

# Design, Development and Evaluation of a Game-Based Learning Application for Room Housekeeping

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**Abstract:** *The transition of practical skills training into a digital format presents distinct challenges and opportunities within the hospitality industry. This study explains the development of an online simulation game specifically crafted to educate hospitality students in room housekeeping. The objective is to seamlessly integrate theoretical knowledge with practical application through a virtual platform that simulates real-life housekeeping scenarios. The methodology was structured into three phases: design, development, and evaluation. In the design phase, the game was tailored to meet educational objectives pertinent to hospitality studies, focusing on essential skills such as attention to detail, customer service, and operational efficiency. The development utilized advanced game engines for rendering realistic 3D environments and interactive gameplay to ensure an engaging user experience. The evaluation phase was particularly significant, involving technology acceptance testing by 40 students from a hospitality and tourism course. This test aimed to evaluate not only the game's educational impact and usability, but also its acceptance among users. Preliminary results from the testing indicated strong engagement and improved learning outcomes among participants. The simulation not only allowed students to practice essential housekeeping skills but also promoted critical thinking and problem-solving within a risk-free environment. The paper concludes with a discussion on potential enhancements such as incorporating adaptive learning algorithms and multiplayer features to support collaborative learning. The scalability of the simulation into other areas of hotel operations is also explored, underscoring its potential as a versatile educational tool in hospitality training.*

**Keywords:** Game-Based Learning, Housekeeping, Simulation, Training

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## 1. Introduction

Simulated hotel room cleaning game refers to simulating hotel room environments in virtual settings to assist in training and educating players on the process of cleaning hotel rooms. This simulation game is typically used for training purposes, helping hotel room service staff become familiar with the procedures for cleaning and maintaining guest rooms or cultivating interest in learning the processes involved in hotel room service (Koelling et al., 2020).

Hospitality students and interested people can only understand what it means to clean a hotel room through imagination before actual learning. The use of simulated hotel room cleaning

games in training and education has been explored in various studies. An author for PROTUR hotel simulator emphasizes the potential of multi-user web applications and computer simulations in the training of hotel staff (Poulova et al., 2022). These tools can provide a realistic and interactive learning experience, allowing users to manipulate elements and create a sense of realism. Through the study, a 3D single player simulated hotel room cleaning game namely as Clean Sweep was developed to educate students major in hospitality management about the skills of cleaning rooms, stimulate student's interests and learn how to allocate time when cleaning a room. Clean Sweep is design for students and staff in hospitality area and people who interest within, mainly for the housekeeping of hotel room. The goal of the game is to allow students to have fun in a virtual environment, increase students' interest in the work of cleaning a room, and deepen understanding of the skills required in real work, including cleaning up trash, making sheets, sorting items, etc. Clean Sweep include time limits gameplay and task scores to the game can make player more stressed and challenged and increase the playability of the game.

## 2. Related Work

Game-based learning (GBL) refers to the incorporation of gaming elements in learning environments to enhance engagement, motivation, and retention among learners. The core principle of GBL is to use the intrinsic entertainment value of games to facilitate learning in a more engaging way. It has been found to be effective in higher education, with factors such as usefulness, perceived intention to use, and architectural design influencing its success (Norhidayah et al., 2020). In a public school setting, GBL has been shown to encourage participation, motivation, and educational inclusion, while also promoting quality learning and reasoning (Pinedo, 2021)

In the hospitality industry, Game-based learning (GBL) is suitable for a dynamic and effective approach to training by integrating gaming mechanics into learning environments (Lin & Hou, 2023). This method is particularly beneficial for enhancing customer service, operational tasks, compliance and safety, and management skills through interactive and engaging simulations. GBL promotes practical skill development by allowing staff to experience real-world scenarios in a risk-free setting, thus improving decision-making, problem-solving, and interpersonal skills essential for the hospitality sector. Moreover, it boosts engagement and motivation among employees, which is crucial given the high turnover rates in the industry. Customizable and scalable, GBL solutions also provide immediate feedback through analytics, helping both employees and managers track progress and identify areas needing improvement. Overall, game-based learning transforms traditional training methods in the hospitality industry, making them more effective and aligned with modern workforce needs, ultimately enhancing both employee performance and customer satisfaction.

