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Gamified environmental Multi-Criteria Decision Analysis: Information on objectives and range insensitivity bias

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This document complements the above-mentioned paper.

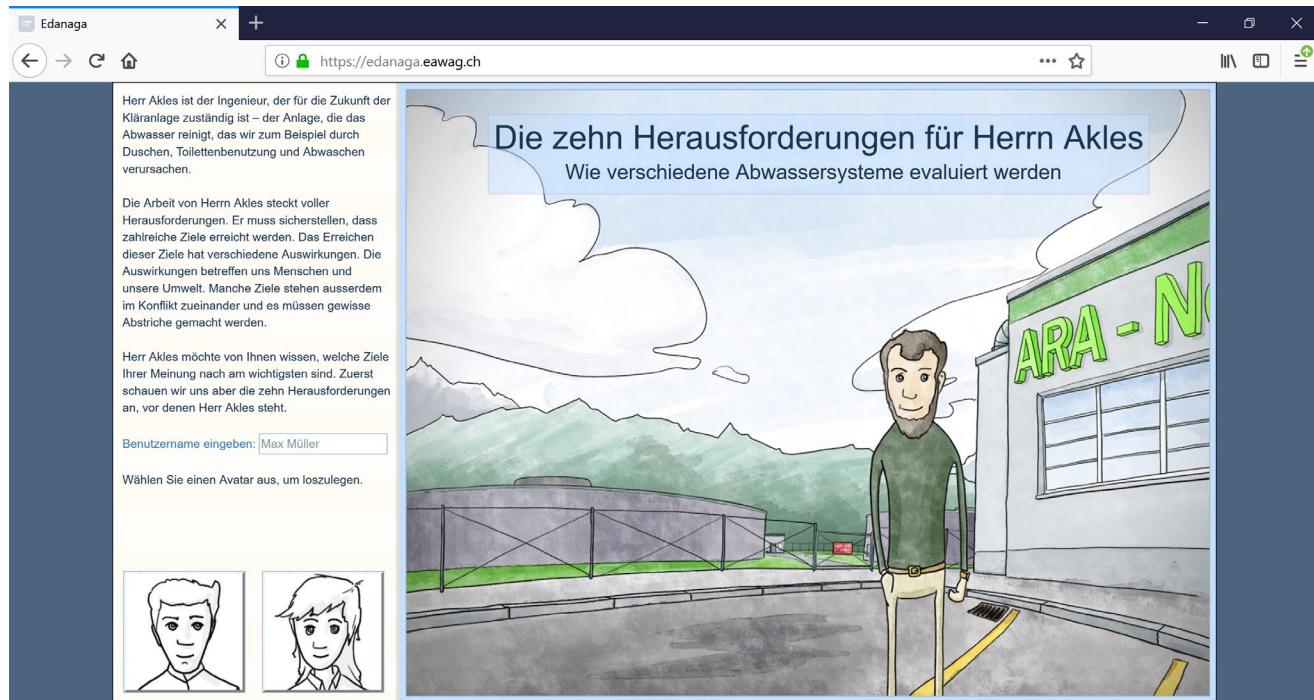
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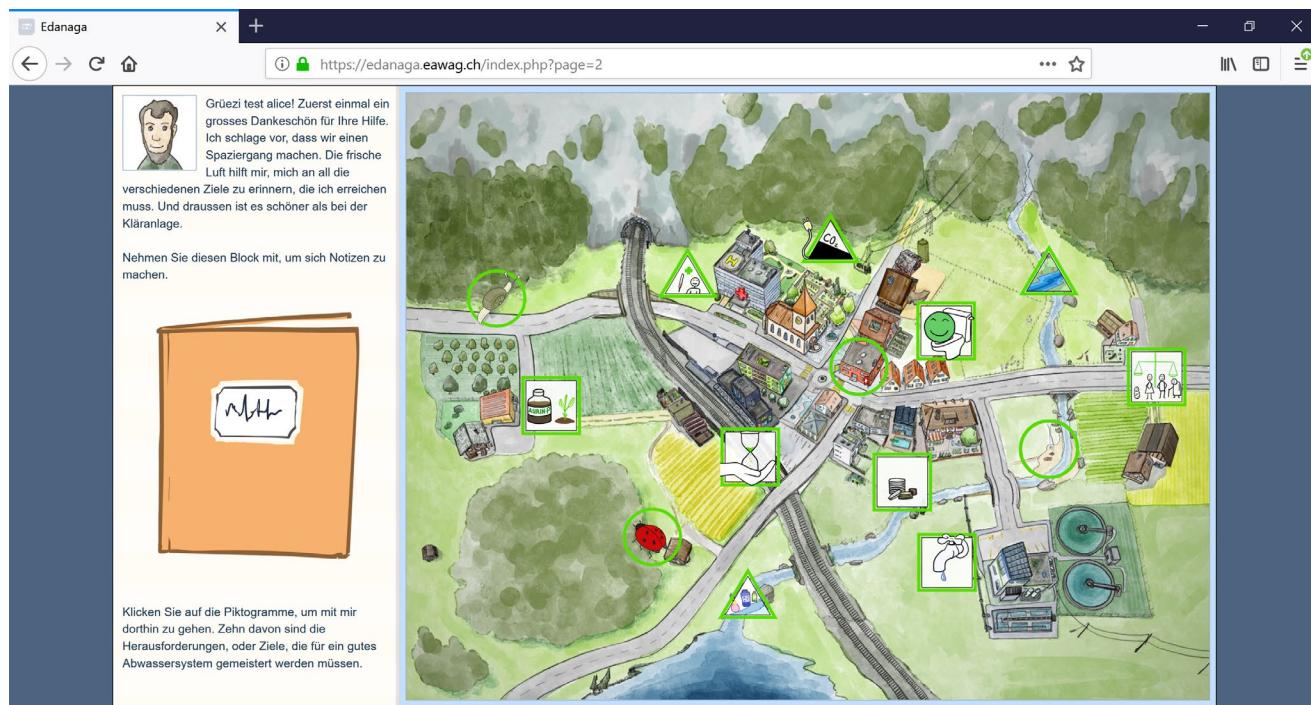
SI 1. The gamified information on objectives

Screenshots of the five web pages, and full description of the users' action.



Page 1. Welcoming and context.

Page 1 introduces the topic and Mister Akles, who in game terminology is a nonplayer character: we provide information to the users through this character embedded in the story. The users can choose avatars, representing themselves in the story, and a user name.



Page 2. Objective definition.

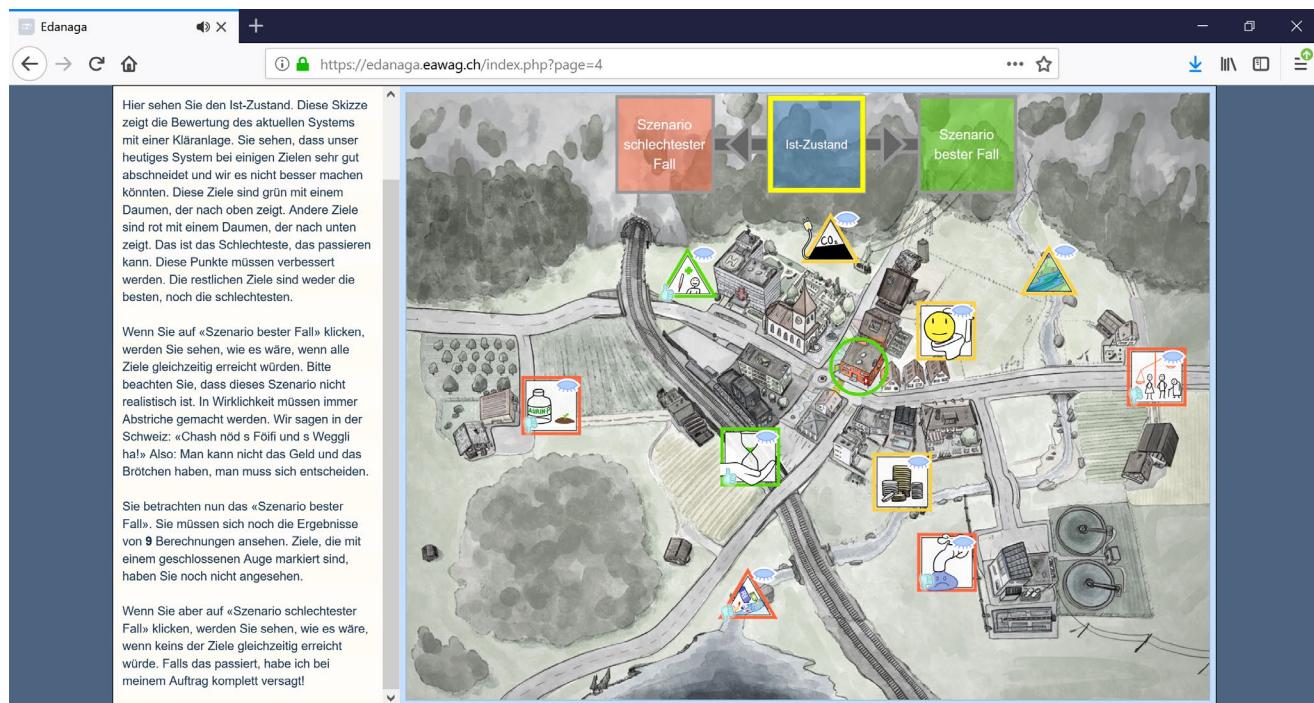
Page 2 was inspired by discovery and exploration games in which players wander in or build virtual landscapes. It represents a Swiss rural village and contains icons. Mr. Akles invites the users for a stroll in the village, where they come across landscape elements, appearing as icons, that remind him of the various challenges, which correspond with the 10 objectives, that he needs to address for sustainable wastewater management. The invitation for the stroll and all Mr. Akles's messages to the users are provided in writing on the left side of the screen and in an audio voice-over. To access information on an objective, the users click on the icon of this objective. This action opens a pop-up window displaying the name of the objective and its definition. Clicking to close the window saves the icon to a notebook. The users have to open all the icons to be able to move on, and we expect that they read all the objectives' definitions. Finding and collecting the icons visualizes and provides a feeling of progress. In addition, a few icons offer shortcuts, and random events occur when the users are inactive.

The screenshot shows a web-based application titled "Edanaga". At the top, there are navigation icons (back, forward, search, etc.) and the URL "https://edanaga.eawag.ch/index.php?page=3". The main area features a cartoon illustration of Mr. Akles, a man with a beard and green shirt, standing in an office. To his left is a vertical column of icons representing various environmental objectives. To his right is a table listing attributes and their definitions.

KWh pro Person und Jahr	Das Ziel wird angegeben als Energiemenge, die für die Abwasserreinigung durchschnittlich pro Person und Jahr verbraucht wird. Der niedrigste Verbrauch ist die beste.
Prozent (%) der Rückgewinnung von Phosphor	Das Ziel wird angegeben als durchschnittlicher Anteil von Phosphor, der durch die Kläranlage zurückgewonnen wird, im Vergleich zum Phosphor, der in die Kläranlage gelangt. Die höchste Rückgewinnung ist die beste.
Prozent (%) der Reinigung von Mikroverunreinigungen	Das Ziel wird angegeben als durchschnittlicher Anteil von Mikroverunreinigungen, die durch die Kläranlage entfernt werden, im Vergleich zu den Mikroverunreinigungen, die in die Kläranlage gelangen. Die höchste Reinigungsleistung ist die beste.
CHF pro Person und Jahr	Das Ziel wird angegeben als Gesamtkosten für Investition, Betrieb und Unterhalt in Schweizer Franken pro Person und Jahr. Die niedrigsten Kosten sind die besten.
Prozent (%) der Reinigung von Schmutzstoffen	Das Ziel wird angegeben als durchschnittlicher Anteil von Schmutzstoffen, die durch die Kläranlage entfernt werden, im Vergleich zu den Schmutzstoffen, die in die Kläranlage gelangen. Die höchste Reinigungsleistung ist die beste.
10-Punkte-Skala	Das Ziel wird angegeben als Skala, die von 0 für sehr unattraktiv bis 10 für sehr attraktiv reicht. Der höchste Wert ist der beste.
Liter pro Person und Tag	Das Ziel wird angegeben als Anzahl der Liter, die ein Mensch täglich für das Spülen der Toilette verwendet. Der niedrigste Verbrauch ist der beste.
Stunden pro Jahr	Das Ziel wird angegeben als Anzahl der Stunden, die ein/ve Endverbraucher/-innen pro Jahr für die Befreiung des Abwassersystems aufbringen muss. Der niedrigste Zeitaufwand ist der beste.
Prozentskala (%)	Das Ziel wird angegeben als Skala, die von äusserst unflexibel (0) bis zu äusserst flexibel (100) reicht. Der höchste Wert ist der beste.
Anzahl Kontakte pro Jahr	Das Ziel wird angegeben als Häufigkeit, mit der Endverbraucher/-innen pro Jahr mit potenziell kontaminierten Teilen des Abwasserreinigungssystems in direkten Kontakt kommen. Die niedrigste Anzahl an Kontakten ist die beste.

