Alfredo's Kitchen: A Serious Game for Food Safety Training

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ABSTRACT

Food safety training is mandatory for restaurant staff in the Netherlands. Existing training primarily relies on video material. Previous research has demonstrated that serious games for food safety training offer a more engaging and effective experience than passive video watching. However, these games have mostly been designed for children. We developed and evaluated a prototype of "Alfredo's Kitchen", a serious game for food safety training specifically aimed at future restaurant staff. Players learn food safety principles through multiple modules, mimicking existing training. The game includes a tutorial mode where head chef Alfredo teaches the modules learning content and game mechanics. This is followed by a challenge mode where players apply their knowledge under time constraints and a scoring system. The game's evaluation findings suggest that Alfredo's Kitchen effectively increases knowledge of proper food storage and that the player's experience is characterized by having to take quick and accurate actions. With more modules to be added in future research, Alfredo's Kitchen has the potential to set a new standard for how food safety training is delivered.

1 INTRODUCTION

Food safety training like the Hazard Analysis and Critical Control Points (HACCP) is mandatory for all people handling food in the Netherlands [3]. Existing HACCP training is based on video material watching. Research has shown that providing information through a 2-minute video already helps to increase people's awareness of food safety hazards [10]. However, researchers also agree that more meaningful interventions are needed to form people's behavioral practices in the kitchen [10, 11, 13, 16]. Only by actively repeating the best practices until they become habitual can safe food handling be assured.

Serious games have the potential to take food safety courses from passive video watching to an engaging experience. These games motivate players to learn, maintain engagement, and improve knowledge retention [16]. Several serious games for food safety training have been developed in the past years [9, 11, 13]; however, these games were mostly intended as educational material for children. People who are required to take HACCP training in the Netherlands mostly include adults who want to work in restaurants. Thus, there is a lack of serious games for this target group.

To increase the effectiveness of food safety training for future restaurant staff, we developed the serious game "Alfredo's Kitchen," which makes a first step towards the gamification of the HACCP online course of Koninklijke Horeca Nederland (KHN) [8]. For the game's development, we applied a user-centered approach to ensure the game mechanics are intuitive, monitor the effectiveness of knowledge acquisition, and evaluate challenge in the game.

2 RELATED WORK

2.1 HACCP training

The HACCP system is a preventive approach to food safety that identifies, evaluates, and controls hazards of food safety. In the EU, the HACCP system is a mandatory requirement for food business operators [3]. Restaurants in the Netherlands are therefore required to implement procedures based on HACCP principles. Staff training is a crucial part of HACCP implementation, as it ensures that staff are knowledgeable about food safety best practices, which can significantly reduce the risk of foodborne illnesses. Industry bodies such as KHN provide online training courses for food safety and HACCP compliance for restaurant staff [8]. These courses comprise short video lessons in 16 modules and three knowledge tests throughout the training. At the end of the training, there is a test with 30 multiple-choice questions.

2.2 Serious games for safe food handling

Traditional training methods, such as videos used in the HACCP online training, often struggle to maintain participant engagement [6, 9]. Serious games, on the other hand, use gamification elements such as challenges and rewards to make learning more enjoyable and sustain players' interest [7, 16]. Research has also shown that serious games improve knowledge retention and the practical application of skills [11, 16]. They allow participants to practice what they have learned, which is more effective than passive methods for knowledge acquisition [16]. Furthermore, players can experiment with different food safety scenarios in serious games without real-world consequences. This allows them to learn from mistakes without risks [16]. In recent years, various serious games for food safety training have been developed [10, 11, 13].

