Gamified online survey to elicit citizens’ preferences and enhance learning for environmental decisions

Alice H. Aubert a*; Judit Lienert a

a Eawag: Swiss Federal Institute of Aquatic Science and Technology, Überlandstrasse 133, CH-8600 Dübendorf, Switzerland

* Corresponding author: e-mail: alice.aubert@eawag.ch

This document is the Supplementary Information of a Published Work that appeared in final form in Environmental Modelling and Software. The final version is available at: https://doi.org/10.1016/j.envsoft.2018.09.013 © 2018. This Appendix is made available under the CC-BY-NC-ND 4.0 license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Contents
Gamified online survey to elicit citizens’ preferences and enhance learning for environmental decision .. 1
Appendix 1. Screenshots of the survey tool for the swing and trade-off weight elicitation .................... 2
   Appendix 1a. Swing weight elicitation interfaces ............................................................................. 2
   Appendix 1b. Trade-off weight elicitation interfaces ......................................................................... 7
Appendix 2. Decision problem descriptions (objectives, alternatives, prediction matrix) ....................... 9
   Appendix 2a. Objectives descriptions ............................................................................................. 9
   Appendix 2b. Alternatives descriptions .......................................................................................... 10
   Appendix 2c. Prediction matrix ...................................................................................................... 12
Appendix 3. Ante-questionnaire ........................................................................................................... 12
Appendix 4. Post-questionnaire .......................................................................................................... 15
Appendix 5. Workshop with ZHdK students ......................................................................................... 19
   Appendix 5a. Material distributed for the individual assessment ..................................................... 19
   Appendix 5b. Result of the first exercise (post-it exercise) ................................................................. 21
Appendix 6. Additional hypotheses testing on factual learning (H1b, H1c) ........................................... 22
Appendix 7. Reported reasons for the difficulty of the survey .............................................................. 24
Appendix 1. Screenshots of the survey tool (gamified and control) for the swing and trade-off weight elicitation

Appendix 1a. Swing weight elicitation interfaces

For the gamified and control survey (left and right, respectively).

In the column to the right, we present the task/step that is visualized in the survey (this is not shown to the respondents).

Task/step

1. Presentation of the worst case alternative
2. Start of the ranking of the swings: selection of the most important swing (which objective is most preferably improved from worst to best?)
Task/step

3. Ranking of the swings: selection of the second swing
### Task/step

4. Ranking of the swings: selection of the third swing

<table>
<thead>
<tr>
<th>Importance of Objectives 1</th>
<th>65%</th>
<th>0%</th>
<th>3.8 h/p/a</th>
<th>234 CHF/p/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexibility of system</td>
<td>20%</td>
<td>90%</td>
<td>3.8 h/p/a</td>
<td>234 CHF/p/a</td>
</tr>
<tr>
<td>Recovery of phosphorus</td>
<td>0%</td>
<td>0%</td>
<td>0 h/p/a</td>
<td>109 CHF/p/a</td>
</tr>
</tbody>
</table>

Now, please choose your third priority from the remaining goals and confirm by tapping next.
5. Ranking of the swings: confirmation of the least important swing, possibility to go back to 1
Appendix
Environmental Modelling & Software
Aubert, Lienert

Task/ step

6. Scoring of the ranked swings

Now, please score the options below from 1 to 99 according to their level of importance by moving the sliders on the axis below each option, while the scores of your preferred option and the null option are fixed at 100 and 0, respectively. The upper color coded bar offers a general overview.

Please note, if you like an option half as much as the preferred one, it should get the score 50.

Hypothetical option 2: Recovery of phosphorus
- 20 % Flexibility of system
- 90 % Recovery of phosphorus
- 3.8 t/a
- 234 CHF/ha
- Annual cost

Hypothetical option 3: Flexibility of system
- Flexibility of system 65 %
- Recovery of phosphorus 0 %
- Time demand for end user 3.8 h/p/a
- 234 CHF/p/a

Hypothetical option 4: Flexibility of system
- Flexibility of system
- Recovery of phosphorus
- Time demand for end user
- Annual cost

Now, the upper, color coded bar offers an overview. Score the remaining options with your preferences in mind, by adjusting the sliders. For instance, if you like an option only half as much as your 100 points option, you should score it with 50 points. Tap next, when you assigned all the scores!
Appendix 1b. Trade-off weight elicitation interfaces

For the gamified and control survey (left and right, respectively).