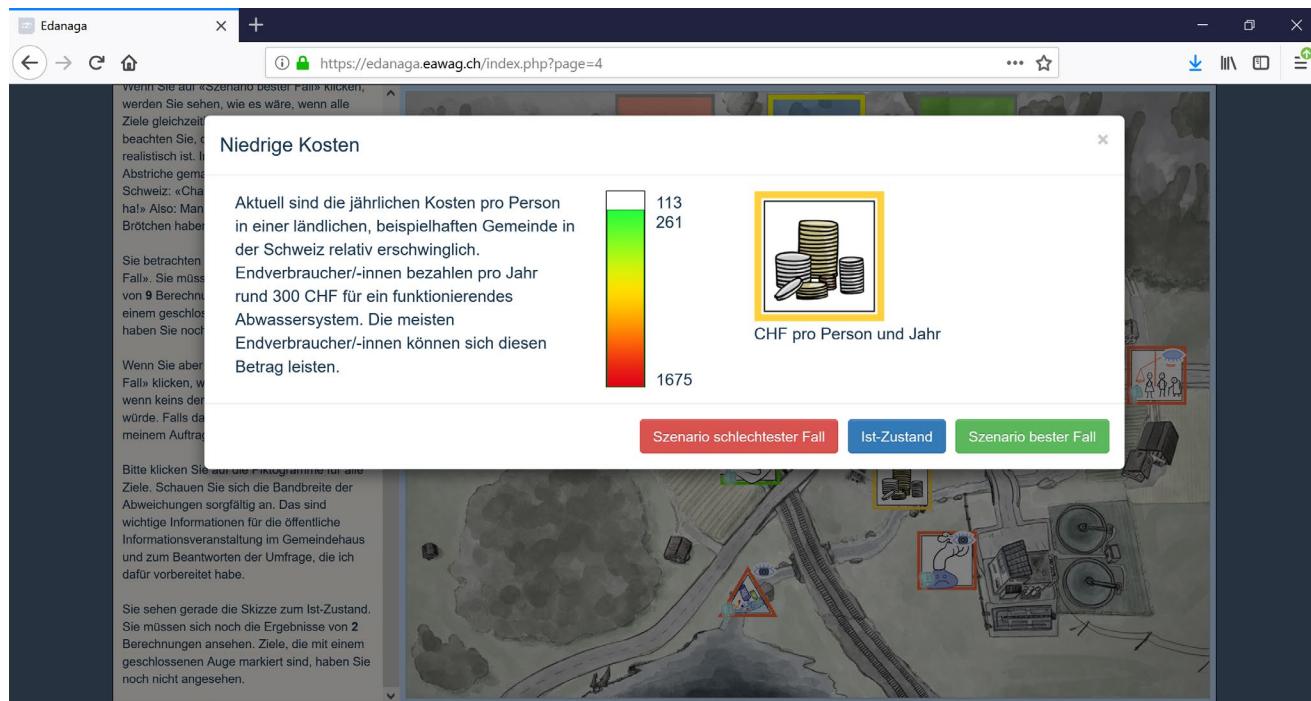
Page 3. Attribute definition and measurement unit.

Page 3 presents Mr. Akles in his office. He gives the users the task of matching the icons of the objectives to their attributes and measurement units. The users can drag and drop the icons to the corresponding attributes. While dragging an icon, the objective's definition is displayed as a reminder at the bottom of the page. Mr. Akles provides encouraging written and voice-over feedback for each action. When all icons have been matched to their attributes, the users can move on.



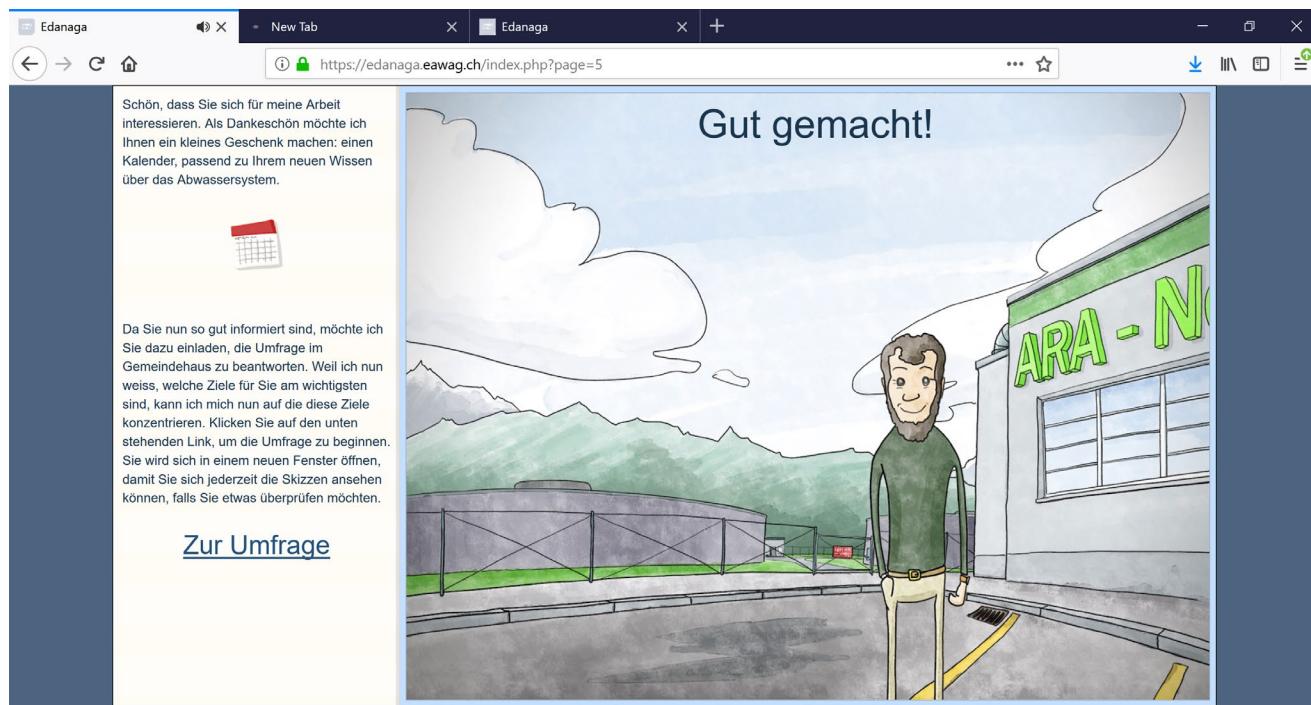
Page 4a. Presentation of best, worst (i.e. range), and status quo levels of attributes.

Page 4 represents the same landscape as Page 1. Mr. Akles invites the users to explore three possible states of the world: a best state, the status quo, and a worst case. These states refer to the ranges of the attributes for various wastewater alternatives, which are needed for later MCDA preference elicitation. When the users click on the icon for an objective, a pop-up window opens, showing a fulfilment bar of the level taken by the attribute and the corresponding numerical values (Page 4b). Two random events occur if the users are inactive: a dove takes the users to the best state of the world, or a raven to the worst state. Once the users have clicked at least once on all of the icons, they can move on. There is no need to click systematically on all icons in the three states of the world because the best and worst levels of each attribute, their ranges, are always displayed.



Page 4b. Presentation of best, worst (i.e. range), and status quo levels of attributes.

When the users click on the icon for an objective, a pop-up window opens, showing a fulfilment bar of the level taken by the attribute and the corresponding numerical values. For instance here, the fulfilment bar for "low costs", the text describing the attribute level and its expected impact, the attributes' unit (e.g. CHF per person and year), and the numerical values for the worst (red, lowest number), and best states (green, number at the top). Clicking on the red (worst state of the world) or green (best state of the world) buttons, the fulfilment of the bar, and the descriptive text change accordingly.



Page 5. Link to weight elicitation survey.

Page 5 is a conclusion. Mr. Akles says good-bye and offers the users a calendar with illustrations of wastewater management. The users are directed towards a weight elicitation survey, which was not assessed in this paper (for more information on assessing weight elicitation for the same application see Aubert et al. (in prep.)).

SI 2. Screenshot of the control treatment for the release of information on objectives

ooo



1. Gute Reinigung von Schmutzstoffen

Was bedeutet das?

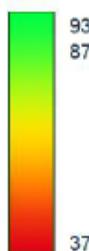
Abwasser enthält einen hohen Anteil an organischen Schmutzstoffen und Nährstoffen, wie menschliche Ausscheidungen oder Lebensmittelrückstände vom Abwaschen. Wenn zu viele Schmutzstoffe und Nährstoffe in die Flüsse gelangen, kann es zu Verschmutzungen kommen. Dadurch kann das Wachstum von Mikroorganismen in Flüssen verstärkt werden. Diese ernähren sich von den Schmutzstoffen und verbrauchen dabei den im Wasser enthaltenen Sauerstoff. Als Folge steht anderen Wasserlebewesen wie Fischen nicht mehr genügend Sauerstoff zur Verfügung. Ein zu hoher Anteil an Schmutzstoffen gefährdet die natürliche Artenvielfalt von Wasserlebewesen. Mit Hilfe der Abwasserreinigung in Kläranlagen werden Schmutz- und Nährstoffe entfernt, bevor das gereinigte Abwasser in die Flüsse eingeleitet wird.

Wie wird es gemessen?

Das Ziel wird angegeben als durchschnittlicher Anteil von Schmutzstoffen, die durch die Kläranlage entfernt werden, im Vergleich zu den Schmutzstoffen, die in die Kläranlage gelangen. Die höchste Reinigungsleistung ist die beste.

Das Ziel wird in Prozent (%) der Reinigung von Schmutzstoffen angegeben.

Wie ist es heute? Wie sieht es im schlechtesten, bzw. besten Fall aus?



Im **besten Fall** besteht kaum ein Risiko für die Verschmutzung von Flüssen (93%). Die Abwasserreinigung funktioniert sehr gut. Nahezu alle Schmutzstoffe werden entfernt. Keine Personen werden beeinträchtigt.

Aktuell ist das Risiko für die Verschmutzung von Flüssen sehr gering (87%). Die Abwasserreinigung funktioniert gut. Viele der Schmutzstoffe werden entfernt. Aktuell werden keine Personen beeinträchtigt.

Im **schlimmsten Fall** besteht ein relativ hohes Risiko für die Verschmutzung von Flüssen (37%). Die Abwasserreinigung ist ungenügend. Nur etwa ein Drittel der Schmutzstoffe wird entfernt. Das würde beispielsweise Fischer beeinträchtigen.

Figure SI2. Example of information on objective in the control treatment. The control consisted of a pdf file containing strictly the exact same information about the ten objectives (name, icon, definition, attribute, unit, best-status quo, and worst-case levels of attribute, and their impact). Each objective description fitted an A4 page.

SI 3. Knowledge questions (used for the pre- and post-test)

We quantitatively measured factual learning with the difference between the knowledge post- and pre-test. There was one question per objective, i.e. two single choice questions, and eight multiple-choice questions. For the single choice questions, one point was given for the correct answer, else no point. For the multiple choice questions (always four possible answers), one point was given if all answers were correct, half a point if three answers were correct, else no point. Accordingly, the difference in the knowledge scores from the pre- and post-test can vary from - 10 to 10. We assumed that factual learning occurred if the difference in knowledge scores was positive, and if the post-test score was statistically significantly higher than the pre-test score.

Hereafter, we give the original question in German on the left, and an English translation on the right. The answers in **bold green** are the correct answers.

<p>1. Gute Reinigung von Schmutzstoffen Diese Frage betrifft Schmutzstoffe und Nährstoffe, die sich im Abwasser befinden können. Was wissen Sie über organische Substanzen? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Sand und Steine sind organische Schmutzstoffe. b) Organische Schmutzstoffe werden von Pflanzen, Tieren und Menschen produziert. c) Menschliche Ausscheidungen und Lebensmittelreste sind ein Teil der organischen Schmutzstoffe im häuslichen Abwasser. d) Eine zu grosse Menge an organischen Schmutzstoffen gefährdet die Artenvielfalt von Wasserlebewesen. 	<p>1. High removal of organic matter This question concerns organic matter and nutrients that may be present in wastewater. What do you know about organic matter? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) Sand and stones are organic matter. b) Organic matter is produced by plants, animals and humans. c) Human excreta and food residues are part of the organic matter in household wastewater. d) Too much organic matter endangers the biodiversity of aquatic life.
<p>2. Gute Reinigung von Mikroverunreinigungen Das Abwasser enthält auch Mikroverunreinigungen. Was wissen Sie über Mikroverunreinigungen? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Zu den Mikroverunreinigungen gehören Hormone, Medikamente und Pflegeprodukte (z. B. Kosmetika). b) Es gibt nur eine Art von Mikroverunreinigungen. c) Heute werden bei der Abwasserreinigung nur wenige Mikroverunreinigungen wie z. B. einige Schmerzmittel entfernt. d) Mikroverunreinigungen haben bei Fischen Radioaktivität verursacht. 	<p>2. High removal of micropollutants Wastewater also contains micropollutants. What do you know about micropollutants? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) Micropollutants include hormones, pharmaceuticals, and personal care products (e.g. cosmetics). b) There is only one type of micropollutant. c) Today, wastewater treatment removes only a few micropollutants such as some painkillers. d) Micropollutants have caused radioactivity in fish.

<p>3. Hohe Rückgewinnung von Nährstoffen für Dünger Stickstoff und Phosphor sind Beispiele für Nährstoffe. Was wissen Sie über Phosphor? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Phosphor wird in der Kläranlage zur Reinigung von Abwasser eingesetzt. b) Phosphor wird zum Düngen von Nutzpflanzen verwendet. c) Es gibt Minen, in denen Phosphor aus Gestein abgebaut wird d) Häusliches Abwasser enthält Phosphor. 	<p>3. High recovery of phosphorus Nitrogen and phosphorus are examples of nutrients. What do you know about phosphorus? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) Phosphorus is used in wastewater treatment plants to purify wastewater. b) Phosphorus is used to fertilize crops. c) There are mines where phosphorus is extracted from rock. d) Wastewater from households contains phosphorus.
<p>4. Niedriger Wasserverbrauch Wie viel Wasser wird zum Spülen der Toilette in der Regel verbraucht? <i>Bei dieser Frage ist nur eine Antwort korrekt. Bitte wählen Sie die korrekte Aussage aus.</i></p> <ul style="list-style-type: none"> a) 1 Liter oder weniger b) 2 bis 6 Liter c) 7 bis 9 Liter d) Über 9 Liter 	<p>4. Low water consumption How much water is usually used to flush the toilet? <i>Only one answer to this question is correct. Please select the correct statement.</i></p> <ul style="list-style-type: none"> a) 1 liter or less b) 2 to 6 liters c) 7 to 9 liters d) More than 9 liters
<p>5. Niedriger netto Energieverbrauch Kennen Sie die Zusammenhänge zwischen Abwasserreinigung und Energie? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Für die Abwasserreinigung braucht man keine Energie b) Aktuell kann bei der Abwasserreinigung Energie erzeugt werden. c) Aktuell erzeugt die Abwasserreinigung Nettoenergie. Sie erzeugt mehr Energie, als sie verbraucht. d) Abwasserreinigungsanlagen mit niedrigem Nettoenergieverbrauch sind umweltfreundlicher. 	<p>5. Low net energy consumption Do you know the relationship between wastewater treatment and energy? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) No energy is needed for wastewater treatment. b) Currently, energy can be generated during wastewater treatment. c) Currently, wastewater treatment generates net energy. It produces more energy than it consumes. d) Wastewater treatment plants with low net energy consumption are more environmentally friendly.
<p>6. Hoher Gesundheitsschutz für Endverbraucher/-innen Welche Krankheiten können durch direkten Kontakt mit Bakterien im Abwasser verursacht werden? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Herz-Kreislauf-Erkrankungen b) Atemwegserkrankungen c) Magen-Darm-Erkrankungen d) Krebs 	<p>6. High health for user Which diseases can be caused by direct contact with bacteria in wastewater? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) Cardiovascular diseases b) Respiratory diseases c) Gastro-intestinal diseases d) Cancer