2.2.1 Safeconsume. SafeConsume (www.safeconsume.eu) is an EU research project focused on developing effective strategies to promote safer food handling and consumption practices [10]. In this project, an online game was developed as an educational tool for 11 to 18-year olds. The game presents players with scenarios where they must make decisions about food safety. These scenarios cover various aspects of food handling, like shopping, storage, preparation, cooking, and serving food. Throughout the game, players receive information about food safety, helping them understand the reasons behind the correct practices. The learning content covers best practices by the World Health Organization (WHO) and the

European Food Safety Authority (EFSA). SafeConsume was found to significantly improve the self-reported food safety behavior of players compared to study participants who were only exposed to informational videos. The ultimate goal of Alfredo's Kitchen is to teach safe food handling holistically, offering all perspectives covered in SafeConsume. However, we will specifically focus on HACCP training, a mandatory training program, rather than the basic guidelines provided by WHO and EFSA.

2.2.2 Ninja Kitchen. Ninja Kitchen is another educational game that promotes correct food safety behaviors among youth [11]. In contrast to Alfredo's Kitchen, this game is specifically designed for use in middle school educational settings. Here, players take on the role of a ninja chef and complete various challenges while adhering to food safety standards. The concepts taught include the hazards of leaving food in "danger zones", preventing cross-contamination, and cooking animal protein to safe temperatures. As players progress through the game, they receive feedback on their performance. This feedback component was a key reason why Ninja Kitchen has been effective in increasing students' knowledge of safe cooking temperatures. Alfredo's Kitchen will therefore adapt this feedback mechanic through a point reward system.

2.2.3 Potluck Panic! Finally, Potluck Panic! is a web game developed for young adults [13]. The game takes the player through all stages of food handling, from production through processing, packaging, distribution, and final handling. Unlike the other games presented, this game is built as a card game. The goal is to recognize and minimize risky food-handling practices. Players are presented with food product cards and the steps involved in processing those foods. One of the steps presents a food safety risk, and the task is to select the action card that mitigates the risky practice. The goal is to minimize as many risks as possible within a limited number of hands to play. Although an evaluation revealed that a significant percentage of students expressed interest in learning more about food safety after playing the game, the design of Alfredo's kitchen will be based on the principles of SafeConsume and Ninja Kitchen. We think it is important to practice the targeted behavior in such a way that it is closer to a real-life situation than a card game.

3 SERIOUS GAME CONCEPT AND DESIGN

We designed Alfredo's Kitchen based on the HACCP training content modules provided by KHN [8], where the primary goal is to have the player learn about how food is safely handled in a restaurant environment. The core idea is simple: the player is a new staff member at a restaurant, and they are expected to learn and work under the guidance of Alfredo, the head chef. The game is divided into small chapters, with each chapter dedicated to a specific game mechanic that is tied to the associated HACCP module. For example, personal hygiene and product procurement are presented as two separate content modules by KHN [8], and thus they will be represented as two different chapters with unique mechanics in the game (see Figure 1).

The game contains a light narrative aspect as the player works for and learns from head chef Alfredo. Each chapter has a tutorial mode, where Alfredo teaches the player how to complete their tasks for the level and the reasons behind certain food safety protocols (see Figure 2). Throughout the game, Alfredo provides helpful tips and comments on gameplay mistakes to help the players complete their tasks, and thus learn more effectively.

When the tutorial is finished, the player is presented with the challenge mode, where they can apply what they have learned in a more restrictive manner (see Figure 3). Specifically, the player has a 45-second time limit to finish the level, and they will be scored based on how many tasks they complete and whether they make any errors during play. Depending on the modules, future work may encompass a broader range of challenges.

By structuring Alfredo's Kitchen in this way, we aim to align the game design with the bottom three levels of Bloom's Taxonomy: Remembering, Understanding, and Applying [4]. The tutorial mode focuses on remembering by introducing key HACCP concepts through game-given tasks. The narrative and interactions with Alfredo enhance a player's understanding. Finally, the challenge mode allows players to apply their knowledge while exposed to time pressure and error penalties.

4 IMPLEMENTATION, INTERFACE, AND INTERACTIONS

The game was implemented using the Unity game engine, with both a gamepad and keyboard-based control scheme. The input method serves as a simple interface with the game environment, where the player controls an avatar from a top-down third-person view to navigate and interact with the surroundings. Given the time limitation of the project, we decided to only focus on a single chapter–proper food storage (Module 12 in KHN HACCP training [8]). The user interface during gameplay is kept minimal, with most actions made as straightforward as possible to minimize cognitive load.