The two-step process is repeated N-1 times, with N=total number of objectives. In the column to the right, we present the task/step that is visualized in the survey (this is not shown to the respondents).

<table>
<thead>
<tr>
<th>Task/ step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Making a preference judgement between: Option A, Option B or indifference</td>
</tr>
</tbody>
</table>
Appendix
Environmental Modelling & Software
Aubert, Lienert

Task/ step

2. If Option A or Option B was selected, adjusting the unfulfilled objective of the least preferred option to reach indifference.
Appendix 2. Decision problem descriptions (objectives, alternatives, prediction matrix)

Appendix 2a. Objectives descriptions

Flexible system adaptation. Flexible system allows coming generations to adapt to changes (e.g. population, climate). A wastewater system is considered to be flexible when a technical extension or deconstruction of the infrastructure can be achieved easily and quickly. The flexibility of the system is estimated in %.

In the best case, the system is highly flexible (60 - 80%), i.e. easy and quick to adapt. In the worst case, the system has a very low flexibility (0 - 20 %), i.e. a technical extension or deconstruction of the system is very difficult.

The current system with centralized wastewater treatment plants is not very flexible (20 – 50% flexibility). Decentralized systems (e.g. wastewater treatment units in the cellar of a building) are more flexible (50 - 70 %).

Recovery of phosphorus. A good wastewater infrastructure makes efficient use of resources such as phosphorus. Phosphorus is a vital fertilizer for the agriculture, and urine contains 50% of the phosphorus that needs to be removed from all wastewater.

The ability to recover phosphorus is expressed in %. In the best case, 90% of the phosphorus contained in the wastewater is recovered, in the worst case, 0% is recovered. Currently, 0% of the phosphorus in the wastewater is recovered. Urine separation technology enables phosphorus recovery from urine.

Low time demand for the end user. To operate or maintain the wastewater infrastructure, the end user (like you) may need to invest time.

The time demand for an end user is expressed in hours per person per year. In the best case, the end user does not need to invest any time to operate the wastewater system. In the worst case, each end user needs to invest 3.8 hours per year. Currently, end users do not need to invest any time to operate the wastewater system. Decentralized systems are more time demanding.

Low annual cost. The annual cost is what the end user (like you) has to pay per year for the wastewater disposal system, including operation and maintenance costs as well as capital costs. It is measured in CHF per person per year.

In the best case, each end user has to pay 109 CHF per year. In the worst case, each end user has to pay 234 CHF per year. Nowadays, every end user pays about 290 CHF per year.
Appendix 2b. Alternatives descriptions

Option Centralized high tech. All wastewater is treated in a central wastewater treatment plant. The treatment is high tech and upgraded to remove micropollutants such as pharmaceuticals. All the services are provided by a communal association. Newly-built areas have a separate drainage system for rain, to limit the sewer overflows of untreated wastewater into rivers.

[Note to the reader of the Appendix: alternative A2 in SWIP project. The publication list can be found at the following link: https://www.eawag.ch/de/abteilung/sww/projekte/swip/ (retrieved on 22.05.2018)]

Option Decentralized low tech. The wastewater in the newly built areas is treated with cheap decentralized technology, e.g. septic tanks. There is a minimal municipal collection service, the households are responsible for the infrastructure and its proper functioning.

[Note to the reader of the Appendix: alternative A5 in SWIP project]
Option Decentralized with nutrient recovery. Urine is first separated from feces in the toilet, then collected and treated in a separate tank to produce a fertilizer, based on cooperative or private responsibility. The feces and the remaining wastewater, e.g. from showers, drains through the existing sewers to the central wastewater treatment plant. [Note to the reader of the Appendix: alternative A7 in SWIP project]

(Re-)use of the nutrients

Collection of urine and the nutrients it contains

Treatment of urine and concentration of nutrients in a fertilizer

Option Status quo (central) with storm water retention. As today, all wastewater is treated in a central wastewater treatment plant and communities are responsible for the infrastructure and its proper functioning. Newly-built areas are connected to rain infiltration facilities to limit the sewer overflows of untreated wastewater into rivers. [Note to the reader of the Appendix: alternative A8a in SWIP project]
Appendix 2c. Prediction matrix

