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**Enhancing Sustainable Fashion Awareness
through A Game Skin Acquisition Model**

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Enhancing Sustainable Fashion Awareness through A Game Skin Acquisition Model

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ABSTRACT

This study explores the unique potential of gaming to raise awareness about the environmental impact of the fashion industry. We investigate how game skin acquisition influences players' learning of sustainability concepts related to clothing. The experiment compares two game skin acquisition models: traditional and proposed. The proposed model uses the water footprint of real clothing as the pricing strategy, while the traditional model uses a fixed gold price for each skin. Results show that the proposed model increases player attitude toward general sustainable issues. The game experience is not negatively affected by the proposed game skin acquisition model. Tangential learning about water consumption in clothing production occurs more frequently in the proposed model, highlighting its educational potential. Our proposed game skin acquisition model offers an engaging experience with a focus on a positive change in attitudes. If widely adopted, this model is expected to influence social norms around consumption, promoting behavioural shifts within the gaming community and beyond.

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KEYWORDS

Games, Tangential learning, Resource consumption, Environmental awareness and attitudes, Potential societal impact

1 INTRODUCTION

The fashion industry, as one of the world's largest and most influential industries, shapes global trends and styles. It also has a significant environmental impact, especially in resource consumption, but this is often overlooked. The industry is responsible for 20% of global wastewater and 10% of global carbon emissions, and it generates an alarming amount of textile waste, with an estimated 85% of textiles ending up as waste each year, contributing to landfills and ocean pollution[45]. Many consumers remain only vaguely aware of the fashion industry's environmental impact, with some even expressing concern about greenwashing, where companies exaggerate or mislead consumers about the sustainability of their products or practices[23, 39]. As the environmental impact of clothing and textile production receives more attention from researchers, many are calling for increased transparency in this industry to help consumers make more environmentally conscious fashion decisions.[23, 31].

Games have been shown to influence awareness, attitudes and behaviour in various contexts, from educational games like SimCity facilitating learning [40] to racing games impacting real-world driving behavior[18]. This ability suggests a potential strategy for raising awareness of environmental impact in the fashion industry through virtual fashion in games.

Game skins, a form of virtual fashion, are increasingly being consumed within the gaming industry. This consumption is primarily driven by players' desires for self-expression, social interaction, and immersion, which mirror the motivations underlying real-world clothing consumption[29, 30]. Recent collaborations like Louis Vuitton x League of Legends, which resulted in the creation of in-game character skins and a capsule collection of real clothes[33], underline the potential of game skins to influence players' attitudes and behaviours toward real-life fashion consumption.

Game skin consumption could be considered a virtual representation of real-world clothing consumption due to similar motivations behind them and the growing overlap between game skin and real-world fashion. To promote greater transparency regarding the environmental impact of real-world clothing production, it may be helpful to include information about this impact in the game skin consumption process. Please note that currently there is no research to support these assumptions, and this study is an initial attempt to explore this topic.

Incorporating information about resource consumption into the acquisition of game skins might be a unique way to promote sustainable practices. This approach could involve using water, energy, and textile resources as in-game currency for purchasing game skins, which provide information about the environmental impact of real-world clothing production. Players may become more aware of the environmental impact of their real-world fashion decisions during the game and potentially engage in more sustainable behaviour both inside and outside of the game.

Moreover, Arias [6] has shown the potential of media and entertainment, including games, to shape social norms and attitudes through individual learning processes and fostering coordination. For instance, campaigns by the Plastic Pollution Coalition encourage actors, writers, and producers to shun single-use plastics on set and to use and show package-free and reusable and refillable systems on screen to help reshape social norms and attitudes regarding plastic pollution and positive behaviour changes[34]. Similarly, the game skin acquisition model incorporating resource consumption information could potentially influence social norms related to resource consumption in the fashion industry, thereby promoting more sustainable behaviours, if it's widely adopted.

However, the game skin acquisition model incorporating resource consumption information must be implemented in a way

that does not alter the game mechanics, or increase game difficulty, to avoid player resistance. It's crucial that players perceive sustainable efforts as an integral part of the game experience to enhance participation and adoption of sustainable behaviours.

In this context, the main research question of this study is: "**Can a game skin acquisition model incorporating resource consumption information during clothing production promote sustainability awareness and attitudes without compromising players' game experience?**"

2 LITERATURE REVIEW

2.1 Resource Consumption in the Fashion Industry

The fashion industry, known for its influential role in shaping trends and styles, has a significant environmental impact due to resource consumption. With complex supply chains involving clothing and accessories production, distribution, and consumption, the industry exerts substantial amounts of water, energy, and chemicals, leading to water pollution, air pollution, and greenhouse gas emissions [45].

2.1.1 Resource Consumption Issues. Textile waste represents a pressing issue within the fashion industry. Only a fraction of textile waste is recycled or reused, with an estimated 85% of textiles ending up in landfills or contributing to ocean pollution [45]. This substantial waste strains landfill capacities and perpetuates the cycle of resource depletion.

Water usage is another critical concern in the fashion industry. Textile production processes, such as dyeing and finishing, require substantial volumes of water. Consequently, the fashion industry is responsible for a significant share of global wastewater generation. United Nations Economic Commission for Europe [45] reports that the fashion industry accounts for approximately 20% of global wastewater. Improper management of wastewater can have severe consequences for ecosystems and local communities.

2.1.2 Challenges and Opportunities. The mounting environmental challenges faced by the fashion industry underscore the urgent need for change. Sustainable fashion has emerged as a promising approach to address these concerns. Sustainable fashion entails manufacturing, marketing, and using clothing, shoes, and accessories in the most environmentally and socio-economically responsible manner possible [45]. This approach encompasses a wide range of practices, including the use of eco-friendly materials, waste reduction, and promotion of fair labour practices.

Despite growing awareness of sustainable fashion, barriers persist, including consumer attitudes prioritizing factors such as affordability, style, and convenience over sustainability when making fashion choices[31]. Greenwashing, where companies mislead consumers about the sustainability of their products or practices[36], is prevalent.

To bridge the gap between consumer attitudes and sustainable behaviour, Ioanna Papolomou and Tsamouridis [23] suggests that greater transparency and awareness about the environmental impact of textile production are essential.

2.2 Game Skin

The term "game skin" refers to non-functional virtual items in video games, impacting only the aesthetic appearance of in-game elements, including characters and interfaces [10]. Originating from the application of skin-like textures and intricate material details to three-dimensional character models [35], it has evolved to include various visual alterations for characters, such as simple colour palette changes, clothing variations, or complete visual overhauls. These modifications significantly influence the overall aesthetic experience of gameplay.

2.2.1 Existing Game Skin Acquisition Method. Due to the absence of academic research in this area, the online article by Kokalitcheva [26] revealed five common ways to acquire game skins:

- Free skins included in games: These skins may be offered as rewards, bonuses, or promotional items.
- Skins earned by in-game achievements: These achievements could be related to reaching milestones, completing challenges, or demonstrating skill in the game.
- Skins paid with in-game currency: In-game currency can be earned through gameplay or acquired by exchanging real money for virtual currency within the game.
- Skins earned through progression in a seasonal battle pass: In this system, players earn rewards, including skins, by completing tasks or levelling up during a specific season or timeframe.
- Skins paid with real currency: This method involves using real money to buy virtual items or skins from the game's marketplace or online store.

In addition to these acquisition methods, there is the phenomenon of loot boxes, which are virtual crates or containers that contain random virtual items, including skins, and their contents are determined by chance[26]. It is noteworthy that loot boxes have become a prominent feature in many games, significantly impacting the way players acquire virtual items, including skins.

2.2.2 Digital Self-Expression. Research has indicated that individuals engage in customizing avatars and acquiring game skins in virtual environments as a means to manifest and personalize a desired self-image[22, 44, 25]. Factors such as character dedication, social distinction, and self-gratification are influential in driving this customization behaviour [29, 30]; Belk [8] has specifically conceptualized this digital consumption of game skins as a form of self-expression, highlighting that avatars, represented by these skins, are extensions of the self, influencing our offline behaviour and sense of identity.

Similar to real-world clothing consumption, virtual customization allows individuals to manifest and personalize a desired self-image. This parallels the motivation for self-expression through both virtual avatars and physical clothing.

2.2.3 Incorporating Real Clothes into Games. In recent years, there has been a noticeable trend of incorporating real clothes into digital gaming environments. This practice, known as 'virtual fashion', allows players to dress their avatars in digitized versions of real-world clothing items. Several high-profile collaborations between

fashion brands and game developers have spotlighted this phenomenon[3]. For example, the partnership between Burberry and Honor of Kings. Burberry designed exclusive game skins that included the brand's signature trench coat and tartan, specifically for Chinese customers[15]. Louis Vuitton also collaborated with League of Legends, designing a skin collection in the game and also launching a capsule collection riffs on the in-game clothes in the real-world[33].

The willingness of people to engage in digital consumption has further fueled this trend. A survey revealed that 82% of participants had purchased some form of virtual item, with a third of them acquiring fashion items. Additionally, 70% of respondents mentioned buying virtual items to create or enhance a digital identity, express themselves, or own something unique. Notably, 62% of US consumers have purchased a digital item, such as an accessory, skin, or garment, for their avatar in a video game[48]. These findings underscore the significance of virtual fashion in contemporary gaming culture, prompting a closer examination of the role that clothes (skins) play in identity formation within corresponding game communities.

