Chef's Arcade: A Cooking Simulation Game for Beginners with Ideal Portion Sizes for Daily Meals

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ABSTRACT

Cooking is a fundamental life skill, yet many individuals, particularly beginners lack confidence and knowledge in preparing healthy meals with the correct portion sizes. There is also limited awareness regarding what constitutes a balanced daily intake, which can lead to poor eating habits. This project will focus on the design and development of a learning application based on a game that will encourage novices to learn about healthy cooking habits and the idea of optimal daily meal sizes. The project is called Chef's Arcade: A Cooking Simulation Game for Beginners with Ideal Portion Sizes for Daily Meals and is designed to provide an interactive and entertaining platform that will teach people through gameplay. This project was developed using the Agile methodology, which enables the project to be improved in an iterative manner during the design, development, and evaluation stages. The game recreates a cooking setting that has three primary meals that include breakfast, lunch, and dinner that are customized based on the Body Mass Index (BMI) category of the user. Through simple controls and step-by-step instructions, players will have to finish meal preparations according to these categories. The results of pre- and post-test assessments of 35 respondents indicated a significant change in the knowledge, confidence, and awareness of portion control and healthy eating among the participants. The mean percentage score increased from 61.25% to 88.75%, and T-test analysis confirmed statistically significant gains in all areas measured. Future improvements can involve the addition of multiplayer or leaderboard functionalities, culturally diverse recipes, and dietary customisation options, as well as more detailed animations and feedback systems to enhance user engagement and learning effectiveness.

Keywords: cooking simulation game, digital game-based learning, eGameflow model

INTRODUCTION

Digital Game-Based Learning (DGBL) has emerged as a modern instructional approach that integrates digital games into educational environments to enhance learning engagement and outcomes (Triantafyllou, 2023). Unlike traditional teaching methods, DGBL allows learners to acquire knowledge through interactive gameplay, where learning occurs through experience, feedback, and problem-solving activities. This approach has been widely recognized for improving motivation and learner participation, particularly in skill-based education domains (Sousa & Costa, 2018).

Simulation games are a key category within DGBL that replicate real-world environments and scenarios, allowing users to practice decision-making in a risk-free setting (Lukosch et al., 2018). These games are widely used in education because they provide experiential learning opportunities that bridge the gap between theory and practice. In particular, cooking simulation games offer a practical platform for users to develop culinary skills, understand food preparation processes, and improve nutritional awareness (Bista & Garcia-Ruiz, 2021).

However, existing cooking simulation games often prioritize entertainment, time management, and general recipe execution, with limited focus on healthy eating behavior and portion control awareness (Loth, 2023).

This gap highlights the need for a more structured educational approach within cooking simulation environments.

The growing concern regarding unhealthy eating habits and improper portion size awareness further supports the need for educational interventions. Studies have shown that individuals often underestimate food consumption due to portion distortion effects (Schwartz, 2023). As a result, there is a need for interactive learning tools that can visually and practically demonstrate appropriate food portions.

To address these issues, this study proposes Chef's Arcade, a 3D cooking simulation game designed for beginners aged 18–23. The game integrates BMI-based personalization, structured cooking tasks, and educational content focused on healthy eating habits. By combining simulation-based learning with gamification elements, the system aims to enhance user engagement while promoting better dietary awareness (Al Ghawail et al., 2021).

LITERATURE REVIEW

A. Digital Game-based Learning (DGBL)

Digital Game-Based Learning (DGBL) refers to the use of digital games or game-based environments to support educational objectives through interactive learning experiences (Triantafyllou, 2023). This approach enables learners to engage actively with content, improving motivation and knowledge retention compared to traditional instructional methods. DGBL environments often incorporate feedback mechanisms that allow learners to correct mistakes and reinforce understanding during gameplay (Dhiyaneshwar & Dewi, 2023).

DGBL also aligns with constructivist learning theory, where learners build new knowledge based on prior experiences. This makes it particularly suitable for applied learning domains such as science, engineering, and culinary education, where practical engagement is essential for mastery (Sousa & Costa, 2018).

B. Simulation Games in Education

Simulation games are interactive systems that replicate real-world environments, enabling learners to experiment with decision-making in controlled and risk-free settings (Lukosch et al., 2018). These games provide structured feedback that helps users understand the consequences of their actions and improve problem-solving abilities.

Research has shown that simulation games enhance cognitive skills, strategic thinking, and teamwork abilities (Lin et al., 2022). They also help bridge the gap between theoretical knowledge and real-world application, making them highly effective for experiential learning.

C. Computer Simulation Games

Cooking simulation games are a subset of simulation-based learning that focuses on culinary processes such as ingredient preparation, recipe execution, and time management (Bista & Garcia-Ruiz, 2021). These games allow players to experience virtual cooking environments that mimic real-life kitchen scenarios.