### **Benefit of Game-Based Learning (GBL) in Hospitality Industry**

In the context of room housekeeping, game-based learning (GBL) offers specific advantages that enhance the training and efficiency of housekeeping staff. By utilizing interactive simulations, GBL allows player to practice and master various tasks in a virtual environment that replicates actual hotel rooms and scenarios. This method is particularly effective for training on proper cleaning techniques, room setup, time management, and adherence to safety and hygiene standards—all crucial aspects of housekeeping.

The engaging nature of game-based scenarios helps to maintain staff interest and motivation, which can otherwise wane given the repetitive and physically demanding nature of

housekeeping work. For instance, a game might simulate the challenge of cleaning a series of rooms within a certain timeframe while also adhering to specific cleanliness and guest satisfaction standards. This kind of training encourages efficiency and improves quality by providing immediate feedback; housekeepers can see the consequences of missed steps or shortcuts in real-time, fostering a deeper understanding of their work's impact on guest experience.

Moreover, GBL can be customized to address the particular standards of a hotel, ensuring that training is directly applicable to the workplace (Silverina A. Kibat et al., 2022). For example, a luxury hotel might incorporate scenarios that require attention to finer details, while a budget hotel could focus on speed and efficiency. Overall, game-based learning in room housekeeping not only elevates the training process but also directly contributes to higher service quality and enhanced guest satisfaction.

### **Review of Existing Games in Hospitality Industry**

There are several virtual applications that are designed to facilitate training and education in the hospitality industry. These applications share the common goal of enhancing the practical skills of hospitality workers through immersive, interactive experiences that mirror real-world challenges and operations. They offer flexible, scalable training solutions that can be tailored to the specific needs of educational institutions and businesses within the hospitality industry.

**Virtel:** An application by The Hong Kong Polytechnic University is a sophisticated virtual hotel simulation designed to improve hospitality education through immersive e-simulations. This application supports active learning by mimicking real-world hotel scenarios that students might encounter in their professional lives. By engaging with these simulations, students can practice applying their theoretical knowledge in a realistic setting, which enhances their problem-solving and decision-making skills. Additionally, Virtel is versatile, allowing instructors to adapt it to various teaching methods and class settings, thereby broadening its utility in hospitality education. This approach not only prepares students for actual workplace situations but does so in a way that promotes reflection and active participation (Kong et al., 2006).

**Cesim Hospitality:** A comprehensive hotel and restaurant management simulation that allows participants to manage operations of a hotel with an attached restaurant. The simulation includes decision-making in areas such as revenue management, sales promotion, food and beverage, housekeeping, staff management, and procurement. It also incorporates environmental, social, and governance (ESG) factors into the business decisions, allowing teams to integrate sustainable practices into their strategies (*Cesim Oy: Hotel and Restaurant Management Simulation*, 2018).

**Takeleap:** VR training simulations specifically for the hospitality industry, allowing participants to "transport" themselves into realistic hotel environments. This helps trainees to experience the space and amenities of a hotel in a way that traditional media cannot replicate, enhancing their understanding and preparation for real-world hospitality settings (*Takeleap: VR Training Simulations for the Hospitality Industry*, 2024).

**Attensi:** A gamified training solutions for the hospitality industry, leveraging advanced 3D modeling and insights into human behavior. Attensi's solutions are designed to enhance performance across various roles within hospitality, from front of house to management, by

using engaging, realistic scenarios that improve staff retention and service quality (*ATTENSI: Hospitality Training Solutions*, 2024).

### 3. Methodology

The design and development of GBL for room housekeeping is using Agile model. It is a development methodology designed to maintain flexibility and adaptability throughout the development process while involving customers in providing requirements feedback and reviews to ensure faster product project launches and iterations. The Agile model contains multiple iterative cycles, with the goal of developing each function of the project, and the time of each cycle is generally 2 to 4 weeks.

Requirement analysis and design are necessary in the Agile model. The final results of each iteration can be delivered to the client for evaluation and feedback to make necessary changes and modifications and to develop plans for the next iteration. Therefore, developers and customers need to work closely together to better meet customer needs and changes and ensure that the final delivery of products that meet customer expectations and needs. In the Clean Sweep project, the development will follow all phases of the Agile model, including requirements gathering, requirements design, development and testing, deployment and feedback. During each iteration, the Clean Sweep project will focus on completing a set of tasks in each iteration cycle and have weekly discussion meetings with on site user to ensure that the project remains on track.

