Development of an Educational Farming Simulation Game to Raise Awareness of the Food Crisis

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Abstract. The global food crisis highlights the urgent need for innovative educational tools to raise awareness of sustainable agriculture and food security. Many existing farming games focus on mechanized processes or farm expansion, providing limited educational value regarding traditional farming practices. This study introduces *Sowterra*, a 3D third-person farming simulation designed to educate students through traditional farming methods and mission-based gameplay. Developed with the GDLC methodology and Unreal Engine 5.5, the game was evaluated using the MEEGA+ framework with 26 participants. Results showed moderate effectiveness in learnability, operability, and aesthetics (mean scores 2.00–2.99), with strong validity (r = .75–.91) and reliability (α = .713–.756). Paired t-tests revealed no significant differences between experienced and new players ($p > 0.05$), suggesting consistent user experience but limited measurable learning gains. Two indicators were excluded due to insufficient validity. These findings indicate that while *Sowterra* addresses gaps in traditional farming education and engages players, further improvements in realistic farming processes, adaptive tutorials, and assessment tools are needed to enhance its educational impact.

1 Introduction

Food supply is one of the most essential needs for human survival. However, the world is currently facing a severe global food crisis. The current global food supply is insufficient to the people needs to live in prosperity [1]. Nowadays, more than 150 million people in every parts of Africa live without food and struggled to survive, many of them are in danger of dying. This situation has been exacerbated by extreme weather conditions such as prolonged droughts, heavy rainfall, and unpredictable climate patterns, all of which have led to increased food prices and severe living conditions [2].

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Furthermore, many countries suffer from hunger because of the global food crisis, including parts of Kenya, Somalia, Ethiopia, Nigeria, Gaza, Sudan, Haiti, Mali, and so on [3]. A number of causes, such as supply chain interruptions, political instability, climate change, conflicts, have made the situation getting worse day by day. Food production and consumption are out of balance, which has resulted in widespread hunger, malnutrition, and a decline in overall public health [1], [4]. To address these challenges, it is crucial to promote sustainable agricultural practices and adopt technological innovations in farming [5]. Thus, educating the public using interactive media, such as farming simulation games, raises awareness of food problems and can greatly influence public perception and encourage proactive solutions.

The global food crisis poses significant barriers to achieving SDG 2 (Zero Hunger), which aspires to ensure food availability, improve nutritional standards, and promote environmentally sustainable agricultural practices. At the same time, it demands a fundamental restructuring of consumption and production patterns as outlined in SDG 12 (Responsible Consumption and Production) [6]. Furthermore, the issue is closely related to SDG 13 (Climate Action), which emphasizes the need to address the impact of climate change on agricultural productivity and food security [7].

The creation of this game is expected to serve as an educational medium that helps people— especially those unfamiliar with agriculture—better understand sustainable farming practices and their role in overcoming the global food crisis.

According to earlier research, serious agricultural games can be used to raise awareness of the value of agriculture. There has been adequate on gamification in farming simulation games. Games like *Stardew Valley*, *Harvest Moon*, and *Hay Day*, have shown how interactive media can be used to teach resource management and farming concepts. However, most of these games focus primarily on farm expansion or productivity growth, often utilizing modernized agricultural tools, while providing limited educational explanations about real-world farming utilizing traditional tools, and the importance of agricultural knowledge for young people [8]. This indicates a gap in integrating agricultural education with interactive and gamified learning experiences.

To address this gap [8], this paper introduces the *Sowterra* game that created specifically for this paper aims to raise awareness of the importance of food security to prevent food crises, designed to educate school-age children—ranging from elementary to high school students to college students. The creation of this game is expected to serve as an educational medium that helps people—especially those unfamiliar with agriculture—better understand sustainable farming practices and their role in overcoming the global food crisis.

Furthermore, players experience evaluation by using quantitative method was able to used for comparison between related game and *Sowterra* game. This study uses a players experience evaluation method to measure players satisfaction and determine whether the 3D farming simulation game significantly encourages home-based farming practices [9].

This research approach helps schoolchild and college students to engage in actual farming. As a result, they will indirectly have a good influence and be able to convince their closest friends and family to take up farming after playing this game. Although not all players's may be able to apply what they have learned in the game to real life, raising awareness at a young age can still contribute to preventing future food crises by fostering a deeper attention to agriculture.