<p>7. Hohe Attraktivität für Endverbraucher/-innen Die Attraktivität der verschiedenen Kläranlagen kann unterschiedlich sein. <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Ein hohes Ekelgefühl bedeutet, dass man etwas unattraktiv findet. b) Einige Menschen empfinden Ekel für eine dezentrale Abwasserreinigung. c) Das Abwasser kann im eigenen Haus gereinigt werden. d) Eine eigene Kläranlage im Hause beeinträchtigt den Bewohner nicht. 	<p>7. High attractiveness for user Different wastewater treatment systems may have different levels of attractiveness. <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) A high feeling of disgust indicates that something is considered unattractive. b) Some people have a feeling of disgust for decentralized wastewater treatment. c) Wastewater can be treated in your own house. d) Having a wastewater treatment system in the house never affects inhabitants.
<p>8. Niedriger Zeitaufwand für Endverbraucher/-innen Die Abwasserreinigung braucht Zeit und verursacht Arbeit. Wie schätzen Sie den Zeit- und Personalbedarf der Abwasserreinigung ein? <i>Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.</i></p> <ul style="list-style-type: none"> a) Bei der heutigen zentralen Abwasserbehandlung investieren Endverbraucher/-innen etwa 30 Stunden pro Jahr für den Betrieb und die Prüfung des Abwassersystems. b) Bei einem dezentralen Abwasserreinigungssystem investieren Endverbraucher/-innen bis zu einigen Arbeitstagen pro Jahr für die Kontrolle des Betriebs. c) Bei einem dezentralen Abwasserreinigungssystem werden keine Abwasserfachleute mehr benötigt. d) Bei einem zentralen Abwassersystem gewährleisten Fachleute das gute Funktionieren des Systems. 	<p>8. Low time demand for user Wastewater treatment takes time and causes work. How do you estimate the time and labor requirements of wastewater treatment? <i>One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.</i></p> <ul style="list-style-type: none"> a) With today's centralized wastewater treatment, end users invest about 30 hours per year for operating and inspecting the wastewater system. b) For a decentralized wastewater treatment system, end users invest up to a few working days per year to check its operation. c) In the case of a decentralized wastewater treatment system, wastewater experts are no longer required. d) In the case of a centralized wastewater treatment system, experts ensure that the system functions properly.
<p>9. Niedrige Kosten Wie viel bezahlt eine Person in einer ländlichen Gemeinde in der Schweiz aktuell ungefähr pro Jahr für die Abwasserentsorgung? <i>Bei dieser Frage ist nur eine Antwort korrekt. Bitte wählen Sie die korrekte Aussage aus.</i></p> <ul style="list-style-type: none"> a) Nichts, es ist kostenlos b) Rund 50 CHF c) Rund 300 CHF d) Rund 1'000 CHF 	<p>9. Low cost How much does a person in a rural community in Switzerland currently approximately pay per year for wastewater disposal? <i>Only one answer to this question is correct. Please select the correct statement.</i></p> <ul style="list-style-type: none"> a) Nothing, it is free b) About 50 CHF c) About 300 CHF d) About 1,000 CHF

10. Hohe Flexibilität (Generationengerechtigkeit)

Es gibt flexible und unflexible Abwassersysteme. Was wissen Sie über diese unterschiedlichen Abwassersysteme, ihre Lebensdauer und Anpassungsfähigkeit?

Bei dieser Frage können eine, mehrere, oder keine der Antworten korrekt sein. Bitte wählen Sie alle Aussagen aus, die Sie für korrekt halten.

- a) Abwasserrohre haben eine erwartete Lebensdauer von 80 Jahren.
- b) Ein unflexibles Abwassersystem erfordert einen hohen Bauaufwand bei der Anpassung.
- c) Bei einem unflexiblen System tragen künftige Generationen keine Last.
- d) Ein regionaler Bevölkerungsverlust hat keine negativen Auswirkungen auf ein zentrales Abwasserreinigungssystem.

10. High flexibility (inter-generation fairness)

Wastewater treatment systems can be more or less flexible. What do you know about these different wastewater treatment systems, their service life and adaptability?

One, several, or none of the answers to this question may be correct. Please select all statements that you think are correct.

- a) Sewer pipes have an expected life span of 80 years.
- b) An inflexible wastewater treatment system requires high construction effort to be adapted.
- c) With an inflexible system, future generations will not bear the burden.
- d) Regional population decline does not negatively affect a centralized wastewater treatment system.

SI 4. Swing weight elicitation: procedure and screenshots of online elicitation tool

To measure preference construction, based on the provided ranges of the attribute, we elicited the weights, or relative importance, given to the ten objectives. For practical reasons, we used the swing method, implemented online.

Procedure:

The swing weighting procedure emphasizes the range of the attribute levels. Hypothetical scenarios, in our case for wastewater management, with all attribute levels of a branch at their worst level but one at its best level are presented to the participants (Fig.SI4c). They are asked to rank these hypothetical scenarios with drag and drop, i.e. to define which objective is most important to swing from worst to best level. The rank order of these scenarios defines the order of the value differences in the attributes. In a second step (Fig.SI4d), the preferred scenario is assigned 100 value points per default, the worst case hypothetical scenario with all attributes at their worst level receives 0 value points per default. The participants are asked to relatively rate the other hypothetical scenarios. Then, the value points are normalized to sum to 1. The same procedure is repeated for each branch. Finally, the procedure is repeated a final time with the most preferred objective from each branch (Fig.SI4e-f).

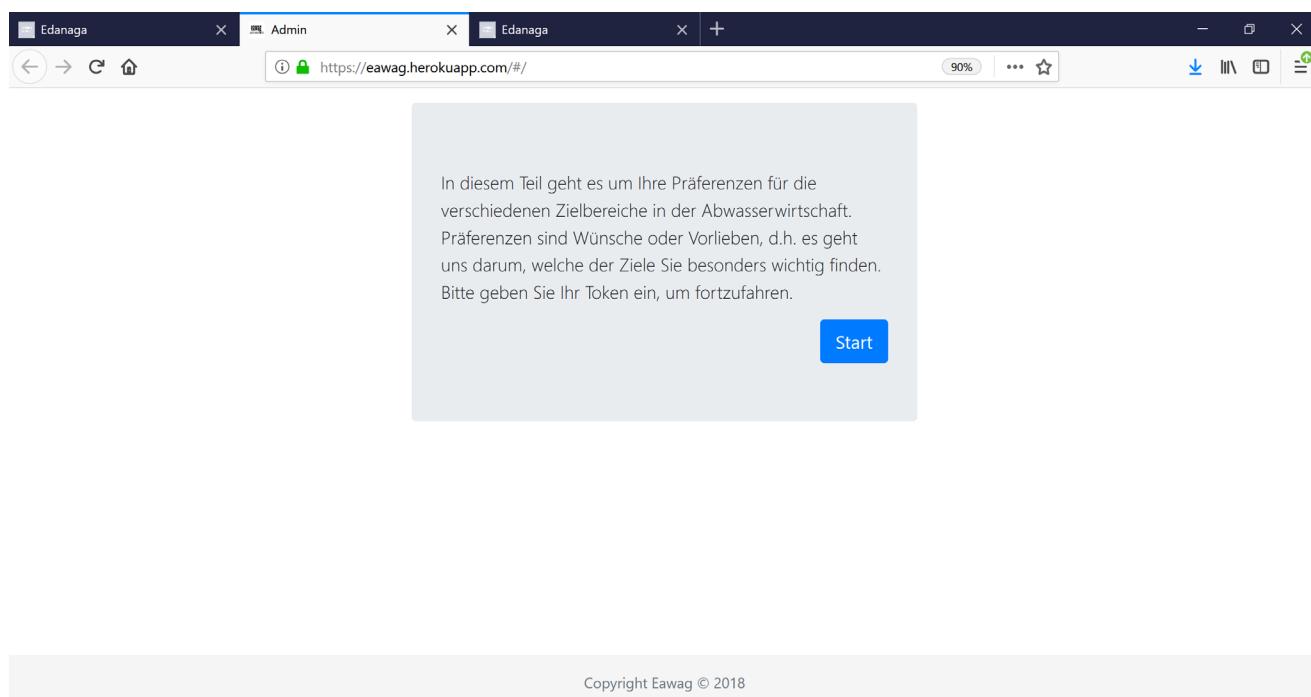
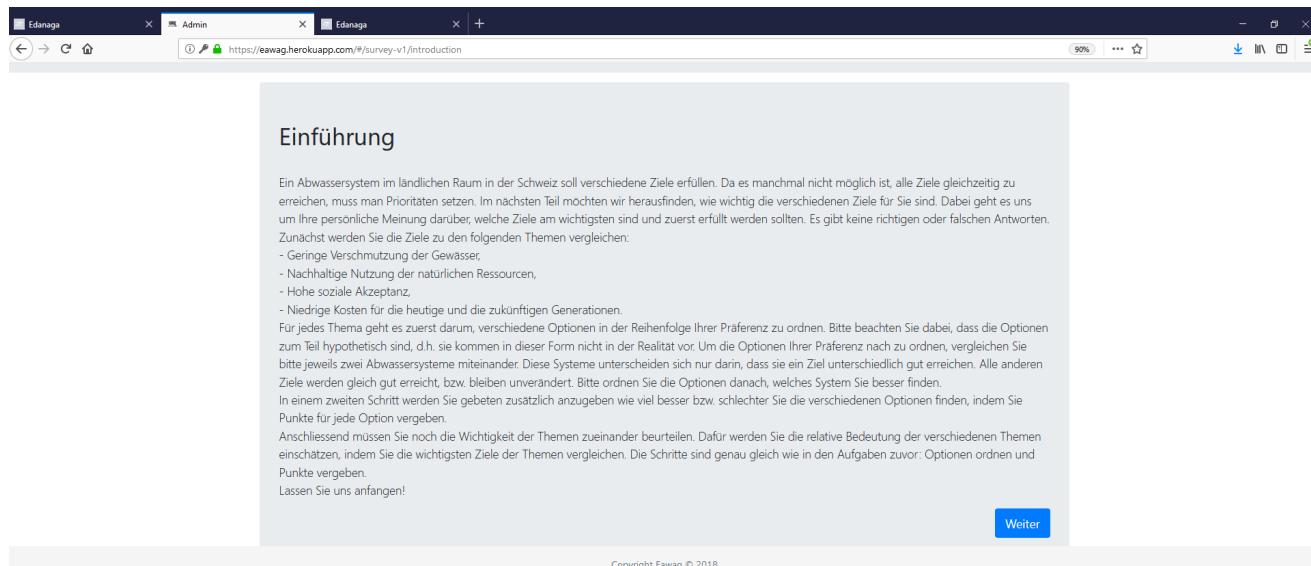


Figure SI4a. Welcoming and entering the experimental identification number to start.



Einführung

Ein Abwassersystem im ländlichen Raum in der Schweiz soll verschiedene Ziele erfüllen. Da es manchmal nicht möglich ist, alle Ziele gleichzeitig zu erreichen, muss man Prioritäten setzen. Im nächsten Teil möchten wir herausfinden, wie wichtig die verschiedenen Ziele für Sie sind. Dabei geht es uns um Ihre persönliche Meinung darüber, welche Ziele am wichtigsten sind und zuerst erfüllt werden sollten. Es gibt keine richtigen oder falschen Antworten. Zunächst werden Sie die Ziele zu den folgenden Themen vergleichen:

- Geringe Verschmutzung der Gewässer,
- Nachhaltige Nutzung der natürlichen Ressourcen,
- Hohe soziale Akzeptanz,
- Niedrige Kosten für die heutige und die zukünftigen Generationen.

Für jedes Thema geht es zuerst darum, verschiedene Optionen in der Reihenfolge ihrer Präferenz zu ordnen. Bitte beachten Sie dabei, dass die Optionen zum Teil hypothetisch sind, d.h. sie kommen in dieser Form nicht in der Realität vor. Um die Optionen Ihrer Präferenz nach zu ordnen, vergleichen Sie bitte jeweils zwei Abwassersysteme miteinander. Diese Systeme unterscheiden sich nur darin, dass sie ein Ziel unterschiedlich gut erreichen. Alle anderen Ziele werden gleich gut erreicht, bzw. bleiben unverändert. Bitte ordnen Sie die Optionen danach, welches System Sie besser finden.

In einem zweiten Schritt werden Sie gebeten zusätzlich anzugeben wie viel besser bzw. schlechter Sie die verschiedenen Optionen finden, indem Sie Punkte für jede Option vergeben.

Anschliessend müssen Sie noch die Wichtigkeit der Themen zueinander beurteilen. Dafür werden Sie die relative Bedeutung der verschiedenen Themen einschätzen, indem Sie die wichtigsten Ziele der Themen vergleichen. Die Schritte sind genau gleich wie in den Aufgaben zuvor: Optionen ordnen und Punkte vergeben.

Lassen Sie uns anfangen!

Weiter

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Figure SI4b. Introduction explaining the swing weight elicitation method, and the hierarchical process.

93 37 37 %	89 5 5 %
(웃) Reinigung von Schmutzstoffen	(웃) Reinigung von Mikroverunreinigungen

Stellen Sie sich vor. Sie können diese schlechteste Option verbessern, indem Sie eines der Ziele vom schlechtesten auf das beste Niveau ändern können. Welches Ziel würden Sie verbessern?
Die Option am Ende der Liste ist die am wenigsten bevorzugt. Hier sind **alle Ziele auf dem schlechtesten Niveau**.
Wählen Sie nun **das Ziel, für das es für Sie wichtigster ist** vom schlechtesten zum besten Fall zu gelangen. Achten Sie dabei bitte auf die Grösse der Änderung, d.h. den Unterschied zwischen dem besten und dem schlechtesten Fall. Sie haben die Möglichkeit, entweder 93% der organischen Substanz oder 89% der Mikroverunreinigungen zu entfernen, während das jeweils andere Ziel auf dem schlechtesten Niveau bleibt.
Ziehen Sie die Option, in der das für Sie wichtigste Ziel verbessert ist an den Anfang der Liste (drag and drop).
Welches ist die Option, in der **das für Sie zweitwichtigste Ziel** vom schlechtesten zum besten Fall verbessert ist?
Ziehen Sie diese Option auf den zweiten Platz in der Liste.
Entspricht diese Reihenfolge nun Ihren Präferenzen?
Bitte ändern Sie die Reihenfolge, wenn Sie möchten. Wichtig ist, dass Sie Ihre eigenen Präferenzen ausdrücken! Vergessen Sie nicht, dabei auf die Grösse der Änderungen zu achten.