Studies show that cooking games can enhance users' understanding of cooking procedures and improve practical culinary skills. However, most existing games focus on entertainment rather than structured nutritional education (Bista & Garcia-Ruiz, 2021).

D. Healthy Eating and Portion Size Awareness

One of the major issues in dietary behavior is the lack of awareness regarding appropriate portion sizes. Research indicates that individuals often consume more food when exposed to larger serving sizes, even without increased hunger levels (Schwartz, 2023). This phenomenon, known as portion distortion, contributes to unhealthy eating habits.

Furthermore, inconsistencies in food labeling and portion size guidelines often lead to confusion among consumers (Loth, 2023). These challenges highlight the importance of educational tools that visually demonstrate correct portion sizes. Simulation-based educational games provide a promising solution by offering interactive representations of meal portions (Lin et al., 2022).

E. Gamification in Learning Systems

Gamification involves the use of game design elements such as points, levels, rewards, and challenges in non-game contexts to increase engagement and motivation (Al Ghawail et al., 2021). In educational systems, gamification enhances learner participation and persistence by providing structured feedback systems.

F. Game Design Frameworks

eGameFlow is a widely used framework for evaluating player experience, focusing on challenge, immersion, feedback, and control (Sweetser & Ozdowska, 2024). In educational simulation games, eGameFlow principles ensure learning objectives are integrated into gameplay experiences. However, some components such as social interaction may be less relevant in single-player simulation environments.

G. Research Gap

Existing cooking simulation games primarily focus on entertainment and general cooking mechanics rather than structured nutritional education. There is also limited integration of BMI-based personalization and portion size awareness (Bista & Garcia-Ruiz, 2021). Therefore, this study proposes Chef's Arcade to address this gap by combining DGBL, gamification, and nutritional education in a 3D simulation environment.

METHODOLOGY

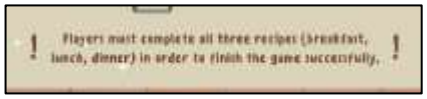
A. The Development

The development of *Chef's Arcade* has implemented eGameFlow model to ensure a balanced and interesting educational experience. This model identifies several of key elements required to establish an environment where players are completely engaged and motivated while playing.

The *Chef's Arcade* approach is designed as a single-player experience which is an educational game but it is also fun and promotes healthy food preparation and mindful eating. The chef and other visual components were made to fit the game's theme and instructional goal, starting with the character development. The environment development comes next, explaining the kitchen scene that stays the same throughout the game but varies in content according to the player's BMI category. Other than that, the design of user interfaces, the organization of gameplay sessions, the use of sound and music to improve immersion, and the scripting logic underlying the interactive features are significant topics covered in the gameplay development section. Furthermore, the use of the e-GameFlow Model, which ensures that the game offers a clear learning path, interesting objectives, instant feedback and general enjoyment, Table 1 presents the implementation of the eGameFlow Model in the development of *Chef's Arcade.*

Table 1 The Implementation based on the eGameFlow Model

Key Element	Description
Concentration 	Players must maintain concentration while performing tasks like meal preparation, cooking, and delivery in the right order. Progress will be slowed by errors like delivering the incorrect items or missing steps.

	
Challenge 	Players need to keep an eye on the food on the stove, react to warnings about burning, and follow recipes exactly. The burning system introduces risk and real-time decision-making by increasing urgency and requiring players to effectively manage several tasks.
Control   	At each station, players decide what to do, when to move, and where to go. Simple keyboard commands (WASD for movement, E for pick/drop/throw, and F for cutting) give the player complete control over the game's pace and flow.
Clear Goals   	To succeed, players must correctly complete all three recipes depending on the session, which is breakfast, lunch, or dinner. Each round of this project has a specific recipe assigned.
Feedback	The player is guided by visual cues such as action animations, burning icons, UI progress bars, and sound effects, which show when they are

 	successful or failing.
Immersion 	The repeated engagement with a well known environment and actions produces a concentrated and immersive experience with the sound and music background even in the absence of realism.

B. The Evaluation

Effectiveness testing has been performed to determine the level of learning and engagement of the users through the game. This method will require the assessment of competence of the players, their performance and understanding of the game before and after the testing. The effectiveness testing will give information on how far the game achieves its intended learning outcomes, for instance; whether the users of the game acquire knowledge on healthy recipes, portions, and cooking skills. It will also determine the level of interaction of the users in the learning process by using the pre and post test.

The evaluation was carried out on individuals between the ages of 18 and 23, representing the primary target age group for this initial iteration of the cooking simulation game. A total of 35 respondents participated in this testing phase, completing both pre and post-tests. While this sample provides an essential baseline for university aged novices, expanding future evaluation phases to encompass a more diverse demographic spanning different age groups and broader cooking skill levels will be necessary to validate generalizability. Moreover, future iterations will expand the evaluation metrics to thoroughly analyze user experience (UX) factors, including game difficulty, interface design usability, accessibility, and player motivation to optimize engagement.