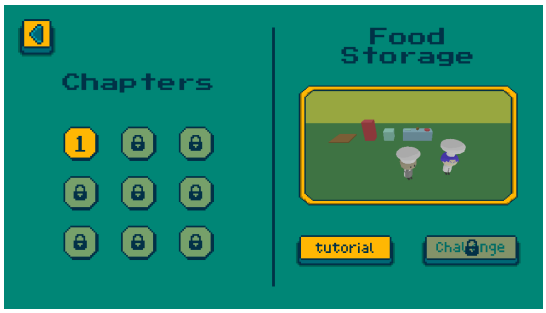

Figure 1: The menu screen

All the models in the game are 3D and were made using Blender. We wanted the game to have a simplistic and pixelated, yet cute aesthetic, which gives players the possibility to fill missing details with their imagination. To achieve this effect, the world is rendered to a low resolution render texture first, and point filtering is applied to that texture. Then, another camera is pointed at this rendered texture and renders the final image to the screen. This technique was inspired by the game A Short Hike [12].

Aligning with our aesthetic, we aimed to make the user interface as simple and compact as possible. Here, we took inspiration from games like Flappy Bird [15] and Cooking Mama [1]. In the level selection menu, players can select levels they have unlocked (this

happens by playing chapters sequentially), and which mode they want to play (see Figure 1). As of the moment of this writing, only the level for food storage is implemented in the game.

Within the tutorial mode, the player is taught the game's control fundamentals, such as pressing "WASD" to walk and pressing "E" to interact with NPCs. Players interact with the head chef NPC Alfredo, who guides them through the tutorial. When players successfully carry out instructions, Alfredo provides compliments. This positive feedback acts as a reward, increasing the likelihood that players will repeat the correct actions. When players make errors, Alfredo lightly scolds them. This acts as a form of punishment. Punishment aims to decrease the likelihood of a behavior being repeated by introducing an unpleasant consequence behavior. By incorporating these elements, the game uses operant conditioning principles to shape player behavior [14].

Figure 2: The tutorial mode

Figure 3: The challenge mode

The player is tasked to store the ingredients in their associated storage spaces based on the type of food and their corresponding storage temperatures. If the ingredient's temperature is wrong, the player will have to return it to the deliverer. A thermometer is situated at the top left corner of the screen to inform the player of the currently held item's temperature. In addition, we provide the player with a manual, which they can access during the level at any time through the escape menu. The manual serves as a summarized "textbook" which includes not only the core knowledge that the player should learn but also the logic and reason behind it. Due to our budget constraints, we were unable to obtain access to the actual materials used in the KHN HACCP training. Despite this limitation, we ensured that the storage temperatures [2] and guidelines for food storage [3] incorporated into this project were obtained from reliable sources.

Upon finishing the tutorial, the player can play the challenge mode, where they will try to complete as many storage tasks as possible within 45 seconds; they will get scored depending on how many correct and incorrect tasks they accomplished. Specifically, 1 point is added if the player stored the ingredient into the right storage, and 1 point is deducted for a mistake. If the player stores at least 3 consecutive items correctly, we enable the streak system: for each stored item, the player now gets 2 points. The streak is lost if the time between two consecutive tasks exceeds 5 seconds or the player makes a mistake. The current score, best score, and remaining time are displayed at the top of the screen (see Figure 3).

4.0.1 Adaptive Gameplay Mechanics. We also implemented an adaptive gameplay mechanic which spawns food according to the player's prior success rate: For each ingredient type i, we compute a spawning probability $p_i = \frac{m_i}{M}$ where m_i is a counter for the amount of mistakes made with the i-th ingredient type so far and M is the sum of all the mistake counters $M = \sum_{i=1}^{ingredients} m_i$. Based on the probability p_i, we spawn the next ingredient for the player to store. This way, we can reinforce the learning for the ingredients for which the player has not had much success. Once the ingredient with type i is stored successfully, m_i is updated using the formula $m_i = \max 1, m_i - 1$. This means that when the player performs optimally, a uniform distribution is implicitly used.