93 37 93 %	89 5 5 %
(웃) Reinigung von Schmutzstoffen	(웃) Reinigung von Mikroverunreinigungen

93 37 37 %	89 5 89 %
(웃) Reinigung von Schmutzstoffen	(웃) Reinigung von Mikroverunreinigungen

93 37 37 %	89 5 5 %
(웃) Reinigung von Schmutzstoffen	(웃) Reinigung von Mikroverunreinigungen

Wenn Sie mit Ihrer Reihenfolge zufrieden sind, klicken Sie auf «Weiter».

Weiter

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Figure SI4c. Presentation of the worst-case hypothetical scenario (with all objectives at their worst level of attribute) and **ranking** of the hypothetical scenarios with one objective at the best level in order of preference. Drag and drop of the representations of the hypothetical scenarios, with the most preferred at the top. The worst-case hypothetical scenario was fixed at the bottom of the page (it can rationally not be preferred).

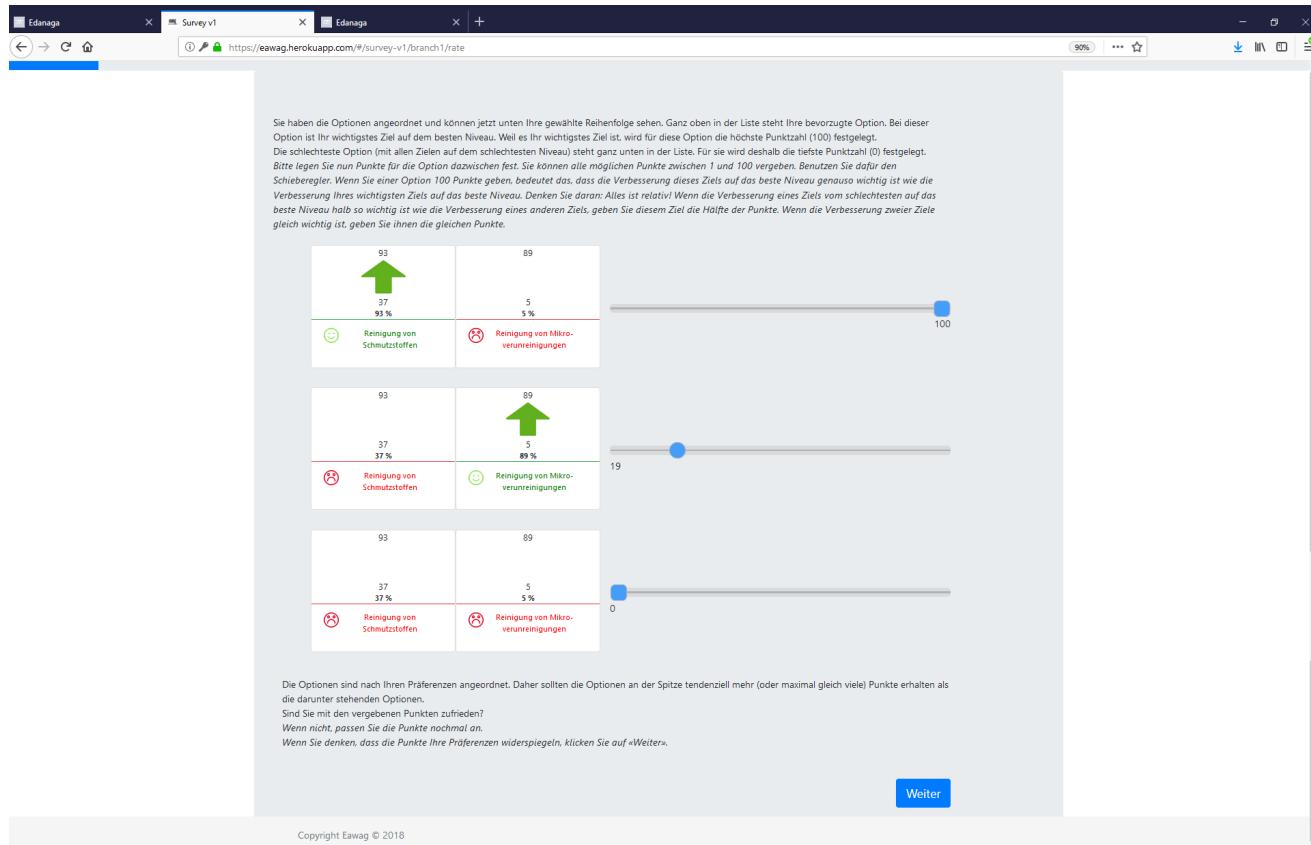


Figure SI4d. Scoring of the previously ranked hypothetical scenarios. The hypothetical scenarios are presented according to the ranking performed on the previous page. By default, the worst-case hypothetical scenario (at the bottom) and the most preferred hypothetical scenario (at the top) receive fixed value points of 0 and 100, respectively (squared buttons on the sliders are immovable). The slider in between (with round button) can be adjusted to give relative value points, the number is displayed. The same procedure (ranking and scoring) is repeated for each branch.

Jetzt geht es darum die Themen zu vergleichen. Dafür werden Sie den gleichen Prozess wie zuvor noch einmal wiederholen: Zuerst müssen Sie die Ziele entsprechend Ihrer Präferenz für die Verbesserung vom schlechtesten auf das beste Niveau in einer Reihenfolge bringen. Dann können Sie wieder Punkte vergeben. Nachfolgend werden Sie immer das Ziel aus jeder Gruppe vergleichen, das Ihnen vorher am wichtigsten war. Stellen Sie sich noch einmal ein Abwassersystem vor, bei dem die vorgestellten Ziele alle schlecht erfüllt werden und somit auf dem schlechtesten Niveau sind. Wenn Sie möchten, schauen Sie sich die Informationen über die Ziele der Abwasserwirtschaft aus dem letzten Teil jetzt noch einmal an.

Diese schlechteste Option ist hier dargestellt:

93	95	0	113
37 37 %	0 0 %	13 13 Kontakte pro Jahr	1675 113 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

Stellen Sie sich vor, Sie können diese schlechteste Option verbessern, indem Sie ein Ziel von schlecht zu gut ändern. Welches Ziel würden Sie verbessern? Die Option am Ende der Liste ist die am wenigsten bevorzugte. Hier sind **alle Ziele auf dem schlechtesten Niveau**. Wählen Sie nun **das Ziel, für das es für Sie wichtigst ist** vom schlechtesten zum besten Fall zu gelangen. Achten Sie dabei bitte auf die Grösse der Änderung, d.h. den Unterschied zwischen dem besten und dem schlechtesten Fall.

Ziehen Sie die Option, in der das für Sie wichtigste Ziel verbessert ist, an den Anfang der Liste (drag and drop).

Stellen Sie sich nun vor, dass jetzt alle Ziele wieder auf dem schlechtesten Niveau sind (Option ganz unten in der Liste). Welches ist die Option, in der **das für Sie zweitwichtigste Ziel** vom schlechtesten zum besten Fall verbessert ist?

Ziehen Sie diese Option auf den zweiten Platz in der Liste.

Stellen Sie sich nun vor, dass jetzt alle Ziele wieder auf dem schlechtesten Niveau sind (Option ganz unten in der Liste). Welches ist die Option, in der **das für Sie drittwichtigste Ziel** vom schlechtesten zum besten Fall verbessert ist?

Ziehen Sie diese Option auf den dritten Platz in der Liste.

Ist **das viertwichtigste Ziel** für Sie, an der vierten Stelle in der Liste?
Wenn nicht, ziehen Sie bitte **dieses viertwichtigste Ziel** auf die vierte Position in der Liste.

Entspricht diese Reihenfolge nun Ihren Prioritäten?
Bitte ändern Sie die Reihenfolge, wenn Sie möchten. Wichtig ist, dass Sie Ihre eigenen Präferenzen ausdrücken!
Vergessen Sie nicht, dabei auf die Grösse der Änderungen zu achten.

93 	95	0	113
37 93 %	0 0 %	13 13 Kontakte pro Jahr	1675 113 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

93	95 	0	113
37 37 %	0 95 %	13 13 Kontakte pro Jahr	1675 1675 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

93	95	0 	113
37 37 %	0 0 %	13 0 Kontakte pro Jahr	1675 1675 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

93	95	0	113
37 37 %	0 0 %	13 13 Kontakte pro Jahr	1675 113 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

93	95	0	113
37 37 %	0 0 %	13 13 Kontakte pro Jahr	1675 1675 CHF pro Person und Jahr
Reinigung von Schmutzstoffen	Rückgewinnung von Nährstoffen für Dünger	Gesundheitsschutz	Kosten

Wenn Sie mit Ihrer Reihenfolge zufrieden sind, klicken Sie auf «Weiter».

Weiter

Figure SI4e. Upper level rank ordering. The previous steps (ranking and scoring) were repeated for each of the four branches on the hierarchy of objective. At the upper level, we showed the most preferred objective of each branch. Thus, there are four hypothetical scenarios to be ordered by drag and drop, the worst-case hypothetical scenario is fixed at the bottom of the page.

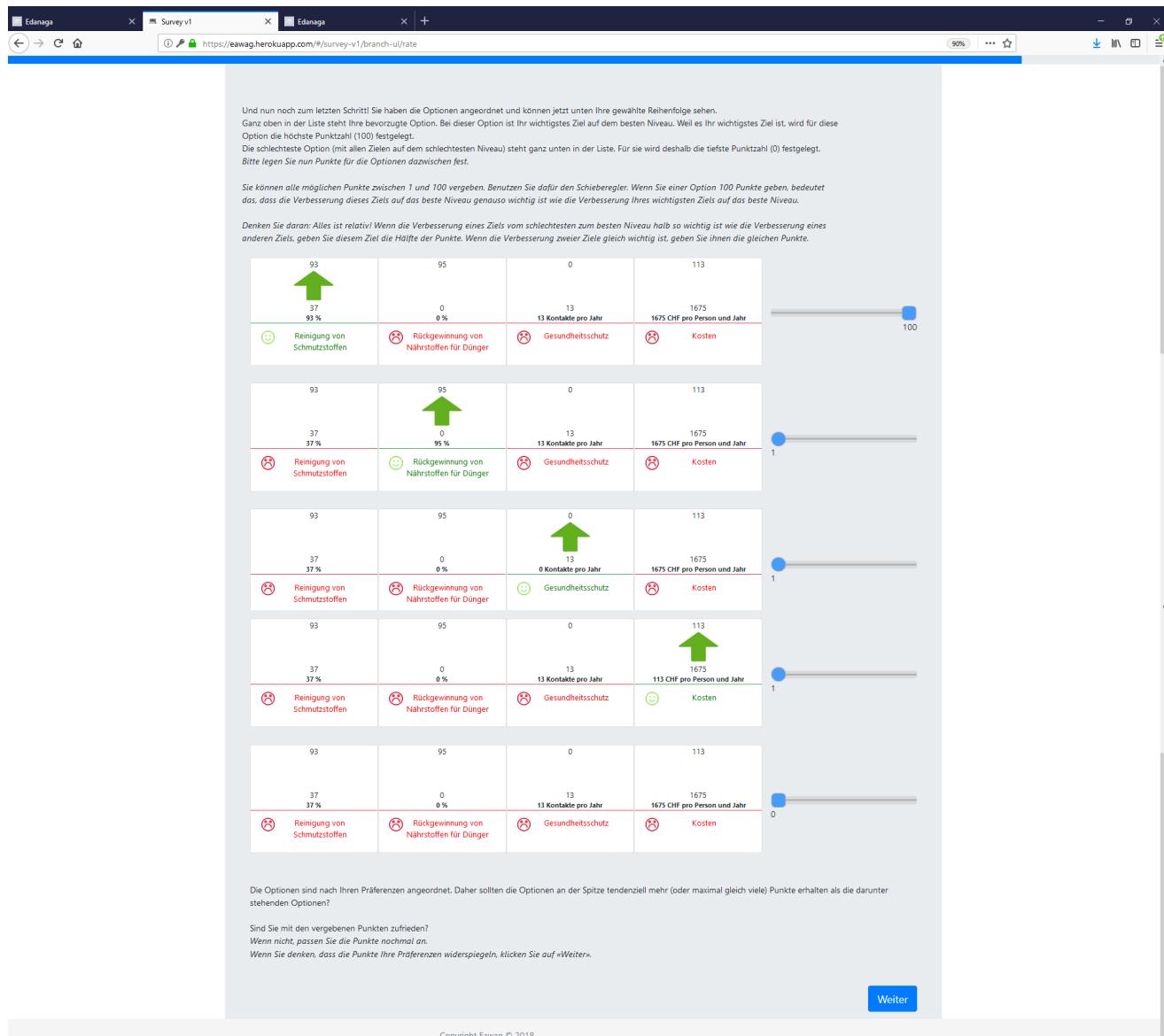


Figure SI4f. Upper level scoring (giving value points). As in Figure SI4d, with the most preferred objective of each branch of the objective hierarchy was presented (according to the ranking on the previous page).