The questionnaire consisted of statements aimed at evaluating two primary areas: the players' knowledge of healthy eating according to BMI categories, and their involvement and experience within the game. Respondents were asked to rate each item on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) based on the questionnaire adapted from Kulshreshth et al. (2012). The original items focused on the game and user feedback, but the revised version was updated to align with the objectives of this research particularly in assessing knowledge of healthy eating based on BMI categories and player involvement during gameplay.

FINDINGS AND DISCUSSION

A. Demography Respondent

A total of 35 respondents participated in the evaluation of *Chef Arcade*. Most participants were aged 22–23 years (71.4%, n = 25), followed by those aged 20–21 years (17.1%, n = 6) and 18–19 years (11.4%, n = 4), representing the game's primary target audience of university students. Female respondents comprised 68.6%

(*n* = 24) of the sample, while 31.4% (*n* = 11) were male. Participants also represented diverse cooking experience levels, with 40.0% (*n* = 14) identifying as beginners, 34.3% (*n* = 12) as intermediate, and 25.7% (*n* = 9) as advanced cooks. Additionally, 65.7% (*n* = 23) reported actively practicing healthier eating or portion control, while 34.3% (*n* = 12) did so occasionally. Overall, the respondents closely matched the intended user group, providing relevant insights into the educational effectiveness of *Chef Arcade*. Table 2 shows the demographic list of the participants.

Table 2 Demography of Participants

Question	Range	Frequency(n)	Percentage(%)
Age	18-19	4	11.4
	20-21	6	17.1
	22-23	25	71.4
Gender	Male	11	31.4
	Female	24	68.6
How would you rate your current cooking skills?	Beginner	14	40
	Intermediate	12	34.3
	Advanced	9	25.7
Are you currently trying to eat healthier or manage portion sizes?	Yes	23	65.7
	No	0	0
	Sometimes	12	34.3

B. Pre-questionnaire

The pre-test results indicated a moderate baseline level of healthy eating knowledge and interest among participants, with an overall mean score of approximately 3.45 on a five-point Likert scale. Respondents reported relatively higher confidence in basic cooking skills (Mean = 3.91) and expressed a positive attitude toward learning about healthy eating (Mean = 3.74). In contrast, lower mean scores were observed for meal planning (Mean = 3.23) and portion size recognition (Mean = 3.26), highlighting these as areas requiring improvement. These findings suggest that while participants possessed foundational cooking knowledge and interest in healthy eating, they had limited confidence in applying practical nutrition skills. The pre-test results therefore support the need for *Chef Arcade* as an educational intervention to strengthen meal planning and portion control competencies. Table 3 shows the Pre-Test evaluation data.

Table 3 Pre-Test Evaluation

No.	Question	SD-1	D-2	N-3	A-4	SA-5	Mean
Q1	I know how to prepare healthy recipes.	2	5	13	9	6	3.34
Q2	I understand what appropriate portion sizes look like.	1	10	9	9	6	3.26
Q3	I feel confident about planning balanced meals.	3	6	13	6	7	3.23

Q4	I can estimate how much food should go into a single serving.	2	9	7	11	6	3.29
Q5	I find learning about nutrition and portion control interesting.	2	5	9	10	9	3.54
Q6	I enjoy learning about healthy eating.	2	2	8	14	9	3.74
Q7	I use healthy cooking techniques in my everyday life.	5	6	10	6	8	3.17
Q8	I know how to measure ingredients and servings when cooking.	3	4	12	6	10	3.46
Q9	I understand what proper portion sizes look like.	0	9	6	11	9	3.57
Q10	I know some basic cooking techniques.	2	1	8	11	13	3.91
	TOTAL MEAN						**3.45**

C. Post-questionnaire

The post-test results demonstrated a significant improvement in participants' knowledge and attitudes after using *Chef Arcade*, with an overall mean score of 4.55, indicating a high level of agreement across all measured items. The highest-rated outcome was participants' understanding of basic cooking techniques (Mean = 4.71), followed by improvements in knowledge of portion sizes (Mean = 4.54), application of cooking techniques in daily life (Mean = 4.46), and enjoyment of the learning process (Mean = 4.60). Compared with the pre-test findings, these results suggest that *Chef Arcade* effectively enhanced participants' practical cooking knowledge, confidence, and awareness of healthy eating and portion control through an engaging, game-based learning experience. Table 4 shows the Post-Test evaluation data.