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>flexible system adaption in %</th>
<th>recovery of phosphate in %</th>
<th>low time demand in hours/person/year</th>
<th>low annual cost in CHF/person/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>174.5</td>
</tr>
<tr>
<td>A5</td>
<td>0.625</td>
<td>0</td>
<td>2.5</td>
<td>109.3</td>
</tr>
<tr>
<td>A7</td>
<td>0.65</td>
<td>0.9</td>
<td>3.8</td>
<td>226.5</td>
</tr>
<tr>
<td>A8a</td>
<td>0.35</td>
<td>0</td>
<td>1.9</td>
<td>234.3</td>
</tr>
</tbody>
</table>

The publication list of the SWIP project can be found at the following link: https://www.eawag.ch/de/abteilung/sww/projekte/swip/ (retrieved on 22.05.2018)

Appendix 3. Ante-questionnaire

Registration

[EN.Q03] Question="When were you born?"
0001="Before 1982"
002="Between 1982 or 1999"
003="After 1999"
004="I do not want to share this information"

[EN.Q04] Question="What is your gender?"
001="Male"
002="Female"
003="I do not want to share this information"

[EN.Q05] Question="What is the highest level of education you have completed?"
001="Secondary School / High School"
002="Apprenticeship"
003="University or other institution of higher education"

[EN.Q06] Question="Do you work in a field related to wastewater and water protection? If yes, please specify how many years you have worked in this field."
001="No, I have not worked in a field related to wastewater and water protection."
002="Yes, I have worked in a field related to wastewater and water protection."

[EN.Q07] Question="If 'Yes', how long have you worked in a field related to wastewater and water protection?"
000="No, I have not"
001="less than 1 year"
002="1-5 years"
Appendix
Environmental Modelling & Software
Aubert, Lienert

003="6-10 years"
004="more than 10 years"

[EN.Q08] Question="Have you ever, personally or through the media, come in contact with wastewater related issues (e.g. wastewater flooding, wastewater related illness, pipe blockages)? (Multiple answers possible)"

[Columns]
C001="Through my own direct experience"
C002="Through the media (newspapers, TV, radio, internet, etc.)"

[Rows]
001="Seeing flooding of streets with wastewater"
002="Seeing blocked wastewater pipes in my house (leading to e.g. flooding of cellar)"
003="Getting a wastewater related illness such as a gastrointestinal infection (e.g. due to swimming in a river or a lake after heavy rainfall)"
004="Seeing wastewater discharged into a river or a lake after heavy rainfall"
005="Using a urine separation toilet"
006="Visiting a wastewater treatment plant"
007="No, I have not come in contact with wastewater related issues"

[EN.Q11] Question="On average, how often do you play board games?"
001="Never"
002="Less than once a month"
003="1 to 4 times a month"
004="5 to 8 times a month"
005="More than 8 times a month"

[EN.Q12] Question="How often do you play video games?"
001="Never"
002="Less than once a month"
003="1 to 4 times a month"
004="5 to 8 times a month"
005="More than 8 times a month"

[EN.Q141]

Knowledge questions

We would like to know about your personal experience and knowledge of water and wastewater related issues. This is important to us since it may influence the survey. The following questions are not intended to test you but rather serve for research purposes.

[EN.Q141-145] Question="The pictures below show a centralized and a decentralized wastewater treatment system."
Decentralized wastewater treatment is performed at the building level with autonomous equipment; the treated effluent is drained into nearby surface waters or soils. Moreover, rain water infiltration is developed (e.g. green roofs, permeable parking lots).

Centralized wastewater treatment is performed as today at a central plant requiring sewers; the treated effluent is drained into the nearby surface waters. Rain water is drained together with the wastewater or in a parallel drainage system.

Which of the two systems do you consider to be more flexible in terms of construction (e.g. capacity extension)?
001="Decentralized wastewater treatment system"
002="Centralized wastewater treatment system"
003="I do not know"

[Note to the reader of the Appendix: 001 is the right answer]

[EN.Q16] Question="Urine constitutes less than 1% of the domestic wastewater. How much of the phosphorus that needs to be removed in wastewater treatment plants originates from urine?"
Appendix
Environmental Modelling & Software
Aubert, Lienert

001="10%"
002="30%"
003="50%"
004="70%"
005="90%"
006="I do not know"
[Note to the reader of the Appendix: 005 is the right answer]

[EN.Q17] Question="Which of the following statements about the time investment by the end user to operate and maintain wastewater treatment plants (WWTP) is true?"
001="Centralized WWTPs demand less time than decentralized WWTPs (e.g. unit in the building) from the end user"
002="Centralized WWTPs demand more time than decentralized WWTPs (e.g. unit in the building) from the end user"
003="I do not know"
[Note to the reader of the Appendix: 001 is the right answer]