2.3 Potential of Games for Learning

The potential of games for learning is increasingly evident in the evolving landscape of education. A spectrum of game-based approaches, including serious games, gamification, and game-based learning, along with the incorporation of Commercial Off-The-Shelf (COTS) games, demonstrates the versatility and effectiveness of games in enriching educational experiences and improving outcomes. Beyond their traditional role in instruction, games offer a unique capacity to raise awareness, cultivate empathy, and facilitate tangential learning, underscoring their multifaceted impact on the educational field.

2.3.1 Serious Games, Gamification, and Game-based learning. Leveraging gaming elements and principles in educational contexts has emerged as a potent tool for enhancing engagement, motivation, and learning outcomes. This spectrum encompasses serious games, gamification, and game-based learning, each with its unique approach and applicability.

Serious games are tailor-made for purposes beyond mere entertainment, extending to industry, training, or simulation [4, 14]. Krath et al. [27] argue these games are not just effective learning tools but also versatile, with applications reaching art, therapy, and advertising. Their ability to enhance engagement and knowledge acquisition while stimulating motivation makes them an invaluable tool in a broad array of contexts.

Gamification applies game design elements and mechanics to non-game contexts, such as education, aiming to harness the motivational power of games and promote desired behaviours [16, 24]. Grounded in concepts like rewards, feedback, competition, and achievement, it offers a unique approach to fostering intrinsic and extrinsic motivation, autonomy, and mastery, thereby creating meaningful learning experiences [37, 27].

Game-based learning uses games - digital or otherwise - as educational tools, promoting active engagement, problem-solving, and critical thinking, and facilitating knowledge acquisition [12]. Drawing on pedagogical theories like constructivism and experiential

learning, it is more effective than traditional instructional methods [27].

Despite their differences, these approaches share a common goal: enhancing the learning experience by leveraging the engaging nature of games. However, their applicability and effectiveness can vary greatly depending on the context, calling for careful consideration in their implementation [16].

2.3.2 COST Games and Learning. Players perceive games as valuable learning experiences, acquiring various skills and knowledge through gameplay [43]. Tanes and Cemalcilar [40] investigate the learning outcomes of Turkish adolescents through playing the game SimCity, and finally found that SimCity which is a commercial-off-the-shelf (COTS) game primarily intended for entertainment and allows players to create and manage virtual cities, also offers educational benefits and has the potential to educate and raise awareness on specific topics, promote learning, and potentially facilitate behaviour change. Within the broader literature on COTS games and learning, they identified two types of learning: learning from COTS games in formal educational settings and informal learning from games.

Learning from COTS games in formal educational settings involves integrating games into curricula and designing structured learning experiences around them. Researchers have explored the effectiveness of educational games in enhancing learning outcomes in subjects such as mathematics, science[13], history[49], and language learning. By leveraging the engaging and interactive nature of games, educators aim to facilitate meaningful learning experiences that align with specific educational goals.

On the other hand, informal learning from games refers to the learning that occurs outside formal educational settings, driven by players' voluntary engagement with games[43]. In this context, players learn through their own exploration and participation in game-related activities. They may acquire knowledge, skills, and insights that are not necessarily tied to a specific curriculum or formal learning objectives[43]. Informal learning from games often takes place within gaming communities, online forums, and social interactions among players. Through these informal channels, players exchange strategies, share experiences, and learn from each other's expertise, thereby fostering a collaborative and peer-driven learning environment[43].

2.3.3 Learning Experiences from Games. In the current era of rapid digital advancement, games serve as powerful tools for multifaceted learning experiences, influencing emotions, perspectives, and even behavioural patterns[43].

Learning from Game Context. Engagement with games can deepen players' understanding of various topics, raising their awareness about them[43]. This is achieved through several game elements, including mechanics, narratives, and social interactions[12]. For instance, game narratives immerse players in diverse contexts, historical periods, or fictional worlds, providing rich and nuanced learning experiences[17]. Games like "Assassin's Creed," set in Renaissance Italy, expand players' understanding of historical periods they haven't personally experienced[43].

Tangential Learning. Moreover, games might lead to tangential learning, a form of self-directed learning where players voluntarily

seek out additional information outside the gaming environment, leading to a deeper exploration of related subjects[19]. An example of this is the game "Minecraft," which encourages children to collaboratively solve problems, fostering skills such as creativity, collaboration, critical thinking, and communication[11, 42, 9].

Collective Learning. The social dynamics of gaming, characterized by knowledge-sharing and collaborative problem-solving, also contribute to learning outcomes[38]. Through gaming communities and forums, players can challenge and expand their viewpoints, fostering a sense of collective learning[43].

Fostering Emotions and Perspectives. In addition to the educational benefits, games can also influence emotional responses and perspectives. Players gain empathy for a variety of characters through immersive storytelling, challenging their preconceived notions and fostering an understanding of social, cultural, and environmental issues[43]. For example, the game "That Dragon, Cancer" restricts player agency to enhance emotional impact, fostering empathy and understanding by depicting a family's struggle with a child's terminal illness[42].

Behavioral Changes. Furthermore, games provide a safer alternative to real-world scenarios, enabling individuals to confront fears and phobias without physical risks. This is demonstrated by a therapy for arachnophobia that used a game-based environment, where participants exhibited positive behavioural changes and overcame their fear[9].

2.3.4 Tangential Learning in Games Design.

Importance of Tangential Learning. Mozelius et al. [32] analyzed three popular entertainment games, namely "Kerbal Space Program," "Crusader Kings," and "Civilization," to identify the key design factors that motivate players to learn. To achieve this, they combined different approaches to explore the relationships between various factors such as prior knowledge, knowledge enhancement, tangential learning, in-game knowledge integration, challenge, curiosity, control, fantasy, cooperation, competition, and recognition. They used Lepper's and Malone's heuristics for intrinsic motivation in interactive learning environments and Habgood's and Ainsworth's theory of intrinsic integration. The findings from their t-test outcomes were significant: tangential learning was found to be highly important in two of the games studied. The correlation analysis further revealed that intrinsic integration was a critical factor not only in terms of knowledge acquisition but also in tangential learning. The study found that control, imagination, and competition also played a role in learning motivation, while the Lepper and Malone factors had less of an impact. By analyzing these interactions, Mozelius et al. [32] emphasized the importance of tangential learning in the design of educational games, contributing to a more comprehensive understanding of effective learning motivation strategies.

Guidelines for Tangential Learning. To leverage the potential of tangential learning in serious games and educational games, Anderson [5] proposes a suggestion that incorporating contextual information through text descriptions or collectable items can spark curiosity and encourage self-guided learning experiences. This additional information acts as a catalyst for players to seek further

knowledge outside of the game. To incorporate the concept of tangential learning into game design, the following guidelines can be employed:

- **Contextual Information:** Provide additional contextual information through in-game text descriptions or collectable items. These elements spark players' curiosity and encourage self-guided learning experiences beyond the game. By presenting relevant information, the game acts as a catalyst for further exploration and knowledge acquisition.
- **Narrative Justification:** Ensure that gameplay mechanics are justified within the game's narrative. By providing a clear narrative rationale for the tasks and challenges players face, the game enhances their motivation to engage in learning activities. This narrative justification adds meaning and purpose to the gameplay, making the learning experience more compelling.

3 METHODOLOGY

3.1 Research Design

To address the research question, "Can a game skin acquisition model incorporating resource consumption information during clothing production promote sustainability awareness and attitudes without compromising players' game experience?" this study employs a between-subjects experimental design. We developed a test game in Unity 2021.3.6f1 with similar game mechanics to Fall Guys and conducted experiments using two versions of that game: Game A, using a traditional game skin acquisition model, and Game B, using a proposed game skin acquisition model incorporating resource consumption information. It is assumed that providing information about resource consumption in Game B may help Group B participants understand resource consumption in clothing production. This might facilitate their tangential learning about more information in this scope, which can lead to positive changes in awareness and attitudes. The only way to measure the integration of resource consumption information in Game B is through the participants' game experience. Then we could have the following hypothesis:

- H1: Participants playing Game B, incorporating the proposed game skin acquisition model, will exhibit a greater increase in general sustainability attitudes compared to those in Game A, utilizing the traditional acquisition model.
- H2: Participants playing Game B will demonstrate more positive changes in awareness towards sustainability related to clothing than those in Game A.
- H3: Overall, participants' game experience will not significantly differ between Game A and Game B
- H4: Game B with the proposed game skin acquisition model may lead to the occurrence of tangential learning experiences.

Therefore, the independent variable should be the game skin acquisition model(traditional VS proposed), and the dependent variables should be the sustainability awareness and attitudes change, the occurrence of tangential learning, and participants' game experience.

3.2 Game Skin Acquisition Model in Test Game

The test game is a single-player game with similar game mechanics in Fall Guys. The mechanics of character control, game physics governing obstacle settings, and character interaction with obstacles in Fall Guys remained in the test game.