The research is introduced in Chapter 1; prior research and games are explained in Chapter 2; the research method in this study presented in Chapter 3; the results and

discussion of the study are presented in Chapter 4; and the research's conclusion is presented in Chapter 5.

2 Literature Review

The global food crisis has been growing concern, affecting millions of people worldwide due to various factors such as climate change, political instability, conflicts, and economic downturns [1]. Based on recent studies, food insecurity is becaming a crucial issue and indicates the limited supply food because of the population growth, which increasing the level of food insecurity [10].

Technological advancements have significantly contributed to agricultural education by providing interactive and engaging learning methods. In this modern era, farmers can easily access social media for gathering all the trend information, such as cultivation techniques, effective types of fertilizer, and also the market price for agriculture [11].

The global food crisis challenges the achievement of SDG 2 and SDG 12, particularly in food security and sustainable agriculture [12]. This study extends prior work [12] by introducing *Sowterra*, a 3D simulation game to raise awareness among non-experts in agriculture. Hence, the digital platform plays an important role in agriculture, a digital education utilizing gamification in farming simulation games will also be helpful for children to raise awareness of the food crisis cases [13].

a. Related Gamification

Gamification in farming simulation games has been widely explored. Games such as *Stardew Valley* and *Harvest Moon* have demonstrated the potential of interactive media in teaching farming principles and resource management. Mission-based gameplay in farming simulations provides structured learning experiences where players engage in tasks such as planting, watering, and harvesting crops. By integrating goal-oriented missions and reward systems, these games encourage players to develop strategic decision-making and collaboration skills [14].

Several studies and commercial games have implemented realistic farming simulation gamification. For example, *Farming Simulator 2013* and *Farming Simulator 25*, both developed by GIANTS Software, as well as *Farmer Tractor 3D Farmer Game* by Game Spirit, primarily showcase modernized farming processes using advanced machinery such as loaders, tractors, cultivators, and trucks. These games highlight large-scale, technology-driven agriculture, which does not accurately represent rural communities that still rely on traditional and manual farming methods [15].

The *Sowterra* game successfully serves as an educational medium that introduces players of various ages and backgrounds to the importance of agriculture and food security. By focusing on the use of traditional farming tools and practices, the game allows players—especially those from non-agricultural or urban environments—to experience realistic and accessible farming activities [15]. This approach helps bridge the knowledge gap between modern society and traditional agricultural understanding, making it easier for students and the general public to appreciate the value of farming as a fundamental human activity.

However, despite its educational benefits, *Sowterra* game still has several limitations. The game currently focuses on the basic processes of planting and harvesting, while more advanced agricultural stages—such as seedling preparation, grafting, fertilization, and crop maintenance— are not yet implemented. As a result, the simulation remains simplified and does not fully represent the complete agricultural cycle. While this simplicity makes the

game easier to play and understand, it also limits its potential as a comprehensive agricultural learning tool. Future development could address these aspects by integrating more detailed stages of farming, thereby enhancing both realism and the depth of learning outcomes.

Additionally, a related study titled "Farming Simulation Game for Sufficient Economy Theory Learning in Thailand" [8] developed a resource management–based game emphasizing farm expansion and income generation. Building on these findings, *Sowterra* game also includes mission-based tasks that require players to collect specific harvest quantities to earn in-game currency represented in Indonesian Rupiah. This feature mirrors real-world farming goals of
maximizing yield for financial stability, continuing the educational approach of previous studies while maintaining accessibility through traditional farming methods.

b. Impact of Farming Simulation Game for Society

Learning agriculture can be challenging, especially for beginners with little exposure to farming. Farming simulation games offer a practical solution by visualizing agricultural processes in an engaging and interactive way for both children and adults. Previous studies have demonstrated that serious games related to agriculture are effective in fostering early awareness of farming and food production. However, many of these games primarily emphasize automated farming processes, including activities like crop harvesting and managing livestock, which may limit players's understanding of the manual and traditional techniques still practiced in rural areas.

In contrast, *Sowterra* game emphasizes traditional agricultural methods, making it accessible to players from various educational and social backgrounds. This approach strengthens the educational impact by showing that sustainable farming does not always require modern technology. Nevertheless, because the game simplifies certain processes, such as seedling preparation and fertilization, its learning scope remains limited compared to real agricultural complexity.