5 EVALUATION I: LOW FIDELITY PROTOTYPE

To evaluate a first prototype of Alfredo's Kitchen, we conducted a "think out loud" play session followed by an interview. This method allowed us to gather feedback on player experience, understanding, control intuitiveness, and UI design. The prototype was still very abstract at this point and only included the tutorial mode.

5.1 Procedure

The evaluation took place during a demo testing session in class. Participants were instructed to play the prototype tutorial mode and verbalize their thoughts while playing. During this time, we observed them and took notes on their behavior, comments, and actions in the game. Afterward, we conducted a short interview to evaluate players' understanding, usability, design perception, and learning effectiveness (see Appendix A). In addition to the set questions, we asked follow-up questions based on the observations. The findings described in the following section are combined summaries of the notes taken during the play-tests and the consecutive interviews.

5.2 Findings

We recruited six peers of which four identified as a "man" and two as a "woman", with a mean age of 24 years old ($M = 24$). All participants were able to explain the learning objective of the level. During the observations, it was evident that they understood what their primary task was. This indicates that the explanations provided in the dialogue with the NPC were clear and effective. Additionally, the controls were found to be intuitive by all participants. The participants agreed that the learning goal can effectively be reached through the applied learning approach.

The evaluation revealed three main areas for improvement. Firstly, players had to interact with Alfredo first to get instructions on the game controls, however, they needed to know how to move and interact with Alfredo to get those instructions in the first place. To improve this, an initial pop-up should appear explaining the controls before the tutorial starts. Secondly, this prototype consisted of simple colored boxes, representing the refrigerator, pantry, and freezer, and three types of "food" which were shapes with matching colors to the corresponding storage. Due to their abstractness, players resorted to color matching rather than matching the food to its right storage based on understanding. To address this, we updated our object models so they looked more distinctive. Finally, a participant recommended implementing a time challenge mode, i.e. the player had to make as many dishes as possible within a set time. Time challenges would encourage players to replay the game to beat their previous scores. Moreover, different time limits could be implemented to ensure that both novice and experienced players find the right level of challenge.

6 EVALUATION II: HIGH FIDELITY PROTOTYPE

For the final evaluation of the game, we conducted a survey and a game session with two primary goals in mind. Our first goal was to understand the player's experience, especially taking note of the type of challenge perceived by the user. In previous evaluations, only the tutorial mode was evaluated. Participants indicated that this game mode lacked challenge and may become boring over time. Therefore, it was crucial to evaluate what kind of challenge players experience when playing the newly implemented "challenge mode," described in Sections 3 and 4. Our second goal was to evaluate if players' knowledge about safe food storage would increase after playing the game. Additionally, we sought player feedback to identify areas for future improvement.

6.1 Participants

The sample consisted of 22 participants, with a mean age of 27 (M = 27.41) years (SD = 8.47). Ages ranged from 22 to 55 years. 17 of the participants identified themselves as a "man" and five as a "woman". 50% of participants had a professional background related to computer science. Participants had to be at least 18 years old and the use of a PC/laptop was required.

6.2 Procedure

Our evaluation involved a pre/post-survey, created in Qualtrix survey, with a game session in between. The Ethics and Privacy Quick Scan of the Utrecht University Research Institute of Information and Computing Sciences classified this research as low-risk with no further ethics review or privacy assessment required. The study took 15 minutes to complete. In the online survey, participants first gave their consent to participate. They then provided demographic data (age, gender, profession) and completed a pre-knowledge test with two open-ended and five true/false questions subsequently. The questions for the pre-knowledge test were adapted from [7], but only the questions on proper food storage were used for this evaluation. Two questions about storage temperatures were added since this was also part of the learning goal (see Appendix B).

After the pre-survey, participants followed a link to download the game for Linux, Mac, or Windows, from Google Drive. They were instructed to play the tutorial mode and subsequently the challenge mode once (for the exact instructions see Appendix C). This playing sequence was ensured by unlocking the challenge mode only after the tutorial was completed. Participants kept their browser with the survey open during the play session.