While the main objective of the test game remains to reach the finish line, the test game did not contain the competitive game characteristics compared to Fall Guys. Besides, we introduced a failure condition by limiting the number of times a player can slip off the track. The game's difficulty is still determined by factors such as the width of the track, the speed of dynamic obstacles, collision forces, etc. Three difficulty levels easy, medium, and hard—are available for players to choose from without any conditions.

There are two types of game skin acquisition methods introduced in that game: skins earned by in-game achievements and skins paid with in-game currency[26]. The skins paid with in-game currency method is mainly addressed to integrate the resource consumption information in the proposed game skin acquisition model.

The traditional game skin acquisition model uses the golden coin icon as the currency icon with the traditional game skin pricing strategy, which is based on the complexity of the modelling techniques and visual effects associated with each skin [35].

Due to the research findings emphasising the positive impact of tangential learning on players' motivation and knowledge acquisition in educational games[32], the game development approach incorporates fundamental design principles, such as contextual information and narrative justification, to facilitate tangential learning[5]. Contextual information was embedded into the pricing strategy itself, closely linked to real-world water consumption associated with in-game clothing, to spark players' curiosity about environmental considerations. The water icon serves as the game's currency symbol and invites players to contemplate the rationale behind the pricing strategy.

3.2.1 Water footprint Calculation. The water footprint serves as a metric to quantify the volume of water utilized and contaminated in the production process of a product or service[50]. Notably, there is a current absence of academic research systematically detailing the water footprint of commonly employed fabric production methods. Given this gap, the majority of the water footprint data in our study is derived from online sources, potentially resulting in a lack of validation and precision.

Our research incorporates specific information obtained online, such as the production of a single cotton t-shirt requiring up to 2700 litres of water and a single pair of jeans potentially demanding 7000 litres of water [41]. While these figures directly contribute to estimating the water footprint of relevant game skins featuring cotton t-shirts and denim trousers, some data required additional processing and calculations due to its complexity.

processing and calculations due to its complexity.

The water footprint of clothing is calculated using three factors: water footprint X litres per kilogram of fabric (L/kg), fabric weight Y grams per square meter (gsm), and surface area of fabric used (square meters). The formula used is:

$$WaterFootprint = \frac{XYZ}{1000} \quad (1)$$

To determine the fabric area of clothing items in the game shop, we utilize water footprint values derived from cotton shirts, with 22000 L/ Kg of cotton fabrics[47], and light cotton batiste weighing 80 gsm [2]. This allows us to estimate the fabric area of one cotton shirt at 1.5 square meters.

Using this calculation, we estimated the fabric area of all game skin clothing items(see Figure 1). The hat's fabric area is estimated to be half of that of one cotton shirt, equating to 0.75 square meters. Each piece of top and short skirt has the same fabric area as one cotton shirt, amounting to 1.5 square meters. Meanwhile, one pair of trousers has a fabric area double that of one cotton shirt, reaching 3 square meters. Lastly, the long coat with a hat is estimated to have a total fabric area of 3.75 square meters, comprising the fabric areas of the hat, shirt, and skirt.

	Polyester		Wool	
	Satin	Taffeta	Lightweight	Coating
X (L/kg)	62	62	17000	17000
Y(gsm)	130	120	250	600

Table 1: Water footprint(L/kg) and weight of fabrics(gsm)[47, 2]

Then the water footprint of clothing items in cotton, denim, polyester satin, polyester taffeta, lightweight wool, and wool coating can be calculated according to the Equation 1 with help of the information in Table 1.

The water footprint of leather-related clothing items in the test game shop was estimated based on information that the water footprint of a cow skin leather tote bag was 17128 litres [46]. Assuming the tote bag has the same fabric area as the cotton shirt (1.5 square meters) and considering that cow skin leather requires 14 times more water than synthetic PU leather production [46], the water footprint of one leather and PU item was estimated accordingly.



Figure 1: Game skins with water footprint price tag

After calculating the water footprint of each clothing item in each game skin, the water footprint of each game skin was displayed in the game shop of Game B(see Figure 1).

3.2.2 Game Balance. Due to the same reward mechanics of the two test games, it's necessary to find a balance between these two pricing strategies to make sure the participants of each test game spend similar efforts to purchase skin. A prescribed task for each participant involves acquiring a minimum of three skins from the game shop. Therefore, the skin prices of the test game with the traditional model are calculated as the average of the cheapest three skins in the test game with the proposed model with an exception for the raincoat skin. The reason behind this exclusion is that the footprint of the raincoat is at least 66 times less than the other

skins in the game shop. These pricing considerations seek to ensure fairness in the purchasing dynamics across both test games, aligning with the overarching goal of the experiment.

3.3 Participants

Participants are divided into 2 groups for a between-subjects design:

- Group A: Participants playing Game A.
- Group B: Participants playing Game B.

To ensure the randomization of participant assignment to game groups, a web page was employed. Through this web page, participants were randomly assigned to either the download site of Game A or Game B, with equal probabilities for each option. This method aims to eliminate bias in group allocation, enhancing the reliability and validity of the study's results.

3.3.1 Ethics and Privacy. The Ethics and Privacy Quick Scan of the Utrecht University Research Institute of Information and Computing Sciences was conducted (see Appendix A.1). While the Quick Scan identified one ethics issue that participants could be younger than 18, this project was allowed to proceed as it is fully covered by the ethical approval for my supervisor's suggestion to let participants fill in the consent form (see Appendix A.3). regarding their age beyond 18.

3.3.2 Participant Recruitment. The study recruited participants through two main channels: online outreach and location-based recruitment. Online outreach involved targeting individuals within gaming community groups on Reddit, as well as students affiliated with Utrecht University's Human-Computer Interaction (HCI) and Game Media Technology (GMT) programs. Location-based recruitment targeted students at Utrecht University.

It is worth noting that during the experiment, a problem arose where most of the participants who filled out the pre-test questionnaire did not complete the post-test questionnaire. To maintain ethical standards, participant contact information was not collected. Therefore, it was impossible to follow up with those participants who did not complete the experiment.

A total of 84 completed responses were gathered, and out of those, 82 responses (41 responses each for both game groups) were used in the data analysis process.

3.4 Experiment procedure

Each participant was anticipated to follow a well-defined procedure as delineated in the document named as "Game Participant Guideline" (see Appendix A.2). At the outset, participants were instructed to thoroughly review this document, which not only imparted essential information but also granted access to the pre-test questionnaire. Additionally, the guideline provided a link to a web page facilitating the random assignment of participants to different test-game download addresses.



Figure 2: Badges page in Game B

The guideline outlined specific in-game tasks participants were expected to accomplish. These tasks included the attainment of three badges through in-game achievements (see Figure 2) and the purchase of a minimum of three game skins. Significantly, the successful completion of these tasks acted as a prerequisite for activating the link button that led to the post-test questionnaire within the test game.

It is noteworthy that the guideline while encouraging participants to engage with the game for at least three days, did not mandate this duration. The intention was to provide flexibility to participants while still promoting an immersive and meaningful game experience.

3.5 Variables and Measurement

Following the initial hypothesis, the study focuses on measuring participants' awareness and attitude towards sustainability, especially in the domain of clothing, both before and after their engagement in the test game experiment. Additionally, an essential aspect involves evaluating participants' overall gaming experience. To facilitate this comprehensive investigation, two distinct questionnaires will be employed: a pre-test questionnaire (see on Appendix A.3) and a post-test questionnaire (see on Appendix A.4). Due to ethical considerations, a consent form will precede the pre-test questionnaire to inform participants fully. This consent form will outline the anonymous nature of the study, the specifics of participant involvement, the estimated time commitment, and the requirement that participants be over 18 years old.

3.5.1 Awareness and Attitudes.

Attitudes. Building upon the methodology presented in Lavelle et al. [28], the consensus survey employed in this referenced research, tailored to measure respondents' attitudes towards the environment, featured six questions addressing multiple dimensions including environmental concern, self-efficacy beliefs, and the willingness to undertake specific actions for environmental protection. Each question underwent evaluation using a 5-scale agreement, spanning from "Strongly Agree", "Agree", "Neither agree nor disagree", "Disagree", to "Strongly Disagree" and included a "Do not know" option.

The current study used five of these questions (see Question 1-5 on Table 2) to assess participants' attitudes towards general sustainability, which were measured on a standard 5-point Likert scale from "Strongly Disagree", "Somewhat Disagree", "Neither agree nor disagree", "Somewhat Agree", to "Strongly Agree". The question "Which one of the following statements best describes how you

feel about environmental issues? (Very concerned, Somewhat concerned, No opinion, Not concerned, Not at all concerned)" was not used in this study due to being too general.

Awareness. Based on the 2020 survey conducted by the EU Commission regarding the Attitudes of Europeans towards the Environment[7], a distinct section of the survey focused specifically on environmental problems and working conditions linked to clothing. This section comprised six questions, each measured on a 4-scale agreement ranging from "totally agree", "tend to agree", "tend to disagree" to "totally disagree" with an additional option for "do not know."