#### Analysis Phase

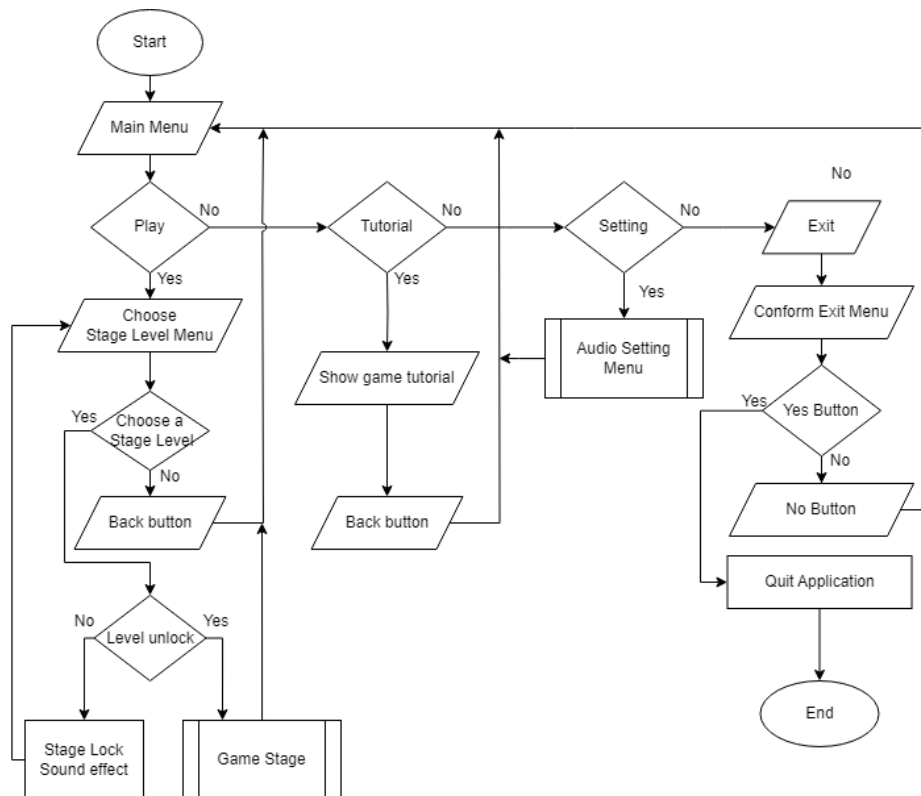
Based on the research for the Standard Operating Procedures (SOP) for cleaning hotel rooms must follow the process starting from entering the guest until ensuring the room close and locked securely (Trinaldo et al., 2022). The analyzing process are according to the hotel room cleaning procedure with comprises crucial steps and techniques to ensure a thorough and efficient cleaning process. Key steps include six (6) steps which are proper inspection and preparation before entering the room, attention to detail while cleaning the room, ensuring all items are in their designated places, prompt replacement of any damaged or stained linens and items, cleaning and disinfection of the bathroom area, systematic dusting and vacuuming to maintain cleanliness and comprehensive room inspection to verify cleanliness and completeness.

#### Design Phase

Analyzing project requirements provide a thorough explanation of the goals that a project must accomplish. It gives a clear knowledge of the project's objectives and the characteristics it should have to meet the needs of stakeholders. Both functional and non-functional requirements are frequently included in project specifications, as well as any constraints or limitations that the project must work within [7]. These project requirements will ensure that Clean Sweep can meets the objectives and scope of the project and provides a useful and engaging learning experience for hospitality students. Specific features and functions was identified to include in Clean Sweep game applications as below:

- a) Clean Sweep should include the information about the to-do task list in each different game level to help the player to find the task objects.
- b) Clean Sweep should include a variety of cleaning tasks, including remove trash, tidying furniture, and cleaning surfaces.
- c) Clean Sweep should include a scoring system to evaluate the player's performance when completing tasks.

- d) Clean Sweep should include a time limit for each level to increase the challenge and difficulty of the game.



**Figure 1: Flow chart of Clean Sweep Games Simulation**

The proposed design for Clean Sweep has the early design and development to complete the project include flowchart, and storyboard. Figure 1 show the flow chart of Clean Sweep game simulation to show overall flow of the games. The flowchart covers the whole function in Clean Sweep such as Main Menu, Game Stage, Game Task and Audio Setting.