After playing the game, participants returned to the survey. They first rated the type of challenge they perceived using the challenge originating from recent gameplay interaction scale (CORGIS) [5]. This scale differentiates four types of challenge: performative, cognitive, emotional, and decision-making challenge (for a definition of the types of challenges see [5]). Participants indicated their agreement with the 30 statements included in the CORGIS on a 7-point Likert scale from 'strongly disagree' to 'strongly agree' (see appendix D). Next, they completed the post-knowledge test, which was identical to the pre-knowledge test (see appendix B). Finally, participants answered two open-ended questions about their learning process and gave suggestions for improving the game (see appendix E).

6.3 Analysis

IBM SPSS Statistics 18.0 was used to analyze the pre- and post-knowledge tests and the CORGIS. For the pre- and post-knowledge tests, participants' responses were scored, with correct answers receiving a score of 1 and incorrect answers a 0. For the first open-ended question (see Appendix E), correct responses included stating something similar to "the fish could thaw" or "its temperature could rise above a safe level." Correct responses for the second question (see Appendix E) included storing the fish in a "freezer" or in a "cooler" to maintain a safe temperature. Incorrect responses included vague and incorrect statements like "go home" or storing the fish in a "refrigerator." Each correct answer in the open-ended questions was scored as 1, while each incorrect answer received a score of 0. Overall scores for pre- and post knowledge tests were calculated by summing scores for correct and incorrect responses in true/ false and open-ended questions. To compare pre- and post-test scores, a Wilcoxon signed-rank test was employed due to the paired nature of the data and its violation of normality.

For the CORGIS, the scores for each subscale were computed as the sum value of its items ranked on a scale from 1 to 7. Subsequently, means for each subscale were calculated [5]. A repeated measures ANOVA was used to evaluate if the mean challenge scores differed significantly between the four types of challenge.

6.4 Findings

A Wilcoxon signed-rank test was conducted to compare the pre- and post-play knowledge scores. The results indicated a statistically significant increase in knowledge about safe food storage after playing the game ($Z = -3.564$, $p < .001$). The median number of correct answers increased from 5.0 in the pre-test to 7.0 in the post-test. This significant improvement suggests that playing the tutorial and challenge mode of the game effectively enhanced players' knowledge regarding safe food storage practices.

A repeated measures ANOVA with a Greenhouse-Geisser correction determined that mean challenge scores differed statistically

significantly between the four types of challenge (F(2.407, 50.542) = 71.801, p < .001). The effect size of η^2 = 0.77, indicates that 77% of the variance in perceived challenge can be explained by the four types of challenge. The four challenge subscale means and standard deviations are summarised in Table 1. Our findings Cognitive and emotional challenges were experienced to a lesser degree. Finally, the decision-making challenge was experienced the least. Post-hoc tests with a Bonferroni correction indicate that players experienced performative challenge significantly more than cognitive (p' < .001), emotional (p' < .001), and decision-making (3.20, p < .001) challenges. Participants also faced a cognitive challenge significantly more than a decision-making challenge (p' < .001), but not as an emotional challenge (p' = .173). No significant difference was found between emotional and decision-making challenges (p' = .122). These findings indicate that the player experienced in Alfredo's Kitchen is predominantly characterized by completing tasks accurately and quickly within the given time constraints in the challenge mode. Moreover, players engage in cognitive challenges by understanding, remembering, and applying the learned HACCP principles. Although Alfredo's Kitchen has a light narrative aspect, the primary focus seems to be on learning and applying skills rather than an emotionally driven storyline. We expected that the game would pose a high decision-making challenge to players, as they have to choose the correct food storage and make decisions about keeping or giving back food based on the thermometer. Contrary to our expectations, decision-making challenges were the lowest perceived challenge. This could be attributed to the guidance provided by Alfredo. His explanations seem to have made the learning content easily understandable for players, which might have simplified decision-making processes. Additionally, the game emphasizes performative tasks. As a result, players may have perceived decision-making as much less demanding compared to the time pressure they felt.