Despite this limitation, *Sowterra* game contributes positively to public agricultural literacy. Through interactive and mission-based gameplay that mirrors real-world farming cycles, it encourages children, adolescents, and adults to appreciate the importance of food production and sustainable practices. By integrating these principles into a 3D learning environment, the game supports long-term agricultural awareness and helps reduce the knowledge gap between urban communities and real farming practices

c. Research Gap And Objectives

Although previous studies have explored the effectiveness of gamification in education, limited attention has been given to the use of farming simulation games to directly address food security and encourage real-life engagement in agriculture. Many existing agricultural games primarily focus on farm expansion and level progression [8], often employing top-down perspectives and modern machinery. Consequently, these games fail to represent the authentic farming experiences of rural communities that rely on traditional tools and manual methods.

To bridge this gap, this study introduces the *Sowterra* game, a 3D third-person farming simulation that emphasizes traditional agricultural practices. The game aims not only to educate young players about farming but also to encourage family involvement in agricultural learning. Through mission-based gameplay, players are tasked with completing specific objectives—such as harvesting 40 bok choy, 50 red chilies, and 60 carrots—to

earn rewards in the form of Indonesian Rupiah, allowing them to understand the concept of income from crop yields.

By integrating a structured mission system and in-game educational content, this research contributes to the development of interactive agricultural learning tools and raises awareness of sustainable food security. Therefore, *Sowterra* game is designed to serve as an engaging medium that fosters public interest in farming and promotes sustainable agricultural practices.

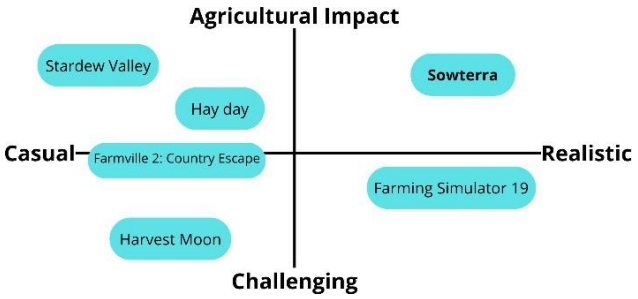

Fig.1. Perceptual Map Games.

From Figure 1, it can be observed that most farm-based games fall under the casual game category, focusing primarily on entertainment rather than delivering a realistic representation of agricultural practices or highlighting their societal impact. In contrast, the proposed game integrates both realistic simulation and educational elements to emphasize the importance of agriculture and its relevance to society.

3 Research method

a. Development Method

This study follows the Game Development Life Cycle (GDLC) method, which consists of six phases: initiation, pre-production, production, alpha, beta, and release.

During the initiation phase, the author decided to develop a 3D third-person farming simulation game without relying on modern machinery. The core mechanics and art style were conceptualized, adopting a stylized visual design for in-game assets. In the pre-production phase, a Game Design Document (GDD) was created, and essential assets, such as 3D characters, crops, farming tools, and environments, were prepared. Most 3D objects were modeled from scratch, while some were sourced from royalty-free platforms (see GDD for full attribution details).

The 3D model for the game was performed using Blender, while textures were created with Adobe Substance 3D Painter. Character models and textures were sourced from Sketchfab.com, contributed by BoredStephan. Environmental assets were obtained from multiple creators, including Stylized Rocks, Stylized Nature Pack, and Low Poly Nature: Essentials. Character rigging and animations were implemented using Mixamo.com. Sound effects were sourced from Pixabay.com, and landscape materials were obtained from AmbientCG.com.

In the production phase, Unreal Engine 5.5 was used to implement core mechanics such as planting, watering, harvesting, and players hydration management. The alpha phase

involved internal testing to identify bugs and ensure functionality of all features. During the beta phase, user experience surveys were conducted. Finally, in the release phase, improvements based on feedback were applied before distribution.

b. Evaluation method

i. Participant

The study involved 26 participants aged below 18 and 18–25, with diverse backgrounds. Participants included computer science students majoring in game development at Bina Nusantara University and individuals who had experience playing or observing farming simulation games (e.g., *Stardew Valley*, *Harvest Moon*), ensuring familiarity with gameplay. The sample size was selected to provide meaningful insights into user experience while remaining manageable for controlled evaluation.

ii. Procedure

Participants first completed a pre-test questionnaire to assess prior knowledge and familiarity with farming games. They then played *Sowterra* game, which focuses on educational agricultural tasks. After gameplay, participants completed a post-test questionnaire developed by the author. Results from both questionnaires were analyzed to determine the educational and experiential impact of *Sowterra* game. Ethical considerations, including informed consent and voluntary participation, were observed to ensure participant safety and data confidentiality.

iii. Questionnaire

Evaluation employed the MEEGA+ model (Model for the Evaluation of Educational Games and Gamification) developed by Petri et al. This model was selected for its focus on assessing usability and user experience, which are critical to ensure that the game is engaging and effective as a learning tool.