	Question Statement
1	I would be willing to accept cuts in my standards of living, if it helped to protect the environment
2	I would be willing to pay higher prices for goods and services, if it helped to protect the environment
3	I would be willing to support higher taxes, if it helped to protect the environment
4	I would be willing to sacrifice some personal comforts, in order to save energy
5	I feel my own personal behavior can bring about positive environmental change
6	Have you ever considered the resource consumption (e.g., water, energy, materials) of a clothing product before purchasing it?
7	Would you be willing to change your purchasing decisions on clothing towards more sustainable choices if provided with information on the environmental impact and resource consumption involved in production?
8	Clothing should be made to last longer
9	Clothing should only be made from materials that can be recycled
10	Second-hand clothing should be promoted more (e.g. through tax cuts)
11	Clothes labelling should provide information on their environmental impacts

Table 2: 11 survey items comprising awareness and attitudes (The first five questions are about attitudes and the remaining six are about awareness, which will be presented in a randomized order in both the pre-test and post-test questionnaires)

The present study modified four of these question statements by excluding information about work conditions(see Question 8-11 on Table 2), still using the standard 5-point Likert scale. Further, two questions germane to this research, Question 6 and Question 7 in Table 2 were introduced, with responses classified as "Yes", "Maybe", and "No".

Additionally, a set of 18 facts of clothing was curated from United Nations Economic Commission for Europe [45] and Abbate et al. [1] for evaluating participants' knowledge in this domain. Ten of these facts found inclusion in the pre-test questionnaire, while the remaining eight were incorporated into the post-test questionnaire. Notably, two questions were duplicated in the pre-test questionnaire to ensure the veracity of responses. Specifically, the entire response of that participant is deemed invalid if a checked sign is present in the pre-test questionnaire while the corresponding box remains unchecked in the post-test questionnaire for these two statements.

These six questions and the fact-check question measured participants' awareness towards sustainability related to clothing.

3.5.2 Game Experience. The 11-item PXI proposed by Haider et al. [21] emerges as a potentially more fitting option in scenarios where employing a longer measure becomes impractical, and when the study does not centrally focus on examining constructs related to immersion or mastery. It uses the 7-point Likert, from -3 to +3 scale over 0, accompanied by the labels ("Strongly Disagree", "Disagree", "Slightly Disagree", "Neither Disagree nor Agree", "Slightly Agree", "Agree", and "Strongly Agree"), which means that all the other measure scales are not validated.

	Question Statement
1	Playing the game was meaningful to me
2	I wanted to explore how the game evolved
3	I felt I was good at playing this game
4	I felt free to play the game in my own way
5	I was fully focused on the game
6	The game gave clear feedback on my progress towards the goals
7	I liked the look and feel of the game
8	The game was not too easy and not too hard to play
9	It was easy to know how to perform actions in the game
10	The goals of the game were clear to me
11	I had a good time playing this game

Table 3: 11 survey items about participants' game experience (using standard 5-point Likert scale, which will be presented in a randomized order in both the pre-test and post-test questionnaires)

Finally, the 11-item PXI was employed to measure the participants' game experience in this study (see Table 3). The previously utilized 5-point Likert scale was maintained even though it was not validated in existing research. This decision aimed at ensuring the consistency of questionnaires and minimizing potential participant confusion in distinguishing between the agreement scales. This choice was particularly driven by the concern that a more finely subdivided 7-point Likert scale might lead to a huge amount of 0-frequency cells in the subsequent ordinal regression analysis.

3.5.3 Game Information. A varied set of additional game-related information and inquiries were conducted(see Table 4). Details like gaming duration and currency-related statistics were gathered through text-filling in the post-questionnaire, while skin purchases and days spent playing the game were collected using a single-choice format.

3.5.4 Tangential Learning. The investigation delved into participants' satisfaction with the game's reward mechanism and pricing strategy, utilizing a 5-point Likert scale with labels such as "Strongly Dissatisfied", "Somewhat Dissatisfied", "Neither Dissatisfied nor Satisfied", "Somewhat Satisfied", and "Strongly Satisfied". Participants were also queried about their understanding of the pricing strategy and whether they sought information to support their perspectives, aiming to discover tangential learning occurrences. The key question explored participants' motivation for tangential learning, with responses categorized as "Yes", "Maybe" and "No". Notably, participants affirming "Yes" to Question 4 in Table 5 triggered subsequent

	Question Statement
1	Total Playtime
2	Playtime of Easy Level
3	Playtime of Medium Level
4	Playtime of Hard Level
5	Current Currency
6	Costed Currency
7	How many skins have you purchased?
8	How many days have you played for this test game?

Table 4: 11 survey items related to participants' self-reported game information

inquiries, streamlining the analysis with responses categorized as "Yes", and "No". This expansion aims to unravel the intricate interplay between player satisfaction, pricing perceptions, and the occurrence of tangential learning in different game types.

	Question Statement
1	Are you satisfied with the rewards you receive based on your in-game performance, such as winning or losing each level?
2	Do you feel satisfied with the price settings of the game skins in the game shop?
3	Based on your experience with the test game, do you believe that the strategy used for setting the prices is reasonable?
4	Based on your understanding of the pricing strategy in the game you tested, would you be willing to search for some information to support your idea?
4.1	Have you searched for any information that can support your idea yet?

Table 5: 4 survey items on tangential learning section

3.6 Data Analysis

This study used IBM SPSS Statistics 27.0 for data processing. During the data-cleaning process, the same statement options in the fact-check sections of the pre-test and post-test questionnaires were compared. It found that only two responses were invalid because the checked sign was present in the pre-test questionnaire, whereas the corresponding box remained unchecked in the post-test questionnaire for these same statement options.

3.6.1 Awareness and Attitudes.

Ordinal Logistic Regression. In this investigation, ordinal logistic regression was utilized to evaluate the influence of predictor variables on the ordinal dependent variable, specifically, ordinal data corresponding to each question in the awareness and attitudes section. Initially, the predictor variables game type and test type were explored. Subsequently, we delved into exploring the interaction variable, game type \times test type, as a predictor for questions where the impact of game type or test type was non-significant.

The inclusion of the interaction variable was guided by the hypothesis that there might be no discernible impact between the Pre-test and Post-test for Game A within the traditional acquisition model and no significant impact between Game A and Game B for the Pre-Test. This anticipated absence of impact is expected to lead

to a lack of significance in the ordinal regression model incorporating game type and test type. Consequently, we conducted focused examinations by comparing Game A \times Pre-test with Game A \times Post-test, Game B \times Pre-test with Game B \times Post-test, and Game A \times Pre-test with Game B \times Pre-test.

The analysis of results was grounded on the SPSS statistics outputs, such as Model Fitting Information, Goodness of Fit, Pseudo R-Square, Parameter Estimates, and Test of Parallel Lines. To check the fitness of the ordinal logistic regression model, we analyze the Goodness of Fit, with a non-significant ($p > 0.05$) result expected. A significant p-value ($p < 0.05$) in Model Fitting Information would indicate that the predictor variable impacts the dependent variable. We use the Test of Parallel Lines to ensure the proportional odds assumption, with Odds ratios (OR) derived from the Parameter Estimates to interpret the impact of predictor variables on the ordinal data

Independent-samples T-test. For the facts, the approach involved computing the sum of checked facts for each participant in both the pre-test and post-test questionnaires. Subsequently, the difference between the sum of checked facts in the post-questionnaire and the sum of checked facts in the pre-questionnaire was calculated for each participant. An independent-sample t-test, considering game type was then employed to conduct a statistical analysis of the independence of these differences. p-value was mainly examined to check whether there was a significant ($p < 0.05$) difference between the two game types.

3.6.2 Game Experience.

Mann-Whitney U Test. For the game experience section, featuring 11 questions with ordinal data, the analytical focus is confined to the test type dimension (pre-test or post-test). Consequently, the Mann-Whitney U test is selected to scrutinize the ordinal dataset of these 11 questions separately within two categorical test-type groups. The pivotal parameter for scrutiny remained the p-value, with a specific interest in detecting any significant ($p < 0.05$) differences between the two game types. Notably, significant findings prompted a comprehensive exploration of the frequency distribution diagrams with mean rank values to pinpoint which test group exhibited more positive results.

3.6.3 Game Information. In the realm of Game Information, where all the data is self-reported by participants, and it occasionally exhibits manifest errors. In at least 8 responses, the reported "Total Playtime" is significantly less than the sum of the reported answers for "Playtime of Easy Level," "Playtime of Medium Level," and "Playtime of Hard Level." Upon closer examination of the detailed data, it becomes apparent that some participants may have filled out the record (the fastest finishing time of each level) on their profile page (see Figure 3). Due to the uncertainty surrounding potential data reporting errors that might have gone unnoticed, we refrained from making any specific adjustments or corrections to this subset of data. This decision was guided by the need to maintain the integrity of the information collected, acknowledging the possibility of varied participant interpretations or accidental discrepancies in reporting.



Figure 3: Profile page

3.6.4 Tangential Learning.

Crosstabulation. The subsequent analysis involves exploring the crosstabulation of Question 4 and 4.1 in Table 5 to understand the interplay between the confirmation of occurrence and participants' responses to tangential learning prompts. For participants confirming occurrence (answering "Yes" to Question 4 and triggering Question 4.1), an in-depth investigation will be conducted. This examination will delve into their test game type. Additionally, the analysis extends to scrutinizing their satisfaction levels concerning in-game rewards and the pricing strategy (Question 1 and 2) and reasonable levels of pricing strategy(Question 3).