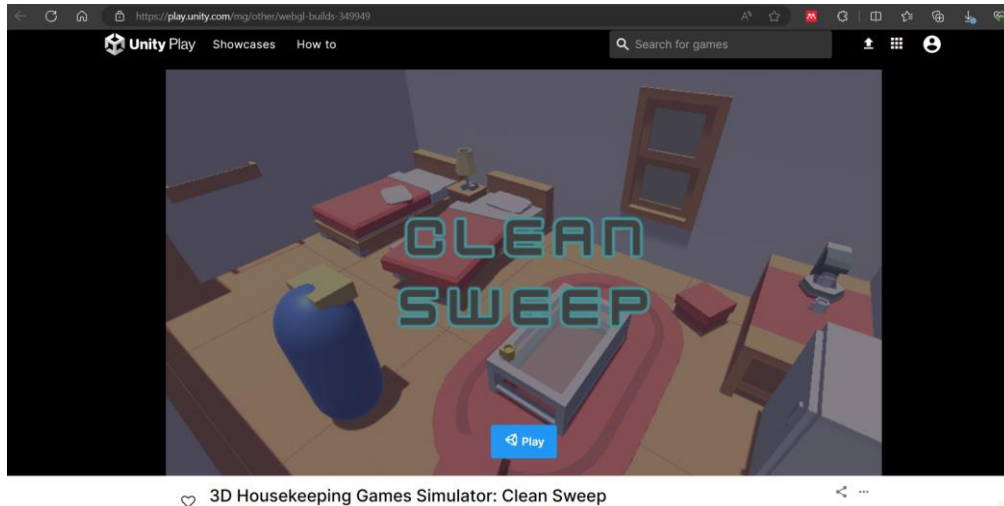
### Development Phase

Clean Sweep is an online 3D Housekeeping Games Simulator design for students and staff in hospitality area and people who interest within, mainly for the housekeeping of hotel room. The goal of the game is to allow students to have fun in a virtual environment, increase students' interest in the work of cleaning a hotel room. Clean Sweep include time limits and scoring system that can make player more stressed and challenged to increase the playability of the game. Clean Sweep contains 6 game stage level, the difficulty of the game levels will gradually increase as the game progresses. Clean Sweep is developed using Unity to create the whole game include build the Web GL file to publish on Unity Play. This game contains of three different tasks, which are tidy, clean and throw.

### Implementation Phase

During the implementation phase, the Game Based Learning project focused on creating a highly detailed simulation of hotel room environments. This included interactive tasks that replicated real housekeeping scenarios commonly found in hotel rooms. These tasks were designed to engage players in hands-on learning experiences, allowing them to practice and master skills relevant to the hospitality industry.

Additionally, educational content was carefully integrated into the game to align with specific learning objectives. This content covered a range of topics such as hygiene standards, room maintenance procedures, guest interactions, and other essential aspects of hotel operations. By combining realistic simulations with educational content, the project aimed to provide an immersive and effective learning experience for participants



**Figure 2: Game Architecture of Clean Sweep**

### Evaluation Phase

the evaluation phase, a Google Form was used to gather feedback from players after they engaged with the games online via Unity WebGL (<https://play.unity.com/mg/other/webgl-builds-349949>). Figure 2 shows the Clean Sweep web application in Unity WebGL platform. The participants primarily consisted of students from the hospitality industry and tourism, with some from other backgrounds but with familiarity in online gaming. In total, 40 participants tested the games and provided valuable insights through both Functional Acceptance Testing (FAT) and User Acceptance Testing (UAT).

### 4. Result and Discussion

According to the process mentioned in methodology process, a final result was produced which covers the game-based learning elements aiming to help students in increasing the knowledge in room housekeeping by using interactive learning through games.

Figure 3 shows overall game architecture of Clean Sweep for a clear understanding of the game, aiming to simulate hotel room cleaning processes and ignite interest in hotel room cleaning skills and knowledge through an engaging and interactive gaming experience. This comprehensive architectural overview encapsulates the essence of Clean Sweep, become a reference for developers, educators, and players alike.

Character and Camera is an important element to control the learning process in Clean Sweep where it helps the player character with combination of the capsule and cube in Unity. Blue capsule as the body and yellow cube be set at the head represents the direction for the player character. Players can determine the direction of player character is facing by the position of the cube head and the camera work will always follow the player character movement in the game scene.