[EN.Q18] Question="How much does a person in Switzerland pay per year for wastewater collection and treatment?"
001="Nothing, it is free."
002="1 – 250 CHF"
003="250 – 500 CHF"
004="500 – 750 CHF"
005="750 – 1000 CHF"
006="More than 1000 CHF"
007="I do not know"
[Note to the reader of the Appendix: 003 is the right answer]

[EN.Q19] Question="This is the end of the opening questions, three main tasks will follow. At the beginning of each you will receive specific instructions."

Appendix 4. Post-questionnaire
Knowledge questions
Repetition of the questions from the ante-questionnaire.

Feedback questions
[EN.Q45] Question="We are interested in your judgement on the whole questionnaire. Overall, how difficult was it to fill in the questionnaire?"
001="Very easy"
002="Easy"
003="Neutral"
[EN.Q46] Question="How certain do you feel about your answers?"
001="Very uncertain"
002="Uncertain"
003="Somewhat certain, somewhat uncertain"
004="Certain"
005="Very certain"

[EN.Q47] Question="Do you think you have a better understanding of wastewater management after filling in the questionnaire?"
001="Not at all"
002="Slightly better"
003="Somewhat better"
004="Better"
005="Extremely better"

[EN.Q48] Question="Now, please give feedback on the different parts of the questionnaire. How difficult was the direct 'Ranking of options' at the beginning of the questionnaire?"
001="Very easy"
002="Easy"
003="Neutral"
004="Difficult"
005="Very difficult"

[EN.Q49] Question="How difficult was 'Importance of objectives 1' (selecting the objectives you want to improve in order of priority, then assigning scores to various options)?"
001="Very easy"
002="Easy"
003="Neutral"
004="Difficult"
005="Very difficult"

[EN.Q50] Question="How difficult was 'Importance of objectives 2' (comparing two options, choosing the preferred one, then adapting the less preferred option until both are equally good)?"
001="Very easy"
002="Easy"
003="Neutral"
004="Difficult"
005="Very difficult"

[EN.Q511] Question="If you had difficulties, please select the reasons. (multiple answers possible)"
001="Lack of sufficient information"
002="Too much information"
003="The questions were difficult to understand (the instructions were unclear)"
004="The comparisons were difficult: I found it difficult to select the objectives to improve in order of priority (start of 'Importance of objectives 1')"
005="The comparisons were difficult: I found it difficult to score the options (end of 'Importance of objectives 1')"
006="The comparisons were difficult: I found it difficult to select the best of the two options (start of 'Importance of objectives 2')"
007="The comparisons were difficult: I found it difficult to adapt the options so that they were both equally good (end of 'Importance of objectives 2')"
008="The topic of wastewater is too complex"
009="Too many questions"
010="I did not have any difficulties"
011="Others"

[EN.Q512] Question="If you selected 'Others', please write the reasons down here:"

[EN.Q52] Question="How strongly did you take the worst-possible and the best-possible state of the objectives into consideration when you chose one option over another?"
001="Not at all"
002="Slightly"
003="Somewhat strongly"
004="Strongly"
005="Very strongly"

[EN.Q53] Question="Feedback on the experience of filling in the questionnaire

How long did it take you to complete this survey?"
001="less than 15 minutes"
002="15-30 minutes"
003="30-45 minutes"
004="45-60 minutes"
005="more than 1 hour"

[EN.Q54] Question="How did you perceive the time it took to complete the survey?"
001="Shorter than the actual time it took"
002="Equal to the actual time it took"
003="Longer than the actual time it took"

[EN.Q55] Question="How much do you agree with the following statements?

It was fun to fill in this questionnaire."
001="I strongly disagree"
002="I disagree"
003="I neither agree or disagree"
004="I agree"
005="I strongly agree"

[EN.Q56] Question="The questionnaire kept me motivated while filling it in."
001="I strongly disagree"
002="I disagree"
003="I neither agree or disagree"
004="I agree"
005="I strongly agree"

[EN.Q57] Question="Filling in this questionnaire was a worthwhile use of my time."
001="I strongly disagree"
002="I disagree"
003="I neither agree or disagree"
004="I agree"
005="I strongly agree"

[EN.Q58] Question="I think that my answers can be useful."
001="I strongly disagree"
002="I disagree"
003="I neither agree or disagree"
004="I agree"
005="I strongly agree"

[EN.Q59] Question="I would recommend this survey to other people."
001="I strongly disagree"
002="I disagree"
003="I neither agree or disagree"
004="I agree"
005="I strongly agree"

[EN.Q60] Question="Do you think that an objective was missing to properly evaluate the options of wastewater management?"
001="No. The objectives covered most of the important aspects."
002="Yes."