4 RESULTS

4.1 Awareness and Attitudes

4.1.1 Ordinal logistic Regression.

Predictor Variable: Game Type and Test Type. All 11 questions exhibited non-significant results ($p > .05$) in both Pearson's Goodness of Fit and Test of Parallel Lines analyses. This suggests a robust fit for these questions and upholds the proportional odds assumption inherent in ordinal logistic regression.

Among all 11 questions, only Question 6, "Have you ever considered the resource consumption (e.g., water, energy, materials) of a clothing product before purchasing it?" demonstrated a significant result ($p = .022 < .05$). Contrastingly, the other 10 questions were reported as non-significant p-values ($p > .05$). This suggests that at least one of the predictor variable have a significant impact on Question 6, and the two predictor variables both have no significant impact on the other 10 questions.

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval		Exp. B	95% Confidence Interval	
							Lower	Upper		Lower	Upper
Threshold	[Q6 = 1]	-1.012	.277	13.359	1	.000	-1.555	-.469	.363	.211	.625
	[Q6 = 2]	1.070	.276	14.991	1	.000	.528	1.611	2.914	1.696	5.008
Location	Game B	.532	.297	3.204	1	.073	-.051	1.116	1.703	.951	3.051
	Game A	.000			0				1.000		
	Post-test	.638	.298	4.577	1	.032	.054	1.223	1.893	1.055	3.398
	Pre-test	.000			0				1.000		

Table 6: Parameter Estimates with Odds Ratio (Exp_B) for Question 6 on attitudes and awareness, where the threshold estimates for [Q6 = 1] and [Q6 = 2] serve as critical cutoff values demarcating transitions between "No" and "Maybe" and between "Maybe" and "Yes" respectively.

In Table 6, the parameter estimates along with the odds ratio results, provide valuable insights into the ordinal logistic regression for Question 6.

Two notable findings emerge from this information:

- Game Type: The odds of participants in Game B with the proposed game skin acquisition model considering more positive ordinal groups was 1.703 (95% CI, 0.961 to 3.051) times that in Game A with the traditional game skin acquisition model, a statistically non-significant effect, Wald $\chi^2(1) = 3.204, p = .073$.
- Test Type: The odds of participants in Post-test questionnaire considering more positive ordinal groups was 1.893 (95% CI, 1.055 to 3.398) times that in Pre-test questionnaire, a statistically significant effect, Wald $\chi^2(1) = 4.577, p = .032$.

Predictor Variable: Game Type × Test Type. Subsequently, the analysis delves deeper into the ordinal logistic regression model with the predictor variable Game Type × Test Type for all 11 questions. Again, all 11 questions exhibit non-significant results ($p > .05$) in Pearson's Goodness of Fit and Test of Parallel Lines analyses, affirming a robust fit and upholds the proportional odds assumption inherent in ordinal logistic regression.

	Question Statement	p-value
2	I would be willing to pay higher prices for goods and services, if it helped to protect the environment.	.048
3	I would be willing to support higher taxes, if it helped to protect the environment.	.038
6	Have you ever considered the resource consumption (e.g., water, energy, materials) of a clothing product before purchasing it?	.033
8	Clothing should be made to last longer.	.048

Table 7: Significant results of Model Fitting Information for the ordinal regression model with interaction variable

Within all 11 questions, only 4 questions in Table 7 had significant results, while the remaining 7 reported non-significant($p > .05$) in Model Fitting Information.

Further scrutiny of detailed p-values for each categorical group in Parameter Estimates for these 4 questions, revealed that only Question 6 exhibited a significant result ($p = .006$) for the Game B × Post-test group within these 4 questions compared to the Game A × Pre-test group. Both Question 3 and Question 6 reported significant results for the Game B × Post-test group compared to the Game B × Pre-test group.

		Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval		Exp. B	95% Confidence Interval	
							Lower	Upper		Lower	Upper
Threshold	[Q3 = 1]	-4.305	.753	32.689	1	.000	-5.781	-2.829	.014	.003	.059
	[Q3 = 2]	-1.656	.331	24.974	1	.000	-2.306	-1.007	.191	.100	.365
	[Q3 = 3]	.184	.295	.389	1	.533	-.394	.762	1.202	.674	2.142
	[Q3 = 4]	2.611	.386	45.673	1	.000	1.853	3.368	13.606	6.382	29.009
Location	Game A × Post test	-.278	.407	.467	1	.494	-1.077	.520	.757	.341	1.682
	Game A × Pre-test	.077	.408	.035	1	.851	-.722	.876	1.080	.486	2.401
	Game B × Post-test	.866	.417	4.307	1	.038	.048	1.684	2.378	1.049	5.389
	Game B × Pre-test	.000			0				1.000		

Table 8: Parameter Estimates with Odds Ratio(Exp_B) for Question 3 on attitudes and awareness

In Table 8, the odds of participants in Game B × Post-test considering more positive ordinal groups was 2.378 (95% CI, 1.049 to 5.389) times that in Game B × Pre-test, a statistically significant effect,

Wald $\chi^2(1) = 4.307, p = .038$. Conversely, the non-significant effect was observed for the other categorical group compared to Game B \times Pre-test.

Threshold	[Q6 = 1] [Q6 = 2]	Estimate	Std.Error	Wald	df	Sig.	95% Confidence Interval		Exp_B	95% Confidence Interval	
							Lower	Upper		Lower	Upper
		-1.402	.323	18.785	1	.000	-2.036	-.768	.246	.131	.464
		.685	.304	5.086	1	.024	.090	1.281	1.985	1.094	3.600
Location	Game A \times Post test	.094	.415	.051	1	.821	-.719	.907	1.099	.487	2.476
	Game A \times Pre-test	-.230	.414	.309	1	.578	-1.043	.582	.794	.352	1.789
	Game B \times Post-test	.961	.428	5.043	1	.025	.122	1.799	2.614	1.130	6.045
	Game B \times Pre-test	.000			0				1.000		

Table 9: Parameter Estimates with Odds Ratio(Exp_B) for Question 6 on attitudes and awareness

According to Table 9, the odds of participants in Game B \times Post-test considering more positive ordinal groups was 2.614 (95% CI, 1.130 to 6.045) times that in Game B \times Pre-test, a statistically significant effect, Wald $\chi^2(1) = 5.043, p = .025$. Again, the non-significant effect was observed for the other categorical group compared to Game B \times Pre-test.

4.1.2 Independent-samples T-test. This t-test analysis suggests that there is no significant difference ($p = .945 > .005$) in the fact-check question between the pre-test and post-test differences of Game A and Game B, with a large effect size, where Cohen's d was estimated at 2.71659 (95% CI, -0.442 to .424).

4.2 Game Experience

Mann-Whitney U Test. The analytical emphasis, exclusively on the game type dimension (Game A or Game B), employed the Mann-Whitney U test to discern patterns and extract meaningful insights. Examining the p-values revealed no significant difference between Game A and Game B only in the question "I liked the look and feel of the game", where $z = 1.544, p = 0.123 > .05$. Significant result ($p < .05$) was observed for the rest 10 questions.

	Question Statement	Mean Ranks		p-value
		Game A	Game B	
1	Playing the game was meaningful to me	31.82	51.18	< .001
2	I wanted to explore how the game evolved	34.12	48.88	.002
3	I felt I was good at playing this game	35.30	47.70	.008
4	I felt free to play the game in my own way	36.10	46.90	.020
5	I was fully focused on the game	35.62	47.38	.010
6	The game gave clear feedback on my progress towards the goals	28.30	54.70	< .001
8	The game was not too easy and not too hard to play	36.43	46.57	.026
9	It was easy to know how to perform actions in the game	35.67	47.33	.007
10	The goals of the game were clear to me	31.21	51.79	< .001
11	I had a good time playing this game	35.63	47.37	.014

Table 10: Significant results of Independent Mann-Whitney U-Test on questions within game experience section

The frequency diagrams resulting from the Independent Mann-Whitney U-Test conducted in SPSS revealed noteworthy distinctions between Game A and Game B concerning participants' responses

to the remaining 10 questions. Specifically, the test revealed that the mean ranks for Game B were always statistically significantly ($p < .05$) greater than those of Game A, except for question 7 as shown in Table 10

4.3 Tangential Learning

Crosstabulation. According to Crosstabulation results of Question 4 \times Question 4.1 and Game Type \times Question 4.1(Yes) in Table 5, 18 out of 29 participants who confirmed their willingness to search for information, confirmed the occurrence of tangential learning, 13 from game group Game B and 5 from game group Game A.

Based on the observation of Figure 4, it is evident that among the 18 participants who confirmed the occurrence of tangential learning, there is a greater concentration of responses in the positive categories for Questions 1, 2, and 3. This suggests that these participants exhibit a more pronounced tendency to positively engage with and learn concepts or information associated with Questions 1, 2, and 3.