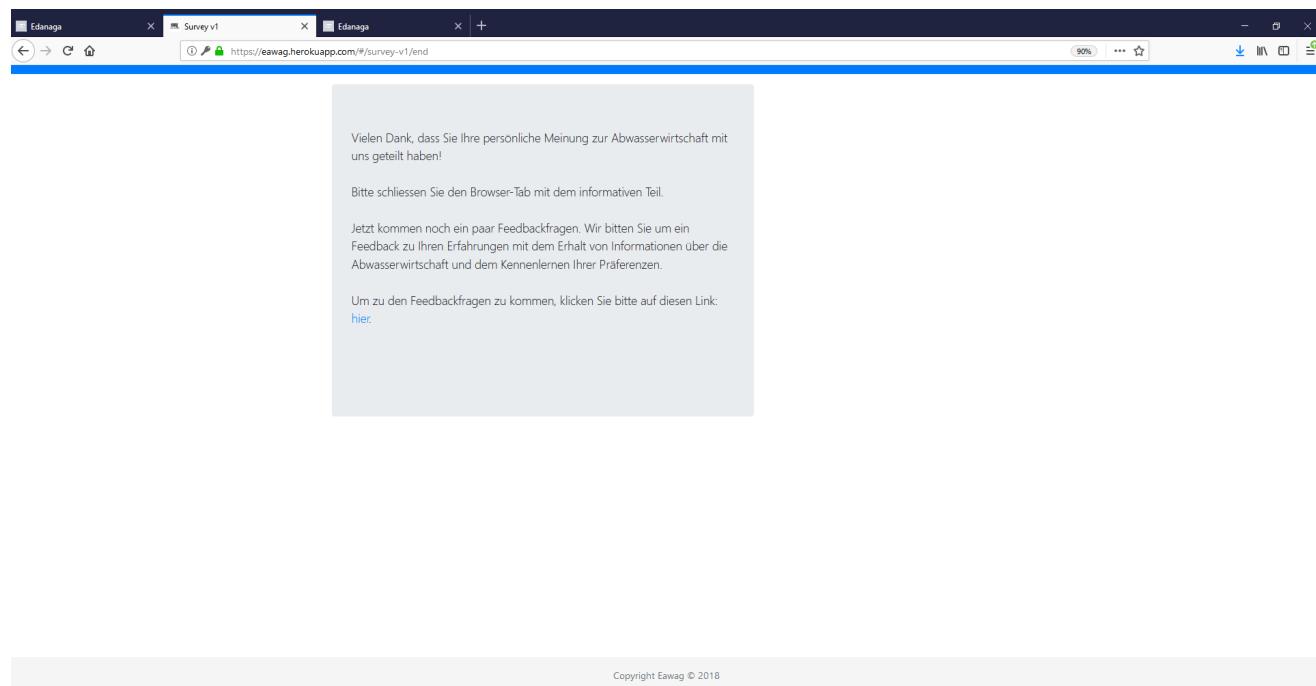


Figure SI4g. Concluding page. It includes a link to the feedback questionnaire.

SI 5. Feedback questionnaire

The feedback questionnaire was coded on the LimeSurvey platform with radio buttons.

SI 5a. Questions to measure the overall experience, and the constructs of the self-determination theory (competence, autonomy, and relatedness)

Table SI 5a. **Construct and item name:** Name of construct and item. **Question type:** type of question and direction of coding; **Answer code:** Code of the answer; **Question and answer options in German:** original formulation of the question and answer options; **Question and answer options in English:** proposed translation of the question and answer options.

Construct Item name	Question type	Answer code	Question and answer options in German	Question and answer options in English
Overall experience				
Frage30 «fun»	List(radio)		Wie viel Spass hat Ihnen die Aufnahme von Informationen zur Abwasserwirtschaft gemacht? A1 Überhaupt keinen Spass A2 Eher wenig Spass A3 Einigermassen Spass A4 Eher viel Spass A5 Sehr viel Spass	How much fun did you have receiving information on wastewater management? No fun at all Rather little fun Some fun Rather a lot of fun A lot of fun
Frage 31 «no boredom»	List(radio)		Wie langweilig war für Sie die Aufnahme von Informationen zur Abwasserwirtschaft? A1 Sehr langweilig A2 Eher langweilig A3 Einigermassen langweilig A4 Eher nicht langweilig A5 Überhaupt nicht langweilig	How boring was it for you to receive information on wastewater management? Very boring Rather boring Somewhat boring Rather not boring Not boring at all

Frage32 «entertainment»	List(radio) Scale (reversed)	A1 A2 A3 A4 A5	Wie unterhaltsam war für Sie die Aufnahme von Informationen zur Abwasserwirtschaft? Sehr unterhaltsam Eher unterhaltsam Einigermassen unterhaltsam Eher nicht unterhaltsam Überhaupt nicht unterhaltsam	How entertaining was it for you to receive information on wastewater management? Very entertaining Rather entertaining Somewhat entertaining Rather not entertaining Not entertaining at all
Frage33 «no irritation»	List(radio) Scale (reversed)	A1 A2 A3 A4 A5	Wie lästig war es für Sie, Informationen zur Abwasserwirtschaft aufzunehmen? Gar nicht lästig Eher nicht lästig Einigermassen lästig Eher lästig Sehr lästig	How annoying was it for you to receive information on wastewater management? Not at all annoying Rather not annoying Somewhat annoying Rather annoying Very annoying
Frage34 «no worry»	List(radio) Scale (reversed)	A1 A2 A3 A4 A5	Wie sehr waren Sie während der Aufnahme von Informationen zur Abwasserwirtschaft beunruhigt? Gar nicht beunruhigt Eher nicht beunruhigt Einigermassen beunruhigt Eher beunruhigt Sehr beunruhigt	How worried were you when you received information on wastewater management? Not at all worried Rather not worried Somewhat worried Rather worried Very worried
Frage35 «contentment»	List(radio) Scale (reversed)	A1	Wie zufrieden waren Sie während der Aufnahme von Informationen zur Abwasserwirtschaft? Sehr zufrieden	How content were you when you received information on wastewater management? Very content

		A2	Eher zufrieden	Rather content
		A3	Einigermassen zufrieden	Somewhat content
		A4	Eher nicht zufrieden	Rather not content
		A5	Überhaupt nicht zufrieden	Not content at all
Frage36 «recommendation»	List(radio)	A1	Würden Sie diese Umfrage weiter empfehlen?	Would you recommend this survey to others?
		A2	Keinesfalls	No way
		A3	Wahrscheinlich nicht	Probably not
		A4	Vielleicht	Maybe
		A5	Ziemlich wahrscheinlich	Quite likely
		A6	Ganz sicher	For sure
Frage37 «worthwhile use of time»	List(radio) Scale (reversed)	A1	Hat der Zeitaufwand für den Erhalt von Informationen zur Abwasserwirtschaft sich gelohnt?	Was the time spent on receiving information on wastewater management worthwhile?
		A2	Sehr gelohnt	Very worthwhile
		A3	Eher gelohnt	Rather worthwhile
		A4	Einigermassen gelohnt	Somewhat worthwhile
		A5	Eher nicht gelohnt	Rather not worthwhile
		A6	Überhaupt nicht gelohnt	Not worthwhile at all
Competence				
Frage1 «factlearn1»	List(radio)	A1	Wie gut konnten Sie die Informationen zur Abwasserwirtschaft aufnehmen?	How well were you able to become informed on wastewater management?
		A2	Überhaupt nicht	Not at all
		A3	Eher nicht	Rather not
		A4	Einigermassen gut	Somewhat
		A5	Eher gut	Rather well
		A6	Sehr gut	Very well

Frage2 «preflearn1»	List(radio)		<p>Wie viel haben Sie über Ihre Präferenzen gelernt (d. h. durch Erkennen, dass einige Zielsetzungen wichtiger sind als andere)?</p> <p>A1 Überhaupt nichts A2 Wenig A3 Etwas A4 Viel A5 Sehr viel</p>	<p>How much did you learn about your preferences (i.e. discovering that some objectives are more important than others)?</p> <p>Nothing at all Little Some A lot Very much</p>
Frage3 «progress»	List(radio)		<p>Hatten Sie das Gefühl, dass Sie beim Erhalt der Informationen vorwärts kamen?</p> <p>A1 Ich kam überhaupt nicht vorwärts. A2 Ich kam etwas vorwärts. A3 Ich kam einigermassen vorwärts. A4 Ich kam gut vorwärts. A5 Ich kam sehr gut vorwärts.</p>	<p>Did you feel that you made progress in receiving the information?</p> <p>I felt no progress at all. I felt little progress. I felt some progress. I felt good progress. I felt very good progress.</p>
Frage4 «preflearn2»	List(radio) Scale (reversed)		<p>Haben Sie die Fragen zu Ihren Präferenzen so beantwortet, dass Ihre Antworten Ihrer Meinung entsprechen?</p> <p>A1 Meine Antworten entsprechen genau meiner Meinung. A2 Meine Antworten entsprechen eher meiner Meinung. A3 Meine Antworten entsprechen einigermassen meiner Meinung. A4 Meine Antworten entsprechen meiner Meinung eher nicht. A5 Meine Antworten entsprechen überhaupt nicht meiner Meinung.</p>	<p>Did you answer the questions about your preferences in a way that your answers reflect your opinion?</p> <p>My answers exactly reflect my opinion. My answers mostly reflect my opinion. My answers more or less reflect my opinion. My answers rather do not reflect my opinion. My answers do not at all reflect my opinion.</p>

Frage5 «factlearn2»	List(radio) Scale (reversed)		Verstehen Sie die Abwasserwirtschaft jetzt besser? A1 Viel besser A2 Eher besser A3 Einigermassen besser A4 Eher nicht besser A5 Überhaupt nicht besser	Do you understand wastewater management better now? A lot better Rather better Somewhat better Rather not better Not at all better
Test5 «factlearn3»	List(radio)		Mein Verständnis der Abwasserwirtschaft hat sich... A1 ...überhaupt nicht verbessert. A2 ...eher nicht verbessert. A3 ...einigermassen verbessert. A4 ...eher verbessert. A5 ...sehr verbessert.	My understanding of wastewater management has... ...not at all improved. ...rather not improved. ...somewhat improved. ...rather improved. ...improved a lot.
Autonomy				
Frage6 «interest1»	List(radio)		Inwiefern trifft folgende Aussage auf Sie zu: «Die Art der Informationspräsentation hat mein Interesse an den Informationen aufrecht erhalten» A1 Trifft überhaupt nicht zu. A2 Trifft eher nicht zu. A3 Trifft teils-teils zu. A4 Trifft eher zu. A5 Trifft vollkommen zu.	How much does the following statement apply to you: «The way the information was presented kept me interested in the information.» Does not apply at all. Does rather not apply. Somewhat applies. Rather applies. Applies very much.

Frage7 «decide.path»	List(radio)		Inwiefern trifft folgende Aussage auf dich zu: «Als ich die Informationen erhielt, hatte ich das Gefühl, frei über den einzuschlagenden Weg entscheiden zu können.»	How much does the following statement apply to you: «When I received the information, I felt free to decide which path to take.»
		A1	Trifft überhaupt nicht zu.	Does not apply at all.
		A2	Trifft eher nicht zu.	Does rather not apply.
		A3	Trifft teils-teils zu.	Somewhat applies.
		A4	Trifft eher zu.	Rather applies.
		A5	Trifft vollkommen zu.	Applies very much.
Frage8 «choice1»	List(radio)		Als Sie die Informationen erhielten, gab es Wahlmöglichkeiten?	When you received the information, were there any choices?
		A1	Es gab keine Wahlmöglichkeiten.	There were no choices.
		A2	Es gab fast keine Wahlmöglichkeiten.	There were almost no choices.
		A3	Es gab einige Wahlmöglichkeiten.	There were some choices.
		A4	Es gab viele Wahlmöglichkeiten.	There were many choices.
		A5	Es gab sehr viele Wahlmöglichkeiten.	There were very many choices.
Frage9 «interest2»	List(radio)		Wie stark stieg Ihr Interesse am Thema Abwasserwirtschaft?	How much did your interest in wastewater management increase?
		A1	Überhaupt nicht stark	Not at all
		A2	Eher nicht stark	Rather not
		A3	Einigermassen stark	Somewhat
		A4	Eher stark	Rather much
		A5	Sehr stark	Very much
Frage10 «choice2»	List(radio)		Als Sie die Informationen erhielten, haben Sie Ihnen gewünscht, Sie hätten mehr Wahlmöglichkeiten?	When you received the information, did you wish you had more choices?

A1	Ich hatte nicht genügend Wahlmöglichkeiten.	I did not have enough choices.
A2	Die Wahlmöglichkeiten waren knapp.	The choices were scarce.
A3	Ich hatte einige Wahlmöglichkeiten, aber ich hätte gerne mehr gehabt.	I had choices, but I would have liked more.
A4	Ich hatte beinahe genug Wahlmöglichkeiten.	I had almost enough choices.
A5	Ich hatte genügend Wahlmöglichkeiten.	I had enough choices.

Relatedness

Frage11 «forsociety1»	List(radio)		Inwiefern trifft folgende Aussage auf Sie zu: «Ich bin überzeugt, dass mein Wissen über die Abwasserwirtschaft der Gesellschaft nützt.»	How much does the following statement apply to you: «I am convinced that my knowledge of wastewater management is useful to society.»
			A1 Trifft überhaupt nicht zu.	Does not apply at all.
			A2 Trifft eher nicht zu.	Does rather not apply.
			A3 Trifft teils-teils zu.	Somewhat applies.
			A4 Trifft eher zu.	Rather applies.
			A5 Trifft vollkommen zu.	Applies very much.
Frage16 «forsociety2»	List(radio)		Inwiefern trifft folgende Aussage auf Sie zu: «Abwasserwirtschaft ist ein gesellschaftliches Problem, das uns alle betrifft.»	How much does the following statement apply to you: «Wastewater management is a societal issue that affects us all.»
			A1 Trifft überhaupt nicht zu.	Does not apply at all.
			A2 Trifft eher nicht zu.	Does rather not apply.
			A3 Trifft teils-teils zu.	Somewhat applies.
			A4 Trifft eher zu.	Rather applies.
			A5 Trifft vollkommen zu.	Applies very much.
Frage17 «helpful»	List(radio) Scale (reversed)		Waren die bereitgestellten Medien für die Aufnahme der Informationen zur Abwasserwirtschaft hilfreich?	Were the provided media helpful for taking in information on wastewater management?
			A1 Sehr hilfreich	Very helpful

		A2	Eher hilfreich	Rather helpful
		A3	Einigermassen hilfreich	Somewhat helpful
		A4	Eher nicht hilfreich	Rather not helpful
		A5	Überhaupt nicht hilfreich	Not at all helpful

SI 5b. Questions to measure the perceived range sensitivity

Four feedback questions (two per manipulated objective) tested the perceived range sensitivity of the participants. They asked them to remember the percentage of improvement between the best and worst case, and the wording used in the text to describe this improvement, by selecting the correct answer among four choices (marked hereafter in green). From this, an average score was calculated, ranging from 0 (all answers related to the ranges were wrong) to 4 (all answers related to the ranges were correct).