Table 4 Post-Test Evaluation

No.	Question	SD-1	D-2	N-3	A-4	SA-5	Mean
Q1	The game helped me understand how to prepare healthy recipes.	0	1	3	8	23	4.51
Q2	I learned how to recognize appropriate portion sizes through the game.	0	0	2	12	21	4.54
Q3	I feel more confident about planning balanced meals after playing the game.	0	0	4	12	19	4.43
Q4	I can now better estimate how much food should go into a single serving.	0	0	3	10	22	4.54
Q5	The game made learning about healthy eating fun and engaging.	0	0	2	10	23	4.6
Q6	I enjoyed learning about nutrition and portion control through the game.	0	0	2	11	22	4.57
Q7	I would apply the healthy cooking techniques I	0	0	3	13	19	4.46

	learned in real life.						
Q8	I know how to measure ingredients and servings when cooking.	0	0	1	15	19	4.51
Q9	The visuals and instructions helped me understand proper portion sizes.	0	1	2	7	25	4.6
Q10	I finally know some basic cooking techniques.	0	0	1	8	26	4.71
	TOTAL MEAN						**4.55**

D. T-Test

The paired *t*-test results shown in Table 5 confirmed the effectiveness of the intervention, with all ten measured items showing statistically significant improvements between the pre-test and post-test ($p < 0.05$). The largest gains were observed in participants' understanding of healthy cooking methods, portion sizes, and food quantity estimation, indicating substantial improvements in practical knowledge and the application of healthy eating concepts. Although the smallest improvement was recorded for basic cooking methods, this may reflect participants' prior familiarity with these skills. Overall, the findings demonstrate that the intervention significantly enhanced participants' knowledge, confidence, and healthy eating practices, supporting the educational effectiveness of *Chef Arcade*.

Table 5 Summary of T-Test

Question	Pre-Test Mean	Post-Test Mean	Improvement	p-value	Significant(p<0.05)
Q1	3.34	4.51	+1.17	0.00	Yes
Q2	3.26	4.54	+1.28	0.00	Yes
Q3	3.23	4.43	+1.20	0.00	Yes
Q4	3.29	4.54	+1.25	0.00	Yes
Q5	3.54	4.6	+1.06	0.00	Yes
Q6	3.74	4.57	+0.83	0.00	Yes
Q7	3.17	4.46	+1.29	0.00	Yes
Q8	3.46	4.51	+1.05	0.00	Yes
Q9	3.57	4.6	+1.03	0.00	Yes
Q10	3.91	4.71	+0.80	0.00	Yes

DISCUSSION

The pre-test and post-test assessment results demonstrate a positive improvement in participants' knowledge and confidence after engaging with *Chef's Arcade*. The overall mean score increased from 3.45 (61.25%) in the pre-test to 4.55 (88.75%) in the post-test, representing an improvement of more than 27%. Although both results were classified as "High" based on the rating scale interpretation (Soeprapto et al.,2020) shown in Table 6, the substantial increase in the post-test score indicates that the game enhanced participants' understanding of healthy eating practices, portion control, and practical cooking skills. These findings suggest that *Chef's*

Arcade effectively supported knowledge development and user engagement through an interactive learning experience.

Table 6 Interpretation of the rating scale score

Percentage	Interpretation
0-29	Very Low
30-59	Low
60-89	High
90-100	Very High

CONCLUSION

The *Chef's Arcade* shows strong potential as an effective learning tool. It can be effectively used to encourage novices to learn about healthy cooking habits and the idea of optimal daily meal sizes. The growth rate of more than 27% proves the effectiveness of the game in developing the knowledge, engagement, and practical skills of users regarding healthy cooking and portion control. A few limitations were identified, but the project's key objectives were met. A few constraints were noted which include lack of multiplayer mode, few meals covered, and simplified graphics. These weaknesses highlight valuable opportunities for future enhancement. Future development of *Chef's Arcade* should focus on expanding the gameplay features by incorporating detailed nutritional information, culturally varied recipes, and specialized dietary customization options tailored to users with specific health requirements. Additionally, integrating multiplayer functionalities, leaderboards, and enhanced visual feedback systems remains a priority to boost long-term engagement.

Beyond system upgrades, future research must address current evaluation boundaries by recruiting a larger, more diverse group of participants to systematically measure the game's effectiveness across various age groups and baseline cooking skill levels. Long-term follow-up studies are also recommended to investigate whether players continue to apply these healthy cooking practices and portion control behaviors in their everyday lives post-intervention. Furthermore, evaluating specific user experience (UX) factors such as game difficulty curves, user interface (UI) design, accessibility features, and motivational drivers will provide crucial insights for improving user retention. Finally, conducting comparative studies between this simulation game and traditional cooking education methods will yield stronger, empirical evidence of its unique pedagogical and learning benefits. In conclusion, *Chef's Arcade* is a promising game-based learning tool that can be further improved to increase its effect and the number of people it reaches.

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AI Usage Declaration

The researchers declared the use of AI Tools in this manuscript to check for grammar and paraphrasing. The AI results are not used directly and are under human supervision for error checking.

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