[EN.Q61] Question="If Yes, please specify which aspect(s) of the issue was/ were not covered:"
Open box
Appendix 5. Workshop with ZHdK students

Appendix 5a. Material distributed for the individual assessment after testing either one of the survey version

---

22.03.2017

Individual assessment of participant’s experience

Write down the 4th letter of your token: P2t ___ ...

1. You have two sheets of paper. Write down the first two adjectives that come to your mind to describe your experience of the App. (One adjective per sheet). Be spontaneous and frank.

2. Perception of the experience can be defined by different factors. Please rate all of them hereafter, on the scales. Put a cross wherever appropriate on the scale.

2.a. Did it feel very difficult ☹ or very easy ☀ or somewhere in between?

2.b. Did the survey feel very demotivating ☹ (you wanted to stop) or very motivating ☀ (you wanted to see what happens next) or somewhere in between?

2.c. Was it not fun at all to answer this survey ☹ or did you had great fun ☀? (Or somewhere in between.)

2.d. How did you feel about the time spend: it was much too long ☹ to it went fast ☀.

2.e. How confident are you about the fact that your answers reflect your preferences? Not at all ☹ to very confident ☀

2.f. Based on your overall experience (look at your answers above), how would you rate the gamification? Very bad ☹ to very good ☀

Please, turn the page!
Individual assessment of participant’s experience Workshop Eawag - ZHdK

Gamifying is incorporating game elements and principles in non-game activities/contexts, in our case online survey about preferences. Please fill in the table below.

<table>
<thead>
<tr>
<th>Here is a list of game elements</th>
<th>Tick the one that you have recognised</th>
<th>Which effect did it produce? (only for the ones with ticks)</th>
<th>On a scale from 1 (not successful use) to 5 (very successful), how do you rate the game elements that you recognised?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Random event</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>3. Offer win/fail situation</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>4. Progress bar</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>5. Reward/penalizing feedbacks</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>6. Score</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>7. Competition</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>8. Non-player Characters</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>11. Award/badge</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>12. If other:</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
<tr>
<td>13. If other:</td>
<td></td>
<td></td>
<td>1–2–3–4–5</td>
</tr>
</tbody>
</table>

Thanks, let’s discuss this after the break!
### Appendix 5b. Result of the first exercise (post-it exercise)

After the individual assessments (as instructed in point 1 of Appendix 5a), the adjectives were collected, classified as “positive” (line +) or “negative” (line -) and discussed in a group session. The following table presents the collection of adjectives that students used to describe their experience of the app.

<table>
<thead>
<tr>
<th>Control:</th>
<th>Gamified:</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Scientific</td>
<td>Different</td>
</tr>
<tr>
<td>Teaching-related</td>
<td>Nice pictures</td>
</tr>
<tr>
<td>Unexpected</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Scrolling (not an adjective)</td>
<td>Strange</td>
</tr>
<tr>
<td>Forced</td>
<td>Prejudiced (advertising something)</td>
</tr>
<tr>
<td>Text-heavy</td>
<td>Unqualified</td>
</tr>
<tr>
<td>Annoying</td>
<td>Complicated/Frustrating</td>
</tr>
<tr>
<td>Frustrating</td>
<td>Confused</td>
</tr>
<tr>
<td>Confusion</td>
<td>Irritating</td>
</tr>
<tr>
<td>Complex (2x)</td>
<td>Complex</td>
</tr>
<tr>
<td>Difficult (2x)</td>
<td>Too complex</td>
</tr>
<tr>
<td>Inconsistent</td>
<td>Inconsistent</td>
</tr>
<tr>
<td>Click-marathon</td>
<td></td>
</tr>
<tr>
<td>Lack of vision</td>
<td>Boring</td>
</tr>
</tbody>
</table>

-                              |                               |
Appendix 6. Additional hypotheses testing on factual learning (H1b, H1c)

Measures to test the hypotheses

To test H1b (participants are aware about this factual learning), we asked: “Overall, do you think you have a better understanding of wastewater management after filling in the survey?” Participants answered using the following scale 1=“not at all better understanding”, 2=“slightly better”, 3=“somewhat better”, 4=“better”, to 5 “extremely better understanding”.