MEEGA+ assesses educational games across three dimensions: learnability, which refers to the ease of learning; operability, which refers to the ease of use; and aesthetics, which refers to the visual appeal. Responses were measured using a 5-point Likert scale, interpreted as very good (4.00–5.00), good (3.00–3.99), moderate (2.00–2.99), bad (1.50–1.99), and very bad (1.00–1.49).

Reverse scoring was applied to negatively worded items to maintain consistency.

Table 1. Variables and Questions

Variables	Code	Question
Learnability	LEA-01	I think this farming-themed game is easy to understand even without prior experience.
	LEA-02	How easy is your understanding of the agricultural system in a simulation medium?

		LEA-03	I understand how farming games teach about human sustainability through in-game resource management and income from harvests obtained at real market prices.
	LEA-04		In your opinion, how important is the presence of tutorials in learning agricultural concepts through simulation?
Operability	OPR-01		Do you sometimes find it a bit difficult when you first use the controls in a farming game?
	OPR-02		Do you feel that a particular feature is less accessible or technically problematic?
	OPR-03		I expect all game features to run smoothly without bugs or technical problems.
Aesthetics	AES-01		Are there any aspects of visual design that you feel are less supportive of understanding agricultural processes?
	AES-02		Are you having trouble following the farming mechanics through the user interface?

4 Result and discussion

a. Application Result

Fig. 2. *Sowterra* main menu

Fig. 3. Initial spawn point

Fig. 4. *Sowterra* guidance for players

Figure 2 presents the *Sowterra* main menu. If the players click the "Play" button, then the game will play. Then, "Settings" button is where players can change the background music and sound effect that will be played in *Sowterra* game. If the players click the "Quit" button, it will closes the game.

Figure 3 illustrates the initial spawn point and mission objectives provided to the players in the *Sowterra* game. In this phase, the players can also collect seed packages that have been placed inside the house.

Figure 4 illustrates the guidance stage in the *Sowterra* game, which functions as a

brief tutorial to help players understand the basic farming mechanics. In this stage, instructional prompts guide the players through essential activities such as planting, watering, and harvesting crops. This feature is designed to support players, particularly beginners, in learning the farming process within the game environment before progressing to more complex tasks.

Fig. 5(a). Seed packages can be found inside the house

Fig. 5(b). Seed packages can be found inside the warehouse

Fig. 5(c). The first step is to hold the shovel first

Fig. 5(d). The second step is to plant the seeds

Figure 5(a)–(d) illustrate the planting process, where players collect seed packages that can be found on the ground, inside the house, or in the warehouse. Players equip the shovel by pressing the “F” key and plant seeds on designated farm tiles using the “Q” key, while switching seed types with the mouse scroll and maintaining a limit of ten seeds per inventory.

This interactive process encourages players to actively engage with agricultural mechanics and understand the sequential nature of farming—from preparation to planting. By simulating real-world farming steps in an accessible manner, the game reinforces procedural learning and promotes player engagement through hands-on interaction and task-based challenges.

Fig. 6(a). The third step is to hold the watering can.

Fig. 6(b). The fourth step to watering and giving fertilizer for plants

Figure 6(a) and Figure 6(b) present the third and fourth steps of the farming process, which involve using the watering can and fertilizing the plants. Figure 6(a) shows the third step, where players must equip the watering can by pressing the “F” key before watering the plants. Figure 6(b) illustrates the fourth step, where players water and fertilize the crops by pressing the “B” key. This stage reflects the real agricultural principle that plants require both water and nutrients to grow properly, helping players understand the importance of consistent care in the cultivation process.

Fig. 7. Failed plants

Figure 7 shows failed plants, simulating real-life conditions where crops may be damaged by disease, bad weather, or pests. In this phase, the plants darken and disappear after a few seconds, reflecting crop failure.