	M ± SD
Cognitive Challenge	3.53 ± 0.91
Emotional Challenge	3.10 ± 0.78
Performative Challenge	5.69 ± 1.04
Decision-Making Challenge	2.49 ± 1.06

Table 1: M ± SD of the four components of challenge (N = 22).

Players indicated appreciation for the hands-on learning approach, detailed explanations, and the information provided in the manual. Alfredo's specific instructions fostered player's understanding of food safety. Additionally, the game's scoring system has reinforced players food-storing actions. For future work, participants suggested expanding the scope of food safety topics. Other suggestions include increasing food variety, making the game fully mouse-compatible, and enhancing graphics and text readability; the latter suggestion is emphasized by the fact that players mistook the fridge and the freezer when playing, and that they indicated to have missed certain details while reading the instruction. Some players believed the tutorial could still be clearer, or that the level could incorporate more interactive elements, and realistic scenarios and consequences for mistakes to facilitate a more in-depth learning experience.

7 DISCUSSION

Alfredo's Kitchen introduces a novel methodological approach to HACCP training, which can potentially set a new standard for how food safety education is delivered. Moreover, this study further elucidates the theoretical relationship between perceived challenge and learning in serious games. Specifically, we showed that our game effectively increased knowledge about proper food storage, while players perceived a performative challenge.

Potluck Panic! [13] has a card game format that is less practical for simulating real kitchen environments compared to the scenario-based approach of Alfredo's Kitchen. The approach used here simulates a real-life environment where guidance by professionals is crucial for skill development. Ninja Kitchen's [11] uses a scoring system to provide performance feedback. This approach was effectively adapted for Alfredo's Kitchen, as players acknowledged that it helped them understand and correct mistakes. While SafeConsume [10], NinjaKitchen [11], and Potluck Panic! [13] were designed for children, Alfredo's Kitchen targets future restaurant staff, which is typically an older age group.

While Alfredo's Kitchen shows a promising foundation for gamified HACCP training, it also faces limitations and opportunities for refinement. There may be challenges in transferring skills learned in the game to real-world settings. The simulated environment cannot fully replicate the complexity of an actual kitchen. While we found a knowledge gain through playing the game, we did not assess whether this knowledge translates into actual safe food handling behavior in real life. Thus, we do not know if playing Alfredo's Kitchen effectively improves real-world food safety practices. Players mistook the fridge for the freezer during gameplay, indicating that the visual and instructional clarity of these elements might not be sufficient. Some players reported missing certain details while reading the instructions, suggesting that the tutorial could be clearer and more engaging.

Future studies can focus on comparing learning outcomes between users of Alfredo's Kitchen and those who undergo traditional HACCP training. Additionally, the long-term retention of food safety knowledge and whether it is applied in real-life scenarios should be investigated. The prototype currently includes one level focused on food storage. Additional levels covering other modules of the HACCP training should be implemented. Graphics design should be refined to ensure that the fridge and freezer are visually distinct to players. Finally, the learning texts should be revised to ensure that important details are not missed by players.

8 CONCLUSION

Existing HACCP training relies on video material, but previous research has shown that serious games can provide a more engaging and effective experience. In the current research, we developed and evaluated Alfredo's Kitchen, a serious game for HACCP training aimed at future restaurant staff. Following a user-centered approach, the game has been evaluated by users multiple times throughout its development. The game's final prototype effectively increases knowledge of proper food storage. In addition, we found that player experience is characterized by a performative challenge, which arises from the game requiring quick and accurate actions. Alfredo's Kitchen can potentially set a new standard for how food safety education is delivered.

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A LOW FIDELITY PROTOTYPE EVALUATION: INTERVIEW QUESTIONS

(1) "What did you have to do in the game?"
(2) "Did you understand what you needed to do in the game immediately? If not, what was unclear? If yes, what helped you with understanding?"
(3) "Were the controls intuitive? Were there any controls that felt difficult to use?"
(4) "What was the biggest frustrations you encountered while playing?"
(5) "Was there anything about the design or layout that you found confusing? Or was there anything about the design or layout that you found especially appealing?"
(6) "The goal of this level was to teach correct food storage. Considering the level flow, do you think users learn correct food storage here?"