(OO: original attribute range for the objective; OM: manipulated attribute range for the objective).

Table SI 5b. **Item name:** Name of the item. **Question type:** type of question; **Answer code:** Code of the answer; **Question and answer options in German:** original formulation of the question and answer options; **Question and answer options in English:** proposed translation of the question and answer options.

Item name	Question type	Answer code	Question and answer options in German	Question and answer options in English
Test1	List(radio)		<p>Wie viele Schmutzstoffe können bei einem Wechsel von der Worst- zur Best-Case-Option zusätzlich gereinigt werden?</p> <p>A1 Etwa 90% der Schmutzstoffe werden zusätzlich gereinigt.</p> <p>A2 Etwa 55% der Schmutzstoffe werden zusätzlich gereinigt. (Correct OO, False OM)</p> <p>A3 Etwa 35% der Schmutzstoffe werden zusätzlich gereinigt.</p> <p>A4 Etwa 10% der Schmutzstoffe werden zusätzlich gereinigt. (Correct OM, False OO)</p>	<p>How much organic matter can be additionally removed when switching from the worst-case to the best-case option?</p> <p>About 90% of organic matter are additionally removed.</p> <p>About 55% of organic matter are additionally removed.</p> <p>About 35% of organic matter are additionally removed.</p> <p>About 10% of organic matter are additionally removed.</p>
Test2	List(radio)		<p>Um wie viel würde sich die Wasserqualität bei einem Wechsel von der Worst- zur Best-Case-Option verbessern?</p>	<p>By how much would the water quality improve when switching from the worst-case to the best-case option?</p>

		A1	Die Verbesserung der Wasserqualität wäre vernachlässigbar: Das sehr geringe Verschmutzungsrisiko bleibt sehr gering.	The improvement in water quality would be negligible: the very low risk of pollution remains very low.
		A2	Die Verbesserung der Wasserqualität wäre klein: Das recht geringe Verschmutzungsrisiko kann auf kaum ein Risiko gesenkt werden. (Correct OM, False OO)	The improvement in water quality would be small: the fairly low risk of pollution can be reduced to hardly any risk at all.
		A3	Die Verbesserung der Wasserqualität wäre erheblich: Das relativ hohe Verschmutzungsrisiko kann auf kaum ein Risiko gesenkt werden. (Correct OO, False OM)	The improvement in water quality would be significant: the relatively high risk of pollution can be reduced to hardly any risk at all.
		A4	Die Verbesserung der Wasserqualität wäre sehr gross: Das sehr hohe Verschmutzungsrisiko kann auf kaum ein Risiko gesenkt werden.	The improvement in water quality would be substantial: the very high risk of pollution can be reduced to hardly any risk at all.
Test3	List(radio)		Um wie viel könnte die Punktzahl im Flexibilitätsindex bei einem Wechsel von der Worst- zur Best-Case-Option erhöht werden?	By how much could the score in the flexibility index be increased when switching from the worst-case to the best-case option?
		A1	Um 87 Prozentpunkte im Flexibilitätsindex. (Correct OM, False OO)	By 87 percentage points in the flexibility index
		A2	Um 51 Prozentpunkte im Flexibilitätsindex. (Correct OO, False OM)	By 51 percentage points in the flexibility index
		A3	Um 37 Prozentpunkte im Flexibilitätsindex.	By 37 percentage points in the flexibility index
		A4	Um 1 Prozentpunkt im Flexibilitätsindex.	By 1 percentage point in the flexibility index
Test4	List(radio)		Um wie viel würde sich die Systemflexibilität bei einem Wechsel vom Worst Case zum Best Case verbessern?	By how much would system flexibility improve when switching from the worst-case to the best-case option?
		A1	Die Systemflexibilität würde sich nicht verbessern: Das System bleibt äusserst unflexibel.	System flexibility would not improve: the system remains highly inflexible.
		A2	Die Systemflexibilität würde sich ein wenig verbessern: von unflexibel zu ziemlich unflexibel.	System flexibility would improve a little: from inflexible to quite inflexible.
		A3	Die Systemflexibilität würde sich erheblich verbessern: von unflexibel zu äusserst flexibel. (Correct OO, False OM)	System flexibility would improve significantly: from inflexible to highly flexible.
		A4	Die Systemflexibilität würde sich sehr stark verbessern: von äusserst unflexibel zu äusserst flexibel. (Correct OM, False OO)	System flexibility would improve very much: from highly inflexible to highly flexible.

SI 5c. Questions to measure the self-reported range sensitivity

Table SI 5c. **Item name:** Name of the item. **Question type:** type of question and direction of coding; **Answer code:** Code of the answer; **Question and answer options in German:** original formulation of the question and answer options; **Question and answer options in English:** proposed translation of the question and answer options.

Item name	Question type	Answer code	Question and answer options in German	Question and answer options in English
Test10	List(radio)		<p>Inwiefern hast du beim Ordnen der Zielsetzungen nach deinen Präferenzen die Extrem-Zustände, also den Best Case und den Worst Case, berücksichtigt?</p> <p>A1 Überhaupt nicht A2 Eher nicht A3 Einigermassen A4 Eher stark A5 Sehr stark</p>	<p>When ordering the objectives according to your preferences, to what extent did you consider the extreme states, i.e. the best case and the worst case?</p> <p>Not at all Rather not Somewhat Rather strongly Very strongly</p>
Test12	List(radio) Scale (reversed)		<p>Wie sorgfältig haben Sie beim Ordnen der Zielsetzungen den Unterschied zwischen dem bestmöglichen Fall (Best Case) und dem schlechtesten Fall (Worst Case) geprüft?</p> <p>A1 Sehr sorgfältig A2 Eher sorgfältig A3 Einigermassen sorgfältig A4 Eher nicht sorgfältig A5 Nicht sorgfältig</p>	<p>How carefully did you consider the difference between the best case and the worst case when ordering the objectives?</p> <p>Very carefully Rather carefully Somewhat carefully Rather not carefully Not at all carefully</p>

SI 5d. Questions to measure relatedness with the nonplayer character (for the gamified treatment)

The following three questions were only shown to the participants who answered “yes” to the filter question: “Did you encounter virtual characters when being informed?”

Table SI 5d. **Item name:** Name of the item. **Question type:** type of question and direction of coding; **Answer code:** Code of the answer; **Question and answer options in German:** original formulation of the question and answer options; **Question and answer options in English:** proposed translation of the question and answer options.

Item name	Question type	Answer code	Question and answer options in German	Question and answer options in English
Frage13 encouraging	List(radio)		Wie ermutigend war es für Sie, mit der/den virtuellen Figur/en zu interagieren? A1 Gar nicht ermutigend A2 Eher nicht ermutigend A3 Einigermassen ermutigend A4 Eher ermutigend A5 Sehr ermutigend	How encouraging was it for you to interact with the virtual figure(s)? Not at all encouraging Rather not encouraging Somewhat encouraging Rather encouraging Very encouraging
Frage14 strong connection	List(radio) Scale (reversed)		Wie stark fühlten Sie sich mit der/den Figur/en verbunden? A1 Ich fühlte mich sehr stark mit der/den Figur/en verbunden. A2 Ich fühlte mich eher stark mit der/den Figur/en verbunden. A3 Ich fühlte mich einigermassen stark mit der/den Figur/en verbunden. A4 Ich fühlte mich eher nicht mit der/den Figur/en verbunden. A5 Ich fühlte mich gar nicht mit der/den Figur/en verbunden.	How strongly did you feel connected to the character(s)? I felt very strongly connected to the character(s). I felt rather strongly connected to the character(s). I felt somewhat strongly connected to the character(s). I felt rather not connected to the character(s). I did not at all feel connected to the character(s).
Frage15	List(radio)		Hatten Sie das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen?	Did you feel like you were entering into a virtual relationship with the character(s)?

virtual relationship		A1	Ich hatte überhaupt nicht das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen.	I did not at all feel like I was entering into a virtual relationship with the character(s).
		A2	Ich hatte eher nicht das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen.	I rather did not feel like I was entering into a virtual relationship with the character(s).
		A3	Ich hatte einigermassen das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen.	I somewhat felt like I was entering into a virtual relationship with the character(s).
		A4	Ich hatte eher stark das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen.	I rather strongly felt like I was entering into a virtual relationship with the character(s).
		A5	Ich hatte sehr stark das Gefühl, eine virtuelle Beziehung mit der/den Figur/en einzugehen.	I very strongly felt like I was entering into a virtual relationship with the character(s).

SI 6. Material used for the workshop with the game design students

On 29.04.2019, a test user workshop with 11 game design students from Zurich University of the Arts (<https://gamedesign.zhdk.ch/>, retrieved on 11.10.2019) and two lecturers took place. The workshop language was English. Participants individually filled in an assessment form (presented below) containing three tasks.

1. You have two sticky notes. Write down the first two adjectives that come to your mind to describe your experience, one adjective per note. Be spontaneous and frank.

2. Different aspects define your experience. Please rate all of them hereafter, on the scales. Put a cross wherever appropriate on the scale.

2.a. How enjoyable was it to be informed about wastewater management?

Not at all enjoyable ☹ or very enjoyable ☺ or somewhere in between?



2.b. How boring was it to be informed about wastewater management?

Very boring ☹ or not at all boring ☺ or somewhere in between?



2.c. How entertaining was it to be informed about wastewater management?

Very entertaining ☺ or not at all entertaining ☹ or somewhere in between?



2.d. How annoying was it to be informed about wastewater management?

Not at all annoying ☹ or very annoying ☺ or somewhere in between?

29.04.2019

Individual assessment of your experience

Workshop Eawag - ZHdK



2.e. Did you feel worried when being informed about wastewater management?

Not at all worried ☺ or very worried ☹ or somewhere in between?



2.f. Did you feel content when being informed about wastewater management?

Very content ☺ or not at all content ☹ or somewhere in between?



2.g. Would you recommend this information tool to others?

Surely not ☹ or very surely ☺ or somewhere in between?



2.h. Was it worth spending time getting informed about wastewater management?

Absolutely worthwhile use of my time ☺ or absolutely not worthwhile use of my time or somewhere in between?



2.i. Based on your overall experience (look at your answers above), how would you rate the gamification?

Very bad ☹ to very good ☺ or somewhere in between



29.04.2019

Individual assessment of your experience

Workshop Eawag - ZHdK

3. Gamifying is incorporating game elements and principles in non-game activities/ contexts.

Start with ticking the game elements that you recognised.

Then, ONLY for the elements that you recognised, fill in the last three columns with a number

from -2 (very negative/bad influence – deteriorate) to +2 (very positive/good influence – increase).

0 means no influence. Add a comment if you wish.

	Here is a list of game elements	Tick if it was in the tool	How did it influenced your feeling of COMPETENCE (feeling effective)?	How did it influenced your feeling of AUTONOMY (need to control, chose)?	How did it influenced your feeling of RELATEDNESS (need to feel related)?
1	Gameplay/ learning loop		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
2	Random event		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
3	Offer win/ fail situation		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
4	Progress bar		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
5	Reward/ penalizing feedbacks		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
6	Score		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
7	Competition		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
8	Non-player Characters		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
9	Mission/ challenge		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
10	Narrative		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
11	Award/ badge		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2
12	If other:		-2 -1 0 +1 +2	-2 -1 0 +1 +2	-2 -1 0 +1 +2

Thanks, let's discuss this after the break!

SI 7. Socio-demographic description of the participants (experiment sample)

Table SI7a. Distributions of the socio-demography of our sample ($N = 184$)

	Number of respondents (%)	
Gender	Male	51 (27.72%)
	Female	132 (71.74%)
	other	1 (0.54%)
Age ($\mu = 23.55$, $SD = 3.16$)	18	7 (3.80%)
	19	11 (5.98%)
	20	15 (8.15%)
	21	19 (10.33%)
	22	31 (16.85%)
	23	13 (7.07%)
	24	19 (10.33%)
	25	14 (7.61%)
	26	18 (9.78%)
	27	13 (7.07%)
	28	9 (4.89%)
	29	10 (5.43%)
	30	4 (2.17%)
	31	1 (0.54%)
Education	University degree	139 (75.54%)
	Higher vocational training	12 (6.52%)
	Highschool	24 (13.04%)
	Basic vocational training	6 (3.26%)
	Secondary School	3 (1.63%)
Previous knowledge of wastewater	Nothing at all	34 (18.48%)
	Rather little	94 (51.09%)
	A little	51 (27.72%)
	Rather a lot	5 (2.72%)
	Very much	0 (0%)