Fig. 8(a). The fifth step is to hold the storage box

Fig. 8(b). The final step is to harvest the crops

Figure 8(a) and Figure 8(b) illustrate the final stages of the harvesting process. Figure 8(a) represents the fifth step, where the player holds the storage box by pressing the "F" key. Figure 8(b) shows the final step, in which the player collects crops by walking over them, triggering automatic pickup. The number of crops obtained from each tile varies

randomly between one and five, allowing players to experience different yields per harvest. This variability reflects real agricultural conditions, where harvest quantities may differ due to natural factors.

To enhance gameplay engagement, a future feature is. planned to include fruit-picking mechanics, where each fruit will have several variants that can be sold at higher prices in the in- game market. This addition aims to provide players with a more dynamic and rewarding farming experience while reinforcing economic aspects of agricultural learning.

Fig. 9. Mission completion for each quest

Fig. 10. Players hydration challenge

Figure 9 shows the completion of each mission, indicated by a green check mark. Figure 10 illustrates the player's hydration bar located at the bottom left of the screen. Players must manage their hydration levels while farming, as falling below 20% prevents sprinting and slows movement. This mechanic encourages players to balance productivity with physical endurance, creating a more engaging and challenging experience similar to survival games. It also fosters environmental awareness by emphasizing the importance of water and climate conditions in agricultural activities, supporting SDG 13 (Climate Action). In future development, a dynamic weather system is planned to enhance realism and further immerse players in real-life farming challenges.

Fig. 11(a). Screenshot of all quests completed

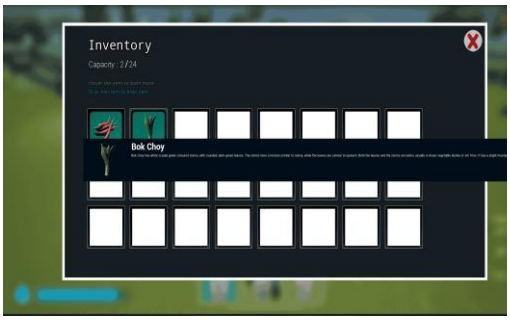

Fig. 11(b). Plant information displayed in the player's inventory

Fig. 11(c). Screenshot of the Game Over stage

Fig. 11(d). Pause menu

Figure 11(a) shows the completed mission screen, where players can view their earnings from harvests. For example, bok choy sells for Rp3,000, red chili for Rp1,000, and carrot for Rp1,250. A total harvest of 40 bok choy, 50 red chili, and 60 carrots yields approximately Rp245,000, with bonus rewards granted for exceeding targets. Clicking the "Main Menu" button returns the player to the main menu. This feature allows players to learn about real-world crop prices using Indonesian Rupiah as the in-game currency, helping them better understand the economic aspects of agriculture.

Figure 11(b) displays the plant information screen within the player's inventory. Players can collect variant plant items that drop on the ground by pressing the "E" key, after which the item is stored in the inventory. The inventory can be accessed by pressing the "I" key. By hovering over an item, players can view the plant's name, description, and image. Through this feature, players can learn about various crops and their characteristics. Future development will include additional educational content, such as information on where each crop can be cultivated, its planting process, and proper maintenance methods.

Figure 11(c) shows the Game Over screen that appears when the player's hydration level reaches 0%. The game then automatically returns to the main menu.

Figure 11(d) presents the pause menu of *Sowterra* game. Selecting "Resume" continues gameplay, while clicking "Audio" opens the audio settings, which include background music (BGM) and sound effects (SFX) options. Choosing "Main Menu" redirects players to the main menu (see Figure 2), and selecting "Quit" closes the game immediately.

As the game is still under development, the missions currently remain static, resulting in each player receiving the same outcomes. This limited variation may lead to reduced engagement over time, as players could quickly lose interest due to repetitive gameplay. In future development, the game is planned to include more challenging elements, where players must overcome various obstacles to achieve successful harvests. A trading feature will also be considered to allow players to buy and sell goods for a more dynamic gameplay experience. Through these features, players will gain an understanding of what it feels like to engage in farming while maintaining sustainable agricultural practices and supporting long-term food security.

1.1 Validation & Reliability Test

This study assessed the validity and reliability of an instrument measuring user perceptions of *Sowterra* game. Participants first completed a questionnaire consisting of three variables (see Table 1) related to their prior experience with Similar Farming Games (SFG). They were then asked to play *Sowterra* (SOW) game to gain firsthand experience with the game. After completing the gameplay session, participants filled out a second questionnaire evaluating their experience with *Sowterra*. The responses were analyzed using mean, standard deviation (SD), and correlation coefficients based on Pearson's R (r) (see Table 2).