As the imitation of real environment give a real situation of learning, the learning environment which is the hotel room environment specifically design in the games. All the hotel room are design based on single room, twin room, double room, with and without bathroom and small sitting space. There are 6 game stage level include 6 different hotel room, all the room design are related with the task include in the level. The sweeping task will be added in later levels to increase the difficulty.

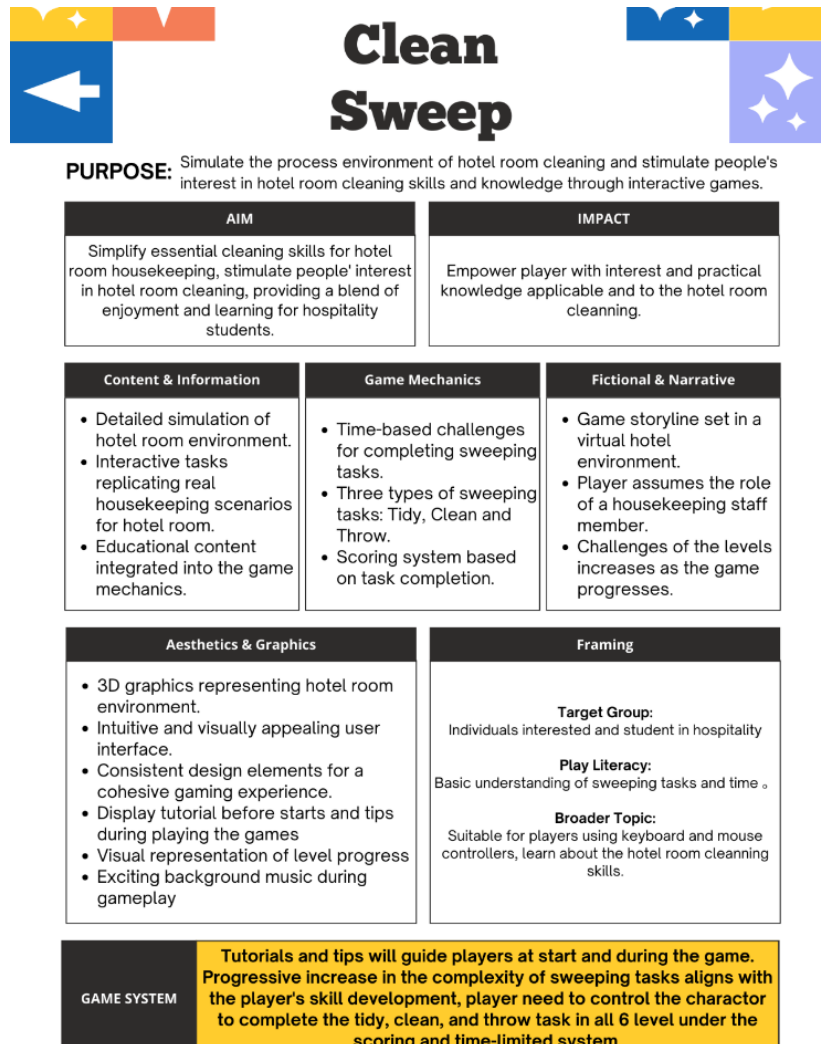


Figure 3: Game Architecture of Clean Sweep

### Module Setup

There are 3 main system modules include in Clean Sweep, there are sweeping tasks system, time limit system and scoring system. There are 6 game stage level and the detail setup include type of room, type of task, task object, player HP, time limit setting and score required to pass the level. Before starting the level, player will start with main user interface as shows in Figure 4. Table 1 shows the description of module setup in clean sweep. The challenge in each level only unlocked if the player completes the task in easy level. Figure 5 shows the interface for the unlocking level for the specific tasks.



Figure 4: Main UI of Clean Sweep

Table 1: Module Setup for Clean Sweep

Game Stage	Module Setup
Level 1	Single room without bathroom, 3 of Tidy Task, 3 of player HP, 20s for time limit, total 30 score required to pass level.
Level 2	Double room without bathroom, 4 of Tidy Task, 1 of Cleaning Task, 3 of player HP, 30s for time limit, total 50 score required to pass level.
Level 3	Single room with bathroom, 2 of Tidy Task, 2 of Cleaning Task, 3 of player HP, 40s for time limit, total 40 score required to pass level.
Level 4	Double room with bathroom and small sitting space, 3 of Tidy Task, 3 of Cleaning Task, 1 of Throw Task, 3 of player HP, 50s for time limit, total 90 score required to pass level.
Level 5	Twin room with bathroom and small sitting space, 5 of Tidy Task, 3 of Cleaning Task, 1 of Throw Task, 3 of player HP, 50s for time limit, total 90 score required to pass level.
Level 6	Double room with bathroom and small sitting space, 7 of Tidy Task, 2 of Cleaning Task, 3 of Throw Task, 3 of player HP, 70s for time limit, total 110 score required to pass level.