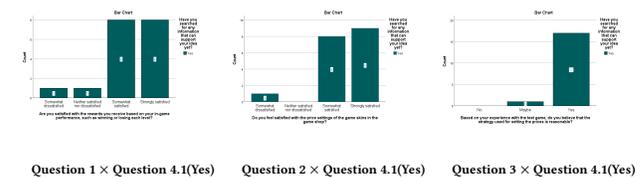


Figure 4: Distribution of tangential learning participants in Question 1, 2, and 3

5 DISCUSSION

This study explored the dynamics of player awareness and attitudes towards sustainable issues related to clothing, game experience, and tangential learning within the framework of two distinct game skin acquisition models: the traditional and the proposed.

5.1 Awareness and Attitudes

5.1.1 Attitudes. Hypothesis H1: "Participants playing Game B, incorporating the proposed game skin acquisition model, will exhibit a greater increase in general sustainability attitudes compared to those in Game A, utilizing the traditional acquisition model." was supported by a significant difference observed in the question "I would be willing to support higher taxes if it helped to protect the environment." between the pre-test and post-test of Game B. The study found no significant differences among the four groups for the other four attitude questions: Game A \times Pre-test, Game A \times Post-test, Game B \times Pre-test, and Game B \times Post-test.

The reason behind these results might be that Game B does have a positive impact on the sustainability attitudes of its participants, but participants may be more inclined to believe that positive change can only be brought about by the government rather than through their personal behaviour. This could be due to the presence of "greenwashing" which undermines people's trust in a company's environmental statements[23, 39]. Consequently, they may hesitate to pay higher prices for goods and services that protect the environment. Additionally, most of the participants are university students

and young adults with low income, who might already live on a minimum standard of living and personal comforts. They might believe that they have already supported sustainability in their daily lives without observing any significant positive environmental change.

5.1.2 Awareness. Hypothesis H2 predicts that "Participants playing Game B will demonstrate more positive changes in awareness towards sustainability related to clothing than those in Game A." faced rejection according to the result of the six awareness questions and fact-check questions.

Only one of these six awareness questions showed significant differences between the Pre-test and Post-test of Game B: "Have you ever considered the resource consumption of a clothing product before purchasing it?". Due to the non-significant different result of the subsequent question "Would you be willing to change your purchasing decisions on clothing towards more sustainable choices if provided with information on the environmental impact and resource consumption involved in the production?", it seems that most of the participants showed an increase in awareness of resource consumption but it was not enough to influence their purchasing decisions.

The non-significant different results of four questions about clothing production, second-hand clothing, and transparency of its environmental impact, also indicate that the participants were unable to come to a consensus on how to address the environmental impact issues in the clothing industry.

Moreover, no significant differences emerged in the fact-check question between pre-test and post-test results for both Game A and Game B. This might be because only a small number of participants had a tangential learning experience, and the options provided in the fact-check question heavily relied on the participants' tangential learning outcome about the consumption of resources in the clothing and textile production industries.

5.2 Game Experience

While there was no significant difference in the Audiovisual Appeal question due to the fact that Game A and Game B share the same audiovisual design, participants consistently reported more positive experiences with Game B across various perspectives, such as Challenge, Ease of Control, Clarity of Goals, Progress Feedback, Autonomy, Curiosity, Immersion, Mastery, Meaning, and Enjoyment, compared to Game A [21]. Therefore, hypothesis H3: "Overall, participants' game experience will not significantly differ between Game A and Game B" was rejected.

As both Game A and Game B share the same game mechanics and game rules, there should be no significant difference in questions assessing Mastery, Challenge, Ease of Control, Clarity of Goals, and Progress Feedback. The more positive result of Game B across these six perspectives might be due to the fact 27 participants of Game B bought three game skins with 7200 or 15650 costed currency, which was less than the minimum amount required to purchase three game skins in Game A, that cost 18900 currency. It appears that Game B had a more positive outcome from various perspectives such as Autonomy, Curiosity, Immersion, Meaning, and Enjoyment. It is possible that the new pricing strategy in Game B sparked participants' curiosity which contributed to their experience. Some of them may have recognized the sustainable concept

of the game, which made it more meaningful. These might have further enhanced their immersive and enjoyable experience.

Besides, a lot of participants from location-based recruitment might be for the first time to fill in game experience assessing questions, they might not fully understand each question statement in this section, giving the results of each question based on their overall experience.

5.3 Tangential Learning

18 participants had tangential learning experiences, with 13 playing Game B (proposed model) and 5 playing Game A (traditional model). This supports hypothesis H4 that Game B could lead to tangential learning experiences.

The tangential learning of the 13 participants of Game B might be facilitated by the proposed game skin acquisition model compared to their previous game experience. On the other hand, the 5 participants who played Game A may achieve tangential learning due to the emphasis placed on searching for information in the questionnaire.

The prevalent positive responses regarding reward mechanics and pricing strategy suggest that participants with tangential learning experiences tended to exhibit a more positive attitude toward these specific aspects of the games. This trend is particularly evident in those participants who have tangential learning experiences, and it could be the key factor that enables them to tangential learning. Further research is required to determine which factors facilitate tangential learning from the game's skin acquisition model.

5.4 Limitation

Game Design Flaws. Due to time constraints, the development of a test game with a storyline and corresponding game world settings was not feasible in this study. This limitation restricted efforts to integrate sustainability concepts related to clothing more deeply into textual information and narrative justifications [5]. Consequently, learning in Game B heavily relied on participants' curiosity about pricing strategy and their ability to learn from tangential, curiosity-driven learning, rather than learning from the game context. Reflecting on the experiment results, there's no significant positive change observed in participants' awareness linked to clothing in Game B.

Confusion between Measurement of Awareness and Attitudes. Although there's a clear difference between the definition of sustainable awareness and attitudes, the questions measuring sustainable awareness and attitudes are designed with the same logic with similar sentences. Especially, compared the Questionnaire for assessing sustainability awareness by Garbie [20] and the Questionnaire by Lavelle et al. [28] and *Attitudes of Europeans towards the Environment* [7] referenced in this study. In this study, the questions assessing sustainable awareness and attitudes are mainly differentiated by the general scope of attitudes and clothing-related awareness containing the knowledge. However, the confusion between the measurement of sustainable awareness and attitudes might lead to different classifications of the questions in this study, resulting in different conclusions regarding hypotheses H1 and H2.

Methodological Constraints in Game Information Collection. The absence of a reliable server for direct game data collection led to a reliance on participants' self-reports based on information presented on profile pages in the test game. This introduced risks of inaccuracies due to potential errors in participant reporting, making the collected information less reliable. Therefore, no data analysis was conducted for the game information in this study. As a result, a deeper analysis of the reasons behind the experimental results with the support of the participants' game information was not possible.

6 CONCLUSION

This study delves into the potential of games as a unique platform to raise awareness about the resource consumption of clothing production. We explore the intricacies of game skin acquisition, its influence on players' identity and engagement, and the potential of games in learning. Examining game skin and its related pricing strategy and reward mechanics, we aim to convey sustainable concepts related to in-game clothing, drawing parallels with real-world fashion.

The experiment examines the intricate dynamics of player awareness and attitudes toward sustainability issues related to clothing, game experience, and tangential learning in the context of two game skin acquisition models: traditional and proposed. The proposed model employs the water footprint of real clothing as the pricing strategy of game skin, using a water icon as the currency symbol. In contrast, the traditional model uses a gold icon with the same price for each game skin.

Results show that the proposed game skin acquisition model significantly increases player attitudes towards general sustainability, especially toward paying higher taxes for environmental protection. It also demonstrates that the proposed game skin acquisition model has no impact on participants' awareness linked to clothing, while the player is becoming more mindful of the resource consumption of clothing before purchasing. Importantly, the gaming experience remains not compromised, with the proposed model yielding more positive responses than the traditional model for 10 out of 11 items in the mini PXI. The occurrence of tangential learning was also more frequent in the proposed model, and a possible linear connection exists where participants with tangential learning experiences generally exhibit more positive attitudes toward reward mechanics and pricing strategy. However, the intricate logic and factors behind tangential learning warrant further research.

In conclusion, this study initially researched and proved a game skin acquisition model can effectively foster positive attitudes toward general sustainability issues while facilitating tangential learning. Further research is needed to explore the key design factors of the game skin acquisition model that facilitate tangential learning. Moreover, it is necessary to explore how to incorporate sustainability concepts into the game's storyline with more textual information and narrative justification to help participants learn from the game's context and promote tangential learning. The ultimate goal, following the widespread adoption of the game skin acquisition model, is to shape new social norms around clothing consumption, potentially sparking behavioral shifts not only within the gaming community but also in the general public.