To test H1c (factual learning is higher for novices and those who spend more time on the informative parts (descriptions of objectives and alternatives)), we used the knowledge tests and the sum of the time spent on the pages describing the objectives and alternatives.

Results

H1b (participants are aware about this factual learning) was verified. Overall, participants reported having a better understanding of wastewater management issues (Tab. 2, last column, in main document). Participants who answered the gamified survey statistically significantly perceived higher learning than those answering the control survey, independently of the actual factual learning (Fig. A1): in the control, perceived learning was low when the factual learning was low; in the gamified survey, perceived learning was high even if factual learning was low. In the control survey, people seemed to have a more accurate perception of their learning. In the gamified survey, people seemed to perceive learning independently of the actual learning. However, the correlation between factual and perceived learning was not statistically significant for the gamified version (Pearson’s product moment correlation: cor=-0.03, p-value=0.80); and was also not statistically significant, but at the border, for the control (cor=0.26, p-value=0.05).
H1c (factual learning is higher for novices and those who spend more time on the informative parts (descriptions of objectives and alternatives)) was partially verified: overall, factual learning was higher for novices. There was a statistically highly significant negative correlation between score difference and the initial knowledge score (Spearman’s rank correlation, rho=-0.57, p-value=1.4e-10), i.e. participants with low prior knowledge learnt more than participants with higher prior knowledge. However, no statistically significant correlation was observed between the score difference and the time spent on the informative parts (rho=0.17, p-value=7.0e-7).
Appendix 7. Reported reasons for the difficulty of the survey

Table A7. Reported reasons for difficulty of the survey (multiple choice question). ‘Importance of objectives 1’ relates to using the swing method for weight elicitation, and ‘Importance of objectives 2’ to the trade-off method. Items in bold were selected by more than 10% of the respondents overall.

<table>
<thead>
<tr>
<th>Question “If you had difficulties, please select the reasons:”</th>
<th>Overall (N=107)</th>
<th>Control (N=53)</th>
<th>Gamified (N=54)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>A Lack of sufficient information</td>
<td>23</td>
<td>21.5</td>
<td>10</td>
</tr>
<tr>
<td>B Too much information</td>
<td>16</td>
<td>15.9</td>
<td>12</td>
</tr>
<tr>
<td>C The questions were difficult to understand (the instructions were unclear)</td>
<td>8</td>
<td>7.5</td>
<td>3</td>
</tr>
<tr>
<td>D The comparisons were difficult: I found it difficult to select the objectives to improve in order of priority (start of ‘Importance of objectives 1’)</td>
<td>11</td>
<td>10.3</td>
<td>5</td>
</tr>
<tr>
<td>E The comparisons were difficult: I found it difficult to score the options (end of ‘Importance of objectives 1’)</td>
<td>13</td>
<td>12.1</td>
<td>5</td>
</tr>
<tr>
<td>F The comparisons were difficult: I found it difficult to select the best of the two options (start of ‘Importance of objectives 2’)</td>
<td>6</td>
<td>5.6</td>
<td>5</td>
</tr>
<tr>
<td>G The comparisons were difficult: I found it difficult to adapt the options so that they were both equally good (end of ‘Importance of objectives 2’)</td>
<td>19</td>
<td>17.8</td>
<td>9</td>
</tr>
<tr>
<td>H The topic of wastewater is too complex</td>
<td>3</td>
<td>2.8</td>
<td>1</td>
</tr>
<tr>
<td>I Too many questions</td>
<td>2</td>
<td>1.9</td>
<td>-</td>
</tr>
<tr>
<td>J I did not have any difficulties</td>
<td>2</td>
<td>1.9</td>
<td>-</td>
</tr>
<tr>
<td>K Others</td>
<td>4</td>
<td>3.7</td>
<td>3</td>
</tr>
</tbody>
</table>

Results of Fisher’s exact tests between gamified and control survey, for items in bold:
- For A: p-value=6.0e-1 (n.s.)
- For B: p-value=3.0e-2
- For D: p-value=1 (n.s.)
- For E: p-value=5.6e-1 (n.s.)
- For G: p-value=1 (n.s.)