### Task Mechanics Design

There are 3 type of the task that include in the different game stage level. Tidy, clean and throw are different type of task that need to be complete by the player. One task will correspond to its own task object. Player needs to get close with the task object when doing the task by press the control key. Table 2 indicate the control key to play the games with specific task to be completed by player.

Table 2: Control Key for Clean Sweep Task

Type of Task	Keyboard Control
Tidy	“R” Key
Clean	“C” Key
Throw	“E” Key





Figure 5: Stage Level on Module

### Time Limit System

Time limit system in Clean Sweep allows players to learn how to complete all tasks within time. The time limit for each game stage level will vary depending on the number and difficulty of tasks in each level. The time limit system includes the player life system. Each level contains 3 life chances as the player's health points (HP). Once the time limit countdown over, player's life will be decrease 1 and the time limit will start again. The game will be over if player cannot complete the task in time and the HP become 0. Player needs to restart the level and complete the task that be able to pass the current level and go to next.

### Scoring System Setup

Players will get the score after completing a task. Completing a task will earn 10 score and display on the UI panel. The number of completed tasks will also be updated on the panel at the same time. The number of tasks in each level will affect the total score that the player can obtain. When all tasks are completed or the countdown ends, the score and the number of completed tasks will be displayed on the menu again. The game level progress will display at the upper right corner at every single level and update after player completed a stage level. Figure 6 shows the arrangement of guidance to player on scoring, task and challenge while playing the games.



Figure 6: Task Mechanics on Professional Practice Evaluation and Discussion

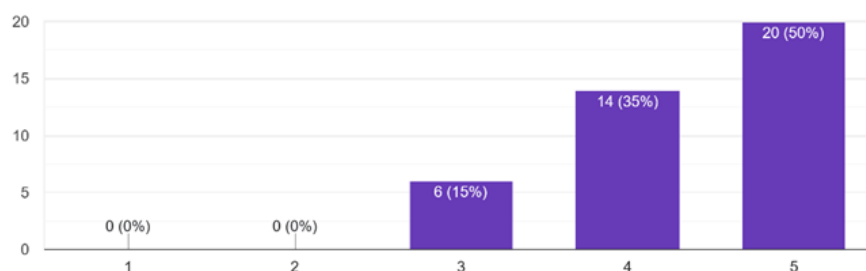
To ensure that the game Clean Sweep functions optimally, a comprehensive testing and validation program will be implemented, focusing primarily on Functional Acceptance Testing (FAT). This method will verify that all game functionalities align with the expected performance criteria. Additionally, Usability Testing was conducted using the User Acceptance Testing (UAT) method by using Technology Acceptance Model (TAM) questionnaire, which will be provided to testers in a feedback form after they complete the game. The evaluation process involves a detailed examination of each functional aspect of Clean Sweep, including core mechanics like player movement, interactions with game mechanics, and scoring systems. The testing will extend to other crucial features such as navigation, game controls, user interfaces, and audio-visual elements. Both FAT and UAT are designed to ensure that all elements work seamlessly together to provide an enjoyable gaming experience. Issues or bugs identified during testing will be meticulously recorded and addressed during the development phase to refine the game.

FAT provides the testing process of the Clean Sweep’s functionality with various test in every different scenario. Before upload and send the Clean Sweep’s game link and feedback form to the tester, developer also double check with the testing table based on the UAT. In Beta phase, a testing program was conducted with several hospitality students and interested people. A set of feedback form were distributed to collect opinions about Clean Sweep. This form is designed to collect feedback from player after playing the game. There will be a google form with demographic information, User Acceptance Testing (UAT), and technology acceptance model (TAM) questionnaire about the Clean Sweep. The player needs to check the status of function and rate the question based on the scale strongly Disagree, disagree, neutral agree, strongly agree. There are 40 players as the tester and the feedback form has been collected by developer with the Google Form.

