sustainable flood systems
How much impact a household can have on decreasing the effects of pluvial flooding.

I did not expect that this game would create the awareness for me that it actually did
i have learned about suds
i learned a lot
Green roofs help to prevent flood, because mostly I think only gardens help
How much influence an individual household can have on flooding and livability in the neighbourhood.
That even without a garden there are possibilities to adapt suds
i learnt about the ways we can prevent the ill effects of pluvial flooding
weather changes fast year by year

Figure F. 21 - Table of open responses to question G.8 "What have you learnt from this game that has surprised you?"

Responses to question G.9 “Do you have suggestions on how the game could be improved? (please describe)”
I dont know
More card options
A lot of suggestions like added income, different events, pve vs pvp, summers and winter dice, ect
0
Game Rules could be more specified however an amazing and creative game in order to understand Sustainable Flood Draining systems
It was very clear for me. I am not a native English speaker
The questions that were asked after rolling the first dice have the same answers. Those answers are coming back, so it is easy to remember. Maybe it is better to have different answers? Also, a suggestion would be to make clear what impact it ha on the game when choosing different kind of “houses”. But maybe it was made clear but I didn’t pay attention so that’s on me then.
no
i think it is a nice game! So i wouldn’t change anything its nice like this
Adjust the sewer capacity
Make it a bit harder. Maybe more heavy rainfloods. Also maybe have more diverse red cards. After a few rounds, the cards repeated, which also is a good thing. These cards were in general quite easy, and I think that has to do with your audience that are TU Delft students or employees. I would think they in generally know more than average about climate change. Overall very nice game!
maybe introduce something like that the community can decide on what happens to the park areas instead of just building apartments on there. For example that they can decide to pay maintainance

for the parks absorbing power or get more money if they allow construction of houses because of rent / extra income for the local economy. So make it a tradeoff between water absorption and money
it was engaging.
Trying to be more realistic. Not all people are available to implement water SUDS; the role of solar panel to improve floods was not clear to me, but it was the most expensive device.

Figure F. 22 - Table of open responses to question G.9 "Do you have suggestions on how the game could be improved?"