B HIGH FIDELITY PROTOTYPE EVALUATION: PRE- AND POST-KNOWLEDGE TEST

B.1 Open questions

Instructions for participants:
In the following, you will be asked some questions about food safety. Please answer them by writing full sentences.

You went grocery shopping and you bought some frozen fish to eat later in the week. You plan to drop past a friend's house on the way home. What could go wrong?

What should you do differently?

B.2 True/ false questions

Instructions for participants:
Please indicate whether you think the following statements are true or false.

(1) You are back home from the supermarket and about to unpack your shopping. You bought frozen fish, rice, and cheese. You should put all food items in the cupboard.
(2) You should check the temperature of the fish.
(3) The cheese should not have gotten warmer than 8°C on the way from the supermarket to your fridge.
(4) The safe transport temperature for frozen products, like the fish, is -18 °C or less.
(5) The rice you have bought does not have to be stored in the fridge.

C HIGH FIDELITY PROTOTYPE EVALUATION: DOWNLOAD AND PLAYING INSTRUCTIONS

"Please open the link in a new tab and download the .zip file. Make sure you download the correct version for your operating system. Please do not close your browser. Extract the .zip file.
For Windows: open the x64 folder and click on the "infomsega-game.exe" file to open the game.
For Mac: click on the "MacOS" file to open the game.
For Linux: run the game using the terminal by executing "./infomsega-game.x86_64"
In case you encounter any problems while trying to download or run the game, please contact the person who sent you the link to this survey.
When opening the game, you will first see a start screen. You can start playing the game by clicking on "play". Only level 1 is unlocked. Please play the tutorial and then the challenge of level 1 once each. Return to the start screen. There you can read "about us" and "credits". Finally, end the game by clicking on "quit" and return to this study, which should still be open in your browser. Press continue to finish up the rest of the survey."

D HIGH FIDELITY PROTOTYPE EVALUATION: CORGIS

Instructions for participants:
Please indicate to what extent you agree/disagree with each of the statements you finished playing the game.

Subscales	Items
Cognitive Challenge	CC1. Succeeding in the game required much planning CC2. I had to memorise a lot of different things when playing the game CC3. I had to think several steps ahead when playing the game CC4. I had to prepare for the things that the game threw at me CC5. Playing the game requires great effort CC6. I felt challenged when playing the game CC7. I had lots of different things to think about at once in the game CC8. The game made me manage several tasks at the same time CC9. I had to constantly keep track of what was going on in the game CC10. I had to think actively when playing the game CC11. Playing the game required me to do my best
Emotional Challenge	EC1. This game is more than just a game to me EC2. The things that happened in the game made me sad EC3. I invested much thought into the game EC4. I felt a sense of responsibility for characters and events in the game EC5. The game made me think about real life issues EC6. Playing the game was stimulating EC7. I felt a sense of suspense when playing the game EC8. The game had moral dilemmas in it where the choice was not obvious EC9. The game involved making moral choices that I didn't agree with
Performative Challenge	PC1. I had to react quickly when playing the game PC2. I had to act quickly when playing the game PC3. Thinking fast was an important part of the game PC4. Quickly responding to things that I saw was an important part of the game PC5. I had to make snap decisions when playing the game
Decision Making Challenge	DMC1. There were some decisions in the game that I regretted DMC2. I wonder how different the outcome in the game would be had I chosen a different option DMC3. I had to make difficult choices in the game DMC4. I had to think about possible alternatives for my actions in the game DMC5. The game made me think hard about my decisions

E HIGH FIDELITY PROTOTYPE EVALUATION: OPEN QUESTIONS

(1) Can you describe any specific scenarios in the game that helped reinforce your understanding of food safety?
(2) What improvements would you suggest to make the game better?