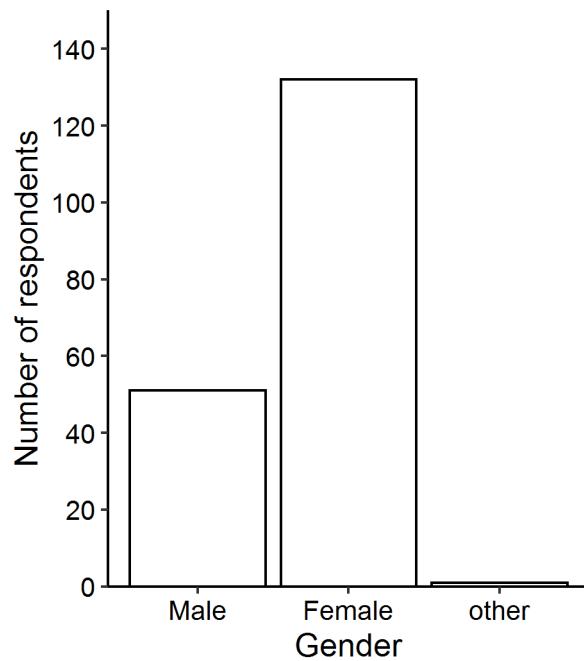
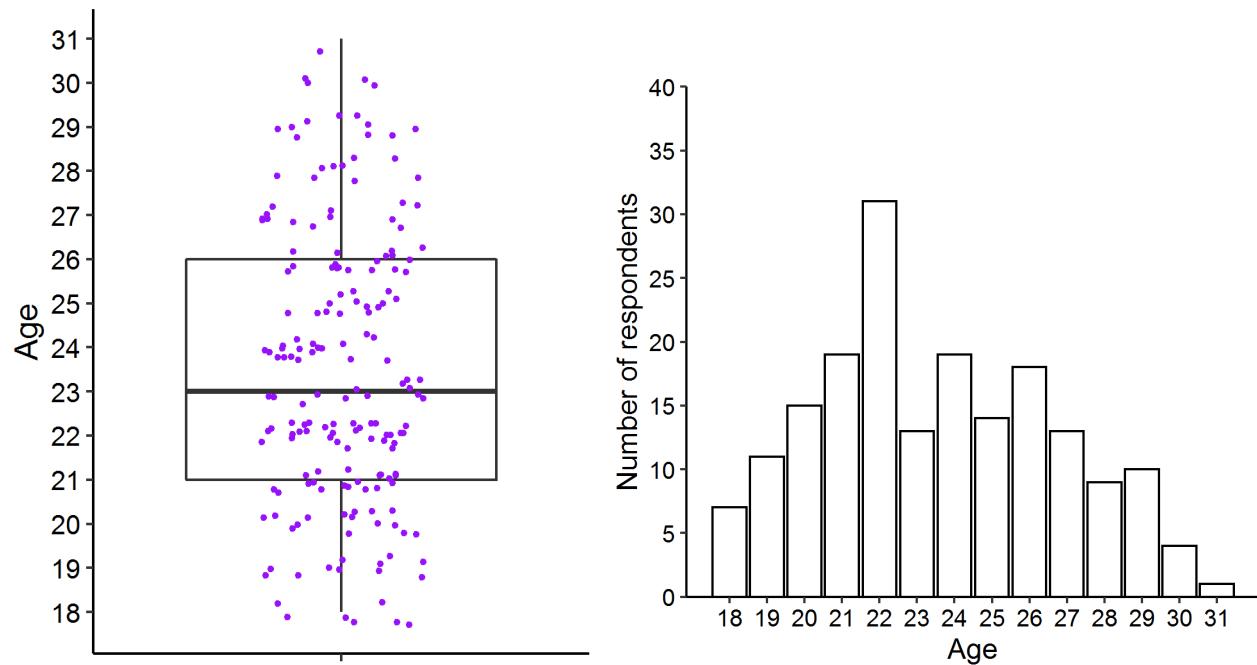


Figure SI7b. Barchart representing the gender distribution in our sample.



Figures SI7c and d. Boxplot and barchart representing the age distribution in our sample (left and right, respectively).

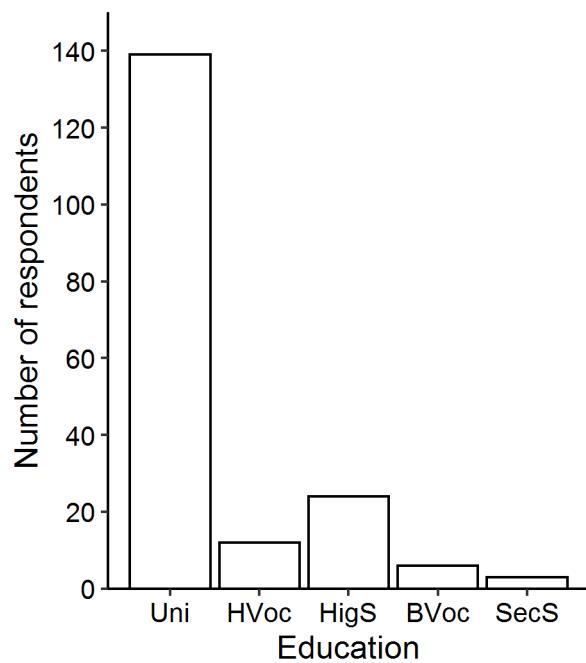


Figure SI7e. Barchart representing the education distribution in our sample. Uni = university degree; HVoc = higher vocational school; HiS = highschool; BVoc = basic vocational school; SecS = secondary school.

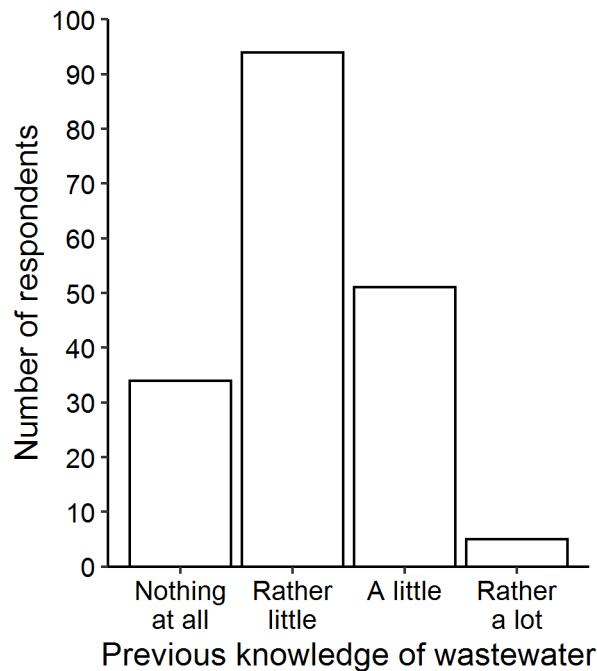


Figure SI7f. Barchart representing the distribution of self-rated knowledge about wastewater previous to the experiment in our sample.

SI 8. Additional quantitative results

SI 8a. Results for testing the questionnaire used to measure factual learning

To test our measurement instrument for factual learning (knowledge test questionnaire), we invited an additional sample of 52 participants between June 2020 and September 2020. The participants answered the knowledge test twice, without receiving any information on objectives before the second repetition.

Table SI 8a.1. Time difference between the first and the second survey in days. **Min** = smallest difference, **Max** = biggest difference, **Mdn** = Median, **μ (SD)** = mean and standard deviation, **N** = total number of respondents.

	Min	Max	Mdn	μ (SD)	N
Difference between survey 1 and survey 2 (in days)	3	53	6	13.04 (14.42)	52

Table SI 8a.2. Comparison of the knowledge scores of the first (**Initial score**) and second survey (**Final score**).

Delta score: Difference between final and initial score. **t-test:** significance test for the difference between scores.¹ Two Sample t-test, ² Welch Two Sample t-test, ³ Paired t-test

Sample	Initial score	Final score	Delta score	t-test
Edanaga (N = 184)	4.97 (1.33)	7.58 (1.33)	2.61 (1.53)	-23.08(183), $p < .001$, $d = -1.97$ ³
Reliability (N = 52)	6.05 (1.42)	5.92 (1.36)	-0.13 (0.98)	0.92(51), $p = .364$, $d = 0.09$ ³
t-test	-5.08(234), $p < .001$, $d = -0.80$ ¹	7.92(234), $p < .001$, $d = 1.24$ ²	-4.89(77.80), $p < .001$, $d = 1.91$ ²	

The initial and the final score of the Reliability sample do not differ ($p = .364$). Note, this effect is negligible ($d = 0.09$). The difference is on average -.125. We expected this lack of difference, because there was no intervention (informing about objectives). Also, the within subject variability between the pre- and post-test was low: the initial and final scores correlated statistically significantly (Pearson: $r = 0.75$, $p < .001$, see Figure SI 8a).

The final scores between the Edanaga sample and the Reliability sample differ significantly (large effect: $d = 1.24$), so does the delta score (large effect: $d = 1.91$). The participants in the Edanaga experiment have improved their factual knowledge by 2.6 points on average by reading the information about the objectives. This is statistically significantly more than the participants not receiving information (Reliability sample).

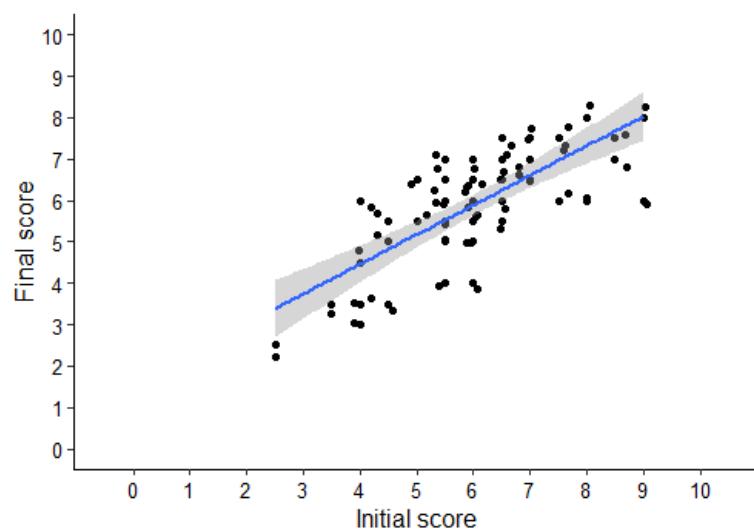


Figure SI8a. Scatterplot of initial and final scores of the Reliability sample ($N = 52$). **Blue line:** regression line.

SI 8b. Results on range-sensitive preference construction

Testing the statistical significance of the **weight differences** for the manipulated and original levels of attribute for the whole sample.

For the manipulation of high removal of organic matter (Orgm):

- Total ($N = 174$): $t(172) = 2.20, p = .030, d = .33 \rightarrow p < .05$

For the manipulation of high flexibility (Flex):

- Total ($N = 174$): $t(172) = -.84, p = .404, d = -.13 \rightarrow$ Not significant

Testing the statistical significance of the weight differences for the manipulated and original levels of attribute within the gamified and nongamified groups.

For the manipulation of high removal of organic matter (Orgm):

- Gamified ($N = 90$): $t(88) = 1.27, p = .207, d = .27 \rightarrow$ Not significant
- Nongamified ($N = 84$): $t(82) = 1.78, p = .079, d = .39 \rightarrow$ Not significant

For the manipulation of high flexibility (Flex):

- Gamified ($N = 90$): $t(88) = -1.97, p = .052, d = -.41 \rightarrow$ Not significant
- Nongamified ($N = 84$): $t(82) = .80, p = .424, d = .18 \rightarrow$ Not significant

Testing the statistical significance of the **difference in self-reported range sensitivity** on the 5-point Likert scales between the groups gamified and nongamified.

- Total ($N = 174$): $t(172) = -.77, p = .440, d = -.12 \rightarrow$ Not significant

Testing the statistical significance of the **difference in self-reported preference learning** on the 5-point Likert scales between the groups gamified and nongamified.

- Total ($N = 174$): $t(182) = -.64, p = .53, d = -.09 \rightarrow$ Not significant

Testing the statistical significance of the **difference in self-reported preference representing opinion** on the 5-point Likert scales between the groups gamified and nongamified.

- Total ($N = 174$): $t(182) = -.69, p = .491, d = .10 \rightarrow$ Not significant

Table SI 8b. Correlations (Pearson, r) between factual learning (final or delta knowledge score) and range sensitivity (perceived: rsts or self-reported: Test10, Test12).

		r	N	p
Final score	rsts	0.040	174	.603
Final score	Test10	0.128	174	.094
Final score	Test12	-0.005	174	.943
Delta score	rsts	-0.078	174	.304
Delta score	Test10	-0.024	174	.749
Delta score	Test12	-0.131	174	.085

SI 8c. Results on the constructs of the SDT

Table SI 8c.1. Mean (μ), standard deviation (SD) and median (Mdn) of the single items of the self-determination theory for all participants (total), participants from the gamified and the non-gamified sample

Construct	Items	Total (N = 184)		Gamified (N = 95)		Non-gamified (N = 89)	
		μ (SD)	Mdn	μ (SD)	Mdn	μ (SD)	Mdn
Autonomy	interest1	3.95(1.00)	4	4.03(0.89)	4	3.85(1.09)	4
	decide.path	3.45(1.07)	4	3.29(1.07)	3	3.62(1.05)	4
	choice1	3.06(0.98)	3	3.28(0.87)	3	2.82(1.04)	3
	interest2	3.15(0.82)	3	3.16(0.78)	3	3.13(0.87)	3
	choice2	3.90(1.11)	4	3.97(1.12)	4	3.82(1.11)	4
Competence	factlearn1	3.91(0.72)	4	3.88(0.68)	4	3.93(0.77)	4
	preflearn1	3.47(0.71)	3.5	3.51(0.74)	4	3.44(0.67)	3
	progress	4.06(0.74)	4	4.05(0.63)	4	4.07(0.85)	4
	preflearn2	4.32(0.65)	4	4.35(0.66)	4	4.28(0.64)	4
	factlearn2	3.99(0.65)	4	4.05(0.64)	4	3.92(0.66)	4
	factlearn3	3.85(0.71)	4	3.83(0.71)	4	3.87(0.71)	4
Relatedness	forsociety1	3.63(1.34)	4	3.66(1.34)	4	3.58(1.34)	4
	forsociety2	4.77(0.50)	5	4.74(0.55)	5	4.80(0.43)	5
	helpful	4.21(0.81)	4	4.24(0.80)	4	4.18(0.82)	4

Table SI 8c.2. Pearson correlation between the constructs of autonomy (resp. competence) and entertainment. r = correlation; p = significance level.

	Autonomy						Competence					
	Total (N = 184)		Gamified (N = 95)		Non-gamified (N = 89)		Total (N = 184)		Gamified (N = 95)		Non-gamified (N = 89)	
	r	p	r	p	r	p	r	p	r	p	r	p
Entertainment	0.404	< .0001	0.387	< .0001	0.414	< .0001	0.398	< .0001	0.452	< .0001	0.363	< .0001

We compared the correlation between competence and entertainment in the gamified group against the same correlation in the nongamified group by means of a Fisher transformation (R package cocor (Diedenhofen & Musch, 2015). The two correlations are not significantly different ($z = 0.71$, $p = .238$). We did the same analysis for the correlations between autonomy and entertainment and did not find a significant difference either ($z = -0.21$, $p = .585$).