REFERENCES

- [1] Stefano Abbate, Piera Centobelli, Roberto Cerchione, Simon Peter Nadeem, and Emanuela Riccio. 2023. Sustainability trends and gaps in the textile, apparel and fashion industries. *Environment, Development and Sustainability*. DOI: <http://doi.org/10.1007/s10668-022-02887-2>.
- [2] ADA. 2021. Fabric weight explained. Accessed on: April, 2021. <https://www.sartorbohemia.com/article/82/fabric-weight-guide/>.
- [3] Christian Allaire. 2021. Video games are becoming a high-fashion playground. *Vogue*. (Oct. 12, 2021). <https://www.vogue.com/article/video-game-fashion-designer-collaborations>.
- [4] R.S. Alsawaier. 2018. The effect of gamification on motivation and engagement. *International Journal of Information and Learning Technology*, 35, 1, 56–79. DOI: 10.1108/IJILT-02-2017-0009.
- [5] Sky LaRell Anderson. 2019. The interactive museum: video games as history lessons through lore and affective design. *E-Learning and Digital Media*, 16, 3, 177–195. DOI: 10.1177/2042753019834957.
- [6] Eric Arias. 2019. How does media influence social norms? experimental evidence on the role of common knowledge. *Political Science Research and Methods*, 7, 3, 561–578. DOI: 10.1017/psrm.2018.1.
- [7] 2020. Attitudes of europeans towards the environment. Fieldwork Date: December 2019 - December 2019, Publication Date: March 2020, EU Institution: European Commission. European Commission. <https://europa.eu/eurobaromet er/surveys/detail/2257>.
- [8] Russell W. Belk. 2013. Extended self in a digital world. *Journal of Consumer Research*, 40, 3, 477–500. DOI: 10.1086/671052.
- [9] Stéphane Bouchard, Sophie Côté, Julie St-Jacques, Geneviève Robillard, and Patrice Renaud. 2006. Effectiveness of virtual reality exposure in the treatment of arachnophobia using 3d games. *Technology and Health Care*, 14, 1, 19–27. DOI: 10.3233/THC-2006-14103.
- [10] Xiaowei Cai, Javier Cebollada, and Mónica Cortiñas. 2022. A grounded theory approach to understanding in-game goods purchase. *PLOS ONE*, 17, 1, (Jan. 2022). DOI: 10.1371/journal.pone.0262998.
- [11] C. Carbonell-Carrera, A.J. Jaeger, J.L. Saorin, D. Melián, and J. de la Torre-Cantero. 2021. Minecraft as a block building approach for developing spatial skills. *Entertainment Computing*, 41, Page Range. DOI: 10.1016/j.entcom.2021.10 0427.
- [12] Liang Chen, Dan Liu, Winnie W. Cheng, and Ruimin Huang. 2016. Game-based learning and 21st century skills: a review of recent research. *Computers in Human Behavior*, 63, 50–58. DOI: 10.1016/j.chb.2016.05.023.
- [13] Douglas Clark, Brian Nelson, Pratim Sengupta, and Cynthia D'Angelo. 2009. Rethinking science learning through digital games and simulations: genres, examples, and evidence. In *Learning science: Computer games, simulations, and education workshop sponsored by the National Academy of Sciences, Washington, DC*. (Oct. 2009). https://sites.nationalacademies.org/cs/groups/dbasseite/documents/webpage/dbasse_080068.pdf.
- [14] Thomas M Connolly, Elizabeth A Boyle, Ewan MacArthur, Thomas Hainey, and James M Boyle. 2012. A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education*, 59, 2, 661–686. DOI: 10.1016/j.compedu.2012.03.004.
- [15] Cristina Criddle. 2021. Burberry designs skins for honor of kings characters. BBC. (Mar. 24, 2021). <https://www.bbc.com/news/technology-56511343>.
- [16] Sebastian Deterding, Dan Dixon, Rilla Khaleel, and Lennart Nacke. 2011. From game design elements to gamefulness: defining "gamification". In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9–15. DOI: 10.1145/2181037.2181040.
- [17] Matthew Farber and Karen Schrier. 2017. The Limits and Strengths of Using Digital Games as "Empathy Machines". Working Paper. UNESCO MGIEP. <http://mgiep.unesco.org/article/working-paper-5-the-limits-and-strengths-of-using-digital-games-as-empathy-machines>.
- [18] Peter Fischer, Jonas Kubitzki, Sven Guter, and Dieter Frey. 2007. Virtual driving and risk taking: do racing games increase risk-taking cognitions, affect, and behaviors? *Journal of Experimental Psychology: Applied*, 13, 22–31. DOI: 10.1037/1076-898X.13.1.22.
- [19] D. Floyd and J. Portnow. 2008. Video games and learning. Online video. (2008). <http://www.youtube.com/watch?v=rN0qRKjFX3s>.
- [20] 2016. *Sustainability awareness. Sustainability in Manufacturing Enterprises: Concepts, Analyses and Assessments for Industry 4.0*. Springer International Publishing, 131–150. ISBN: 978-3-319-29306-6. DOI: 10.1007/978-3-319-29306-6_12.
- [21] Aqeel Haider, Casper Hartevelde, Daniel Johnson, Max V. Birk, Regan L. Mandryk, Magy Seif El-Nasr, Lennart E. Nacke, Kathrin Gerling, and Vero Vanden Abeele. 2022. Minipxi: development and validation of an eleven-item measure of the player experience inventory. *Proceedings of the ACM on Human-Computer Interaction*, 6, (Nov. 2022), 1–26. DOI: 10.1145/3549507.
- [22] Juho Hamari and Lauri Keronen. 2016. Why do people buy virtual goods? a literature review. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. IEEE. (Apr. 2016), 1358–1367. DOI: 10.1109/HICSS.2016.171.

- [23] Yioula Melanthiou Ioanna Papasolomou and Anestis Tsamouridis. 2023. The fast fashion vs environment debate: consumers' level of awareness, feelings, and behaviour towards sustainability within the fast-fashion sector. In *Journal of Marketing Communications*, 29:2, 191–209. doi: 10.1080/20932685.2021.2016063.
- [24] Karl M. Kapp, Lucas Blair, and Rich Mesch. 2014. *The Gamification of Learning and Instruction Fieldbook: Ideas into Practice*. Wiley.
- [25] Insaf Khelladi, Catherine Lejealle, Saeedeh Rezaee Vessal, and Sylvaine Castellano. 2021. Individuals' motivations to purchase virtual clothes. In *2021 IEEE International Conference on Technology Management, Operations and Decisions (ICTMOD)*, 1–5. doi: 10.1109/ICTMOD52902.2021.9739372.
- [26] Kia Kokalitcheva. 2016. Newzoo: u.s. gamers are in love with skins and in-game cosmetics. (Apr. 2016). <https://venturebeat.com/games/newzoo-u-s-gamers-are-in-love-with-skins-and-in-game-cosmetics/>.
- [27] Jeanine Krath, Linda Schürmann, and Harald FO von Korfflesch. 2020. Revealing the theoretical basis of gamification: a systematic review and analysis of theory in research on gamification, serious games and game-based learning. *Computers & Education*, 146, 103739. doi: 10.1016/j.chb.2021.106963.
- [28] Mary Jo Lavelle, Henrike Rau, and Frances Fahy. 2015. Different shades of green? unpacking habitual and occasional pro-environmental behavior. *Global Environmental Change*, 35, 368–378. doi: <https://doi.org/10.1016/j.gloenvcha.2015.09.021>.
- [29] Vili Lehdonvirta. 2009. Virtual item sales as a revenue model: identifying attributes that drive purchase decisions. *Electronic Commerce Research*, 9, 1-2, 97–113. doi: 10.1007/s10660-009-9028-2.
- [30] Ben Marder, David Gattig, Elizabeth Collins, Leyland Pitt, Jan Kietzmann, and Antonia Erz. 2019. The avatar's new clothes: understanding why players purchase non-functional items in free-to-play games. *Computers in Human Behavior*, 90, 160–167. doi: 10.1016/j.chb.2018.09.006.
- [31] Lisa McNeill and Rhiannon Moore. 2015. Sustainable fashion consumption and the fast fashion conundrum: fashionable consumers and attitudes to sustainability in clothing choice. *International Journal of Consumer Studies*, 39, 3, 212–222. doi: <https://doi.org/10.1111/ijcs.12169>.
- [32] Peter Mozelius, Andreas Fagerström, and Max Söderquist. 2017. Motivating factors and tangential learning for knowledge acquisition in educational games. *Electronic Journal of e-Learning*, 15, 343–354. <https://api.semanticscholar.org/CorpusID:49321230>.
- [33] Nicole Phelps. 2019. Louis vuitton's new capsule with league of legends brings french high fashion to online gaming—and vice versa. *Vogue*. (Dec. 9, 2019). <https://www.vogue.com/article/louis-vuittons-new-capsule-with-league-of-legends>.
- [34] [n. d.] Plastic pollution coalition - plastic in hollywood. Retrieved May 5, 2022 from <https://www.plasticpollutioncoalition.org/tag/plastic-in-hollywood>.
- [35] Alia Reza, Sabrina Chu, Adanna Nedd, and Daniel Gardner. 2022. Having skin in the game: how players purchase representation in games. *Convergence*, 28, 4, (May 2022), 1354–8565. doi: 10.1177/13548565221099713.
- [36] Astrid Sailer, Harald Wilfing, and Eva Straus. 2022. Greenwashing and bluewashing in black friday-related sustainable fashion marketing on instagram. *Sustainability*, 14, 3. doi: 10.3390/su14031494.
- [37] Katie Seaborn and Deborah I. Fels. 2015. Gamification in theory and action: a survey. *International Journal of Human-Computer Studies*, 74, 14–31. doi: 10.1016/j.ijhcs.2014.09.006.
- [38] Constance A Steinkuehler and Sean C Duncan. 2008. Scientific habits of mind in virtual worlds. *Journal of Science Education and Technology*, 17, 6, 530–543. doi: 10.1007/s10956-008-9120-8.
- [39] Sufia Munir, and Vivek Mohan. 2022. Consumer perceptions of greenwashing: lessons learned from the fashion sector in the UAE. In *Asian Journal of Business Ethics volume 11*, 1–44. doi: <https://doi.org/https://doi.org/10.1007/s13520-021-00140-z>.
- [40] Zeynep Tanes and Zeynep Cemalcilar. 2010. Learning from SimCity: an empirical study of turkish adolescents. *Journal of Adolescence*, 33, 5, 731–739. doi: 10.1016/j.adolescence.2009.10.007.
- [41] WWF7 Team. 2023. The water footprint of a pair of jeans. Accessed on: July, 2023. <https://worldwaterforum7.org/the-water-footprint-of-a-pair-of-jeans/>.
- [42] Julie Tenz. 2016. A father, a dying son, and the quest to make the most profound videogame ever. (Jan. 2016). Retrieved May 20, 2017 from <https://www.wired.com/2016/01/that-dragoncancer/>.
- [43] Selen Turkay and Sonam Adinolf. 2012. What do players (think they) learn in games? *Procedia - Social and Behavioral Sciences*, 46, 3345–3349. 4th WORLD CONFERENCE ON EDUCATIONAL SCIENCES (WCES-2012) 02-05 February 2012 Barcelona, Spain. doi: <https://doi.org/10.1016/j.sbspro.2012.06.064>.
- [44] Heikki Tyni, Olli Sotamaa, and Saara Toivonen. 2011. Howdy pardner!: on free-to-play, sociability and rhythm design in frontierville. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*. ACM, 22–29. doi: 10.1145/2181037.2181042.
- [45] United Nations Economic Commission for Europe. 2018. Sustainable fashion: challenges and opportunities. Presentation at the Regional Forum on Sustainable Development for the UNECE Region. (Apr. 2018). https://unece.org/fileadmin/DAM/RCM_Website/RFSD_2018_Side_event_sustainable_fashion.pdf.
- [46] unknown. unknown. Calculating the water footprint of cow skin leather goods. Accessed on: unknown. <https://circumfauna.org/leather-water-footprint>.
- [47] unknown. 2023. Polyester fabric vs. natural fabric resources consumption. Accessed on: March, 2023. <https://www.jongstic.com/en/blog/resources-consumption#:~:text=1.3%20Water%20%3A%20Polyester%20fabric%20production,carb on%20dioxide%20into%20the%20atmosphere..>
- [48] Veda. 2022. Real money for virtual clothes: the new trend in digital fashion. *Analytics Insight*. (Mar. 10, 2022). <https://www.analyticsinsight.net/real-money-for-virtual-clothes-the-new-trend-in-digital-fashion/>.
- [49] William R. Watson, Christopher J. Mong, and Carla Amaro Harris. 2011. A case study of the in-class use of a video game for teaching high school history. *Computers & Education*, 56, 466–474. doi: 10.1016/j.compedu.2010.09.007.
- [50] Juxiang Zhu, Yiduo Yang, Yi Li, Pinghua Xu, and Laili Wang. 2020. Water footprint calculation and assessment of viscose textile. *Industria Textila*, 71, 1, 33–40.