The instrument for the SFG group demonstrated strong and significant correlations, with Pearson's R values ranging from .75 to .91 ($r \geq .75$), and showed high internal consistency, as indicated by Cronbach's Alpha values ranging from .713 to .756 ($\alpha \geq .713$).

However, the LEA-01 and OPR-03 indicators were excluded from subsequent analyses because both items did not meet the validity criterion ($r < .70$) and demonstrated low reliability ($\alpha < .70$).

Table 2. Descriptive Statistics

Code	Group	Mean		SD		r
LEA-02	SFG	2.8	2.765	1.27	1.23	0.84
	SOW	2.73		1.19		0.84
LEA-03	SFG	3.19	2.94	1	1.05	0.75
	SOW	2.69		1.09		0.74
LEA-04	SFG	2.69	2.44	1.52	1.47	0.87
	SOW	2.19		1.41		0.89
OPR-01	SFG	2.77	2.845	1.27	1.2	0.91
	SOW	2.92		1.13		0.95
OPR-02	SFG	2.42	2.46	1.03	1.1	0.86
	SOW	2.5		1.17		0.95
AES-01	SFG	2.38	2.65	1.13	1.13	0.86
	SOW	2.92		1.13		0.83
AES-02	SFG	2.61	2.67	1.36	1.22	0.91
	SOW	2.73		1.08		0.81

b. Results

Based on the evaluation results, most aspects were rated within the moderate category (2.00– 2.99), indicating that while the game provides a functional and engaging experience, several areas require refinement to enhance its educational impact and user engagement. This suggests that *Sowterra* game has successfully introduced core farming mechanics but needs further improvement in interactive feedback and learning reinforcement to strengthen its role as an educational medium.

The game employs a third-person perspective, which is rarely used in 3D farming games. Combined with its appealing visuals and user-friendly controls, this perspective enhanced the game's ratings in both operability and aesthetics, making it more attractive to players. Its simple mechanics and visually engaging design also encouraged players to stay invested and enjoy the experience until they completed the game.

Two indicators, LEA-01 and OPR-03, were excluded from interpretation because they did not meet the validity and reliability thresholds ($r < .70$ and $\alpha < .70$), reflecting limited measurement accuracy. Moreover, the presence of a ceiling effect in these items—indicated by low response variability—suggests that participants may have found the related learning tasks too easy or insufficiently differentiated. These findings highlight the importance of refining game-based learning elements to ensure balanced challenge levels and stronger alignment with learning objectives.

Table 3. Summary of normality using t-test (paired)

Group			Descriptive Statistics				Test Statistics		
Outcome	Predictor	Group	n	Mean	Standard Deviation	Mean Difference	df	t	p
Learnability (LEA)	Factor	SFG	26	8.692	3.427	1.077	25	1.231	0.23
		SOW		7.615	3.06				
Operability (OPR)		SFG	26	5.192	2.04	0.231	25	-0.448	0.658
		SOW		5.423	2.194				
Aesthetics (AES)		SFG	26	5	2.209	0.654	25	-1.498	0.147
		SOW		5.654	1.81				

Based on the Shapiro-Wilk normality test as listed in Table 3, all three variables (LEA with p
= 0.23, OPR with p = 0.658, and AES with p = 0.147) were normally distributed, as all p-values were above 0.05 ($p > 0.05$). Therefore, it was appropriate to use the paired sample t-test, which showed no statistically significant differences across these variables ($p > 0.05$).

In the Learnability (LEA) variable, the results showed no significant difference between the SFG (control group) and SOW (experimental group) scores p = 0.23. This indicates that the participants background or prior exposure to farming games did not significantly influence their learning gains as measured through the *Sowterra* game. Similarly, in the Operability (OPR) and Aesthetics (AES) variable, the results also showed no significant improvement, with p = 0.658 and p = 0.147 respectively (See Table 3). This suggests that while the game provided moderate engagement and educational value, it may not have been sufficient to produce measurable learning outcomes, possibly due to factors such as ambiguous item phrasing or limited intervention duration.