The result is about the feedback after playing Clean Sweep. This questionnaire consists of 10 questions based on Technology Acceptance Model (TAM), which are:

- a) Question 1 to 3 are Perceived Usefulness (PU). Considering the game's design and content, the degree of alignment between the game and the learning or training objectives. An example of questions related to the stimulation interest in learning and result of PU feedback from user as shows in Figure 7.
- b) Question 4 to 6 are Perceived Ease of Use (PEOU). The ease with which players can navigate the game and understand its mechanics. Figure 8 shows the result collected for PEOU on guidance and tutorials in games.
- c) Question 7 to 10 are Behavioral Intention to Use (ITU). To get individual's intention or willingness to adapt and use a particular technology or system. Figure 9 shows the result collected for ITU on effectiveness of Clean Sweep to motivate the learning in cleaning skills.

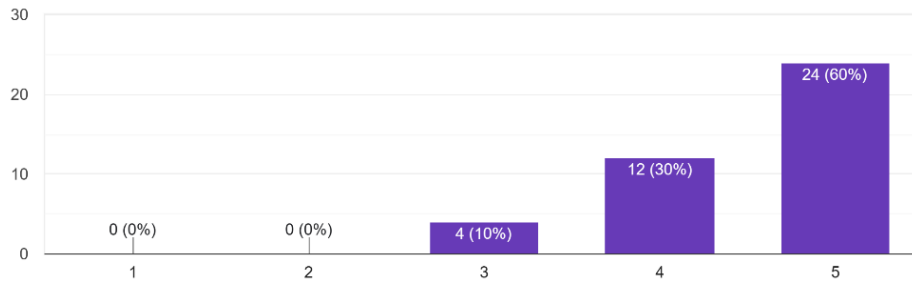
1. Do you think that using this Clean Sweep will stimulate your interest in learning about the knowledge and skill for hotel room cleaning?  
 40 responses



**Figure 7: Result for Perceived Usefulness (PU)**

6. Do you feel that the guidance and tutorials in the game are sufficiently clear and helpful in understanding and applying the required skills?

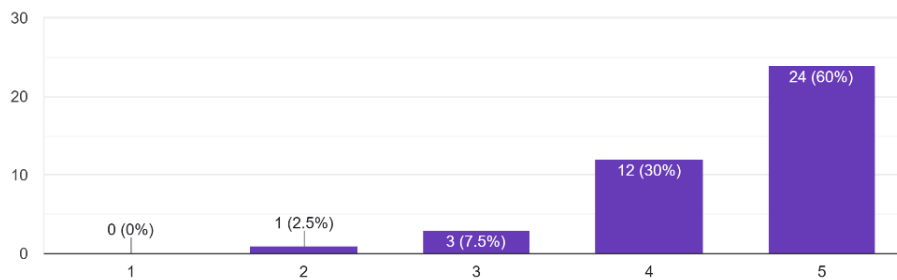
40 responses



**Figure 8: Result for Perceived Ease of Use (PEOU)**

9. Do you believe this game can effectively motivate the learning of cleaning skills?

40 responses



**Figure 9: Result for Behavioral Intention to Use (ITU)**

## 5. Conclusion

In the development of the simulated room housekeeping game Clean Sweep, the primary challenge was designing engaging and educational game mechanics. This involved referencing existing game mechanics used in hotel cleaning simulations while adapting them to suit modern player preferences and ensuring the game's difficulty was appropriately challenging yet feasible. Clean Sweep offers several advantages as a learning tool for hotel room cleaning operations. It is accessible on most devices without the need for game file installation or high-end hardware and is designed to engage players effectively. The game's simple operation allows even those with minimal gaming experience to become proficient quickly, making it a practical educational tool for understanding the intricacies of hotel housekeeping. However, Clean Sweep also presents limitations, such as the requirement for an internet connection, which could restrict access for users without reliable connectivity. Furthermore, while the game provides a basic understanding of room cleaning, it cannot replace the comprehensive learning experience of hands-on training and tutorials in a real-life hospitality setting. Additionally, the absence of a user system to save progress limits the ability to monitor long-term learning outcomes. These challenges underscore the importance of integrating supplementary training methods alongside virtual simulations like Clean Sweep to fully prepare individuals for real-world housekeeping tasks.

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