Diedenhofen, B. & Musch, J. (2015). cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. PLoS ONE, 10(4): e0121945. doi:10.1371/journal.pone.0121945

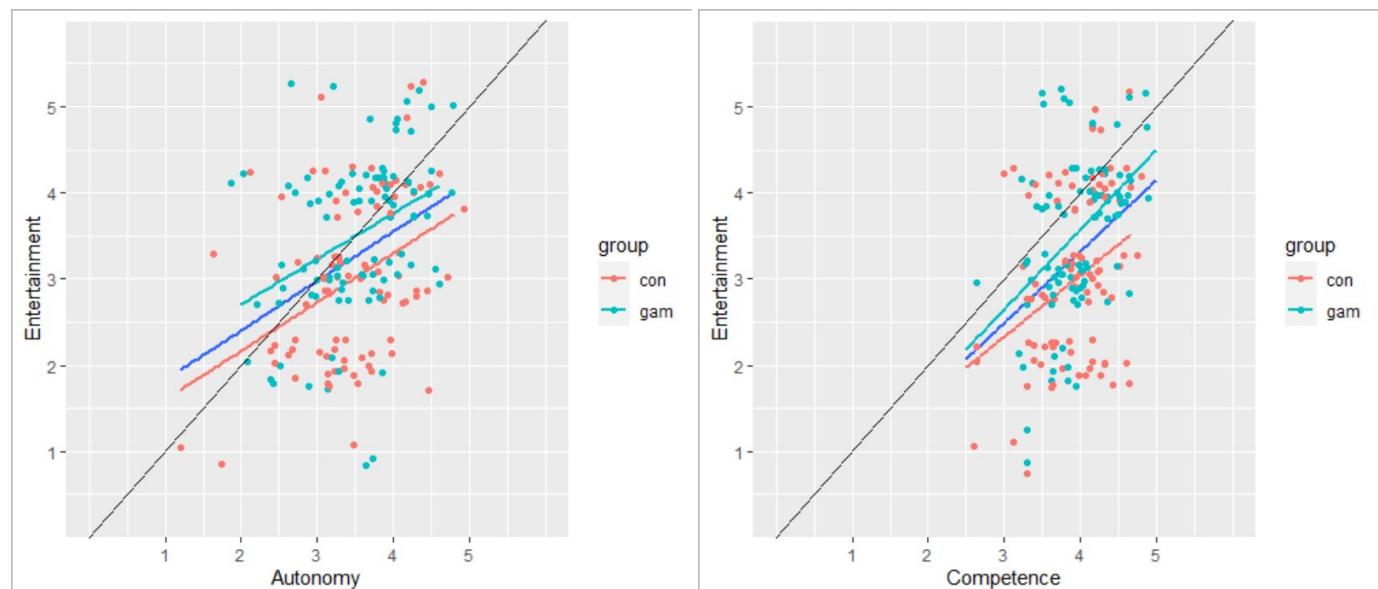


Figure SI 8c. Scatterplot for autonomy (resp. competence) and entertainment with lines for the linear regressions. con = nongamified; gam = gamified; dark blue line = linear regression for whole sample, black line = 1x1 line.

SI 8d. Results for relatedness with the nonplayer character

Table SI 8d. Results are only for the gamified treatment, for the Edanaga experiment ($N = 95$) and participants in the real-world Swiss case-study ($N = 18$).

	Edanaga ($N = 95$)		Case study ($N = 18$)	
	Mean(SD)	Median	Mean(SD)	Median
Encouraging (Frage13)	3.26(1.12)	3	3.1(1.1)	3
Strong connection (Frage14)	2.24(.95)	2	2.0(.84)	2
Virtual relationship (Frage15)	2.16(.98)	2	1.9(.94)	2

SI 8e. Results supporting the focus on the constructs of competence and autonomy

A Confirmatory Factor Analysis (CFA; R package lavaan (Rosseel, 2012)) for the three theoretically assumed factors competence, autonomy, and relatedness showed no satisfying fit to the data. We found a non-positive definite matrix, suggesting untrustworthy data. Additionally, both the Comparative Fit Index (CFI = .843) and the Tucker-Lewis Index (TLI = .807) were below .9, and the RMSEA (.074) indicated a bad fit of the model with the data.

By means of a Principal Component Analysis (PCA; R package psych (Revelle, 2020)), we determined the factor structure fitting the data best. Two tests both spoke in favor of a PCA: the Bartlett's test ($\chi^2(91, N = 184) = 585.59, p = .000 < .001$) and the Kaiser-Meyer-Olkin factor (KMO = .8 with none of the values for the single items below .5). The eigenvalues suggested extracting four factors. The scree plot suggested extracting three or four factors. The PCA with four factors and orthogonal rotation (varimax) was the best fit with a *fit based upon off diagonal values* = .89 (values $>.95$ are considered a good fit (Field, Miles, & Field, 2012)) (Table SI 8e, below). However, both tests on the residuals were disconcerting; 58% of the residuals were larger than .05 and the root-mean-square residual (RMSR) was .084. The first two factors were compatible with the constructs of autonomy and competence. The third and fourth factors were not at all compatible with the self-determination theory (SDT).

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. Journal of Statistical Software; Vol 1, Issue 2 (2012). doi:10.18637/jss.v048.i02

Revelle W (2020). psych: Procedures for Psychological, Psychometric, and Personality Research. Northwestern University, Evanston, Illinois. R package version 2.0.9, <https://CRAN.R-project.org/package=psych>.

Field, A., J. Miles, and Z. Field, *Discovering Statistics Using R*. 2012: SAGE Publications Ltd 992.

Table SI 8e. Results of PCA with four factors and orthogonal rotation (varimax)

		<i>Orthogonally rotated factor loadings</i>			
<i>Affiliation to scale (theory based)</i>		<i>factor 1 competence</i>	<i>factor 2 autonomy</i>	<i>factor 3</i>	<i>factor 4</i>
Competence	factlearn1	0.78	0.12	0.19	-0.08
Competence	progress	0.76	0.13	0.06	0.09
Competence	preflearn2	0.58	0.15	0.05	0.01
Competence	factlearn3	0.56	-0.05	0.26	0.36
Competence	factlearn2	0.56	-0.03	0.25	0.42
Autonomy	choice2	0.06	0.78	0.07	0.23
Autonomy	choice1	0.03	0.78	0.07	0.05
Autonomy	decide.path	0.21	0.66	0.16	-0.22
Relatedness	forsociety2	-0.09	-0.09	0.79	0.00
Autonomy	interest2	0.27	0.13	0.56	0.24
Autonomy	interest1	0.36	0.38	0.55	0.00
Relatedness	helpful	0.25	0.35	0.48	0.07
Competence	preflearn1	0.28	0.28	0.43	-0.07
Relatedness	forsociety1	0.07	0.08	0.02	0.87
		Eigenvalues	2.56	2.10	1.86
		% of variance	0.18	0.15	0.13
		α	0.74	0.67	0.67
					/

Note: factor loadings over .40 are in bold.

SI 8f. Results of the feedback survey from the Swiss case study

We kept the 18 full answers (from citizens who answered both the weight elicitation and the feedback surveys). These 18 full answers contain three from project team members and 15 from the general population. All received the gamified information on objectives. Note the items for “no worry” and “contentment” were removed from the case study survey.

Case study (N = 18)		
	Mean(SD)	Median
Fun	3.1(.68)	3
No boredom	3.7(1.1)	3
No irritation	4.5(.51)	4.5
Entertaining	3.3(.97)	3.5
Worthwhile use of time	3.6(.78)	4
Recommendation	3.6(1.2)	4

SI 9. Results from the workshop with the game design students

SI 9a. Result from the sticky notes exercise

Raw transcription of the notes. The workshop was held in English, the common language for all participants although no participants had English as mother tongue.

	Rather negative	Somewhat neutral	Rather positive
info	<ul style="list-style-type: none"> - Overwhelming (too much information, hard to remember it all) - Complex/ too much text - Complex - Tired/ too much text - Demotivating/ too much text 	<ul style="list-style-type: none"> - Short while having a lot of text but what was the goal? - Click-to-win but possible NOT to read the text! 	<ul style="list-style-type: none"> - Informative (*3) - Feeling informed - Weiterbildend - Knowledgeable - Element - Being curious - Interesting
image		<ul style="list-style-type: none"> - Lack of match between the background illustrations and the "objectives ID cards"/ pictograms 	<ul style="list-style-type: none"> - Art work - Illustrative (watercolor map etc.)
general	<ul style="list-style-type: none"> - Bland (not spicy at all) - Boring - Boring - Monotonous 	<ul style="list-style-type: none"> - Slightly awkward (voice over unnatural) - Komischer stil (does it meet the targeted audience?) 	<ul style="list-style-type: none"> - Friendly - Cute (in terms of the illustrations and story) - Persönlich [(nettes) schweizerdeutsch*]

SI 9b. Result concerning the nonplayer character (Mister Akles)

The gamification included Mister Akles in an attempt to create relatedness. The qualitative feedbacks (transcription from the workshop, done by the first author) about Mister Akles vary from positive to negative.

Positive statements

(16'20") "You have the feeling that there is really a person there"

(30'58") "about the voice of that Mister Akles, I am not sure it was intentionally funny, but I thought he was amusing because he was dramatizing a little bit, thinking his topic is super exciting, I kind of enjoyed it, because he was a little nerdy, I thought that worked, but I am not sure it was intentional. (...) That he was so nerdy, it was funny"

(46'46") "... I felt more addressed at the first person by him [Mister Akles] and I could more relate to his duty. I did not really needed an avatar for myself (...)"

(1°00'00") "I also felt the relatedness in this part (in the office) because he was encouraging and giving feedbacks, helped and made me fulfill the task"

Negative statements

(12'22") "When the guy starts talking, (...) I think that the voice over is very unnatural"

(27'49") "At the end, I had already forgotten that we could chose a character at the beginning, so this is not really working for me (...) in the part in the office, he is like teaching you, also the feedbacks were quite **childish**"

(1°14'00") "For me the relation to him [Mister Akles] was not completely clear, what am I doing, am I visiting him? And then, I was taking notes for him, and then he was asking for my notes and he said oh thank you, and that was a little be awkward because I did not do anything (...) that is a little bit narratively unclear"

(1°17"00) "If I would have more direct interaction with the characters, it would be more attractive"

Statement for improvements about the non-player characters

(27'12") "the art work fits to the game, the information is there, (...) but the problem is the way you show it, it is frozen (...) if is it possible maybe you can make more dialogue into it with two characters talking to each other"

(34'53") "the key element is that the player gets attached very quickly (...) the game [play against all odds from UHNCR] plays with empathy, and this is a very strong element that works very well in this game"

(35'42") "The character or the main character could be some sort of a farmer who is directly involved with the wastewater, the character that you are playing"

SI 10.Qualitative results from the feedback survey (open textboxes)

SI 10a. Ten examples of statements supporting factual learning

Translated from the original German texts.

"I did not know that our current wastewater system is so inflexible (...)"

"In addition, I also understood the concept of net energy use"

"Now, I have just a rudimentary understanding of how complex wastewater management is (...) I think many people ignore how complex it is, despite the fact that we need it daily, and it impacts our nature"

"I did not know that today micropollutants are not filtered: this surprised me. I also had never thought about the flexibility of the pipe network, which can be a problem when the demography changes (...)"

"Until now I had never heard about decentralized wastewater management and their higher flexibility"

"I did not know that one can recover phosphorus from wastewater and use it further. I also did not know about the operational status of current wastewater system such as cost, time and energy demand (...)"

"I was not aware that wastewater management is so important for us, Humans. Not only there are direct consequences for health, but also for our future (through the net energy consumption (...)"

"Technical issue presented in an understandable way"

"I find the current informative part very informative and entertaining"

"The information of the 10 objectives was easy to understand and interesting (...)"

SI 10b. Statements (positive and negative) about the gamification in general and the nonplayer character Mister Akles

Examples of positive statements about gamification in general and the nonplayer character Mister Akles in particular.
*Only comment about the non-player character from the Swiss case study.

Positive statements (six examples)

“I found it an innovative idea which provided fun. Go on!” [NB, not specifically about the non-player character]

“I found this great ☺” [NB, not specifically about the non-player character]

“The idea with the virtual character is nice and can be motivating”

“The part about the release of information with the engineer is very well done and completely caught my attention”

“I found it as it is now very informative and entertaining” [NB, not specifically about the non-player character]

“The whole story with the virtual character was interesting”

Negative statements (ten examples)

“I personally found the voice-over [of the non-player character] unnecessary, and the intonation artificial”

“The part when the colleague [i.e., the non-player character] is speaking could be somewhat shortened or faster”

“The information seems exposed in simplified version, combined with the way it is exposed it looks like a partial or **childish** interaction, a game. Personally, I would prefer that the facts are exposed by a proper expert (...) that would strengthen the reference to reality”

“I had the feeling that the information was rather prepared for children, so I did not find it so exciting (...) I also found the voice over of Mister Akles annoying and too dramatic (ok for kids, not for adults).”

“At no point did I had the feeling that I developed a virtual relationship with this character. I would find a movie, where the facts are clearly exposed much better than this system with the map and the virtual guide, Mister Akles”

“The virtual character sound not simply read over the text (...) maybe it would be better to display the text after the virtual character said it (...) the way the virtual character accentuated some words sounded absurd and I wished for more seriousness”

“I did not understand why I needed to choose for an avatar”

“Less **childish** graphical presentation and more serious task; less declamatory voice over”

“I found the virtual character somewhat tiring”

“(...) I could not make friend with the virtual figure”*

SI 10c. Statements about the gamified information on objectives from the Swiss case study

When unclear, we kept hereafter statements that may also refer to the weight elicitation survey. The statements are classified per valence (positive, negative). Statements are translated from the original German texts.

Positive statements (two)

"I found it really good, maybe a bit too time consuming, when it has to be completed at once. I would find it worthwhile that this informative part, gamified, would be accessible over months on a webpage. It could be a kind of journey/process, for which, upon achievement, one would receive a type of "certificate" for the acquired knowledge"

"I would recommend it to others the way it is. I find it overall well done, considering that only few people are interested in this information. I could imagine that the questions could be asked in municipalities, for instance at the local council. This would stimulate a discussion. Nowadays, everyone has a smartphone, right...!?"

Negative statements (six)

"(...) [in the gamified part] one must read far too much text. For me, the question is whether all our contemporary people in a hurry manage it! (...) One thing annoyed me: while I was thinking (in the task requiring matching the pictograms to the provided sentences), I was repetitively offered to drink a coffee. A gag that should be left out to my opinion"

"The survey is really long"

"Less complex and less conceptual wording"

"Improvement: for both the informative and survey part, create a cockpit, so that one knows where she is at the moment, and what the objectives of this part are. I could not make friend with the virtual figure"

"In case the survey is planned for a wide general audience, the wording of the questions should be simplified"

"The little story was for me rather annoying"