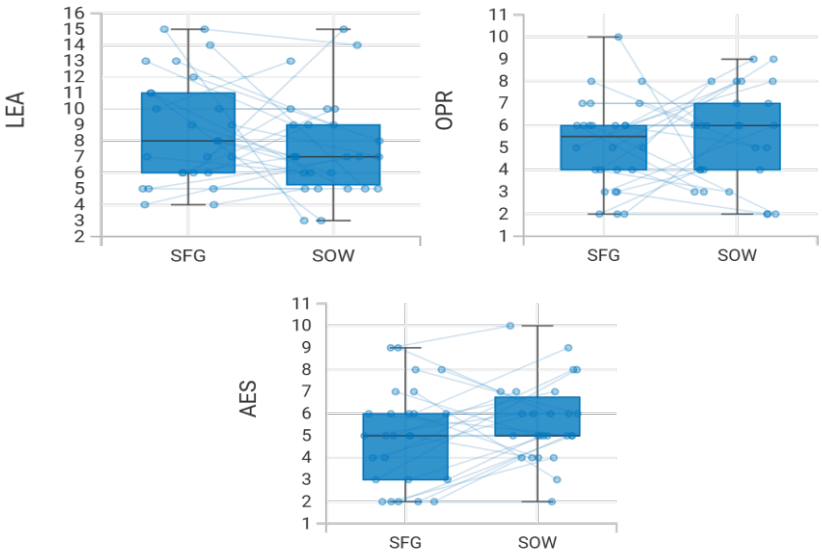

Fig. 12. Results of three variables comparing the control group (SFG – Similar Farming Game) and the experimental group (SOW – Sowterra Game).

Enhancements to the moderate-scoring elements are essential for maximizing user engagement and achieving the intended learning outcomes of the farming simulation, while maintaining the game existing strengths in comprehensibility and technical stability. Future research should refine the questionnaire items to more accurately measure user's understanding of agricultural concepts and sustainable practices acquired through gameplay.

As shown in Figure 12, the comparative analysis between the control group (Similar Farming Game – SFG) and the experimental group (*Sowterra* – SOW) indicates that *Sowterra* demonstrates relatively higher median values in operability (OPR) and aesthetics (AES), suggesting that players found the game visually appealing and intuitive to navigate. However, learnability (LEA) scores were slightly lower compared to the control group, implying that some players required additional guidance or more explicit in-game tutorials to fully grasp the farming mechanics. This outcome aligns with the earlier findings that *Sowterra* game, while engaging, still needs improved instructional design to enhance its educational impact.

Overall, the results reflect that *Sowterra* effectively fosters engagement and aesthetic appreciation but should incorporate more adaptive learning cues and progressive mission structures to better support learning retention and player motivation.

5 Conclusions

This study introduces *Sowterra*, a 3D third-person farming simulation game designed to raise awareness of food security and sustainable agriculture among youth. Developed with Unreal Engine 5.5 using the GDLC methodology and evaluated with 26 participants via

MEEGA+, the game showed moderate effectiveness in learnability, operability, and aesthetics (mean scores 2.00–2.99/5). No significant differences were found between experienced and new farming game players, indicating consistent user experience but limited measurable learning gains.

The game emphasizes traditional farming, mission-based harvests, and economic rewards in Rupiah, teaching procedural farming, risk management, and agricultural literacy. It aligns with SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

Limitations include simplified farming processes, static missions, a small homogeneous sample, and exclusion of two indicators due to low validity. The study did not assess real-world impact on attitudes or behavior.

Future improvements should include adaptive tutorials, full farming cycles, dynamic missions, realistic economic systems, integrated educational content, and technical upgrades such as mobile support, multilingual options, accessibility features, and dynamic weather.

Sowterra game demonstrates that engaging gameplay alone is insufficient for learning, explicit educational design is necessary to ensure game mechanics effectively support sustainable agriculture education and food system awareness.

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Open Data :

The authors affirm their commitment to data transparency and openness. To support future research efforts, the data utilized in this study has been made publicly accessible. It can be accessed through the following links:
Open Data

Funding:

This research project is funded by Bina Nusantara University (BINUS University)

Author Contribution:

Brillian Braydent : Author, Conceptualization, Software, Visualization, Data curation, Formal analysis, Investigation, Writing—original draft preparation.
Muhamad Fajar : Co-author, Supervision, Writing—review and editing, Funding acquisition.

Declaration of generative AI and AI-assisted technologies in the writing process:

The author used ChatGPT, Claude.ai, and QuillBot for paraphrasing assistance. The final content was reviewed and edited, and the authors take full responsibility for the publication.