A QUESTIONNAIRES

A.1 Ethics and Privacy Quick Scan

Section 1. Research projects involving human participants.

P1. Does your project involve human participants? This includes, for example, the use of observation, (online) surveys, interviews, tests, focus groups, and workshops where human participants provide information or data to inform the research. **Yes**

Recruitment

P2. Does your project involve participants younger than 18 years of age? **Yes**

P3. Does your project involve participants with learning or communication difficulties of a severity that may impact their ability to provide informed consent? **No**

P4. Is your project likely to involve participants engaging in illegal activities? **No**

P5. Does your project involve patients? **No**

P6. Does your project involve participants belonging to a vulnerable group, other than those listed above? **No**

Ethics Warning. As you are dealing with vulnerable participants (yes to one (or more) of P2-P6), a fuller ethical review is required. Please add more detail on your participants here:

We will post the participant recruitment on Reddit, but we cannot guarantee that every participant is above 18.

P7. Do you intend to be alone with a research participant or have to take sole responsibility for the participants at any point during your research activity? **No**

P8. Does your project involve participants with whom you have, or are likely to have, a working or professional relationship: for instance, staff or students of the university, professional colleagues, or clients? **Yes**

P9. Is it made clear to potential participants that not participating will in no way impact them (e.g., it will not directly impact their grade in a class)? **Yes**

Informed consent

PC1. Do you have set procedures that you will use for obtaining informed consent from all participants, including (where appropriate) parental consent for

children or consent from legally authorized representatives? (See suggestions for information sheets and consent forms on the website.) **Yes**

PC2. Will you tell participants that their participation is voluntary? **Yes**

PC3. Will you obtain explicit consent for participation? **Yes**

PC4. Will you obtain explicit consent for any sensor readings, eye tracking, photos, audio, and/or video recordings? **Not applicable**

PC5. Will you tell participants that they may withdraw from the research at any time and for any reason? **Yes**

PC6. Will you give potential participants time to consider participation? **Yes**

PC7. Will you provide participants with an opportunity to ask questions about the research before consenting to take part (e.g., by providing your contact details)? **Yes**

PC8. Does your project involve concealment or deliberate misleading of participants? **No**

Section 2. Data protection, handling, and storage.

D1. Are you gathering or using personal data (defined as any information relating to an identified or identifiable living person)? **No**

Section 3. Research that may cause harm.

H1. Does your project give rise to a realistic risk to the national security of any country? **No**

H2. Does your project give rise to a realistic risk of aiding human rights abuses in any country? **No**

H3. Does your project (and its data) give rise to a realistic risk of damaging the University's reputation? (E.g., bad press coverage, public protest.) **No**

H4. Does your project (and in particular its data) give rise to an increased risk of attack (cyber- or otherwise) against the University? (E.g., from pressure groups.) **No**

H5. Is the data likely to contain material that is indecent, offensive, defamatory, threatening, discriminatory, or extremist? **No**

H6. Does your project give rise to a realistic risk of harm to the researchers? **No**

H7. Is there a realistic risk of any participant experiencing physical or psychological harm or discomfort? **No**

H8. Is there a realistic risk of any participant experiencing a detriment to their interests as a result of participation? **No**

H9. Is there a realistic risk of other types of negative externalities? **No**

Section 4. Conflicts of interest.

C1. Is there any potential conflict of interest (e.g., between research funder and researchers or participants and researchers) that may potentially affect the

research outcome or the dissemination of research findings? **No**

C2. Is there a direct hierarchical relationship between researchers and participants? **No**

Section 5. Your information.

Z0. Which is your main department? **Information and Computing Science**

Z1. Your full name: **Ruisi Wang**

Z2. Your email address: **r.wang4@students.uu.nl**

Z3. In what context will you conduct this research?
As a student for my master thesis, supervised by: Nina Rosa

Z5. Master programme for which you are doing the thesis **Game and Media Technology**

Z6. Email of the course coordinator or supervisor (so that we can inform them that you filled this out and provide them with a summary): **n.e.rosa@uu.nl**

Z7. Email of the moderator (as provided by the coordinator of your thesis project): **j.frommel@uu.nl**

Z8. Title of the research project/study for which you filled out this Quick Scan: **Enhancing Sustainable Fashion Awareness through A Game Skin Acquisition Model**

Z9. Summary of what you intend to investigate and how you will investigate this (200 words max):

As a part of my research, I plan to study the participants' awareness and attitudes about the clothing production industry. The research will involve the following steps: all participants will be required to complete a consent form and a pre-test questionnaire. Then, they will need to install and play the game we provide, following the given guidelines. Finally, they will have to fill out the post-questionnaire after completing the game.

Z10. In case you encountered warnings in the survey, does the supervisor already have ethical approval for a research line that fully covers your project? **No**

Scoring.

Privacy: 0

Ethics: 1

A.2 Game Participant Guideline

Welcome to our serious gaming experiment! In this experiment, you will have the opportunity to participate in either Game A or Game B. Please follow these steps to participate:

Step 1: Pre-Test Questionnaire. Please note that a pre-test questionnaire is required prior to starting. The questionnaire includes a participant consent form that must be read and checked by every participant. This questionnaire will gather some initial information about your awareness and attitudes towards certain topics. To ensure smooth data analysis, please provide the username you intend to register in the test game. It is essential that you answer all the questions honestly and to the best of your knowledge.

You can access the questionnaire through the following link: [Pre-Test Questionnaire](#).

Step 2: Game Download and Installation. After completing the pre-test questionnaire, you can download it by accessing the [Game](#). Once downloaded and decompressed, you will find an executable file named "Ultimate Sprint" within the folder. We kindly advise you to adhere to the following steps to ensure a smooth gaming experience, after you double-click the executable file to play the game.

Step 3: Game Instructions and Practice. Before beginning the game, please make sure that your login username matches the one you provided in the pre-test questionnaire. By logging in with this username, you will be able to maintain your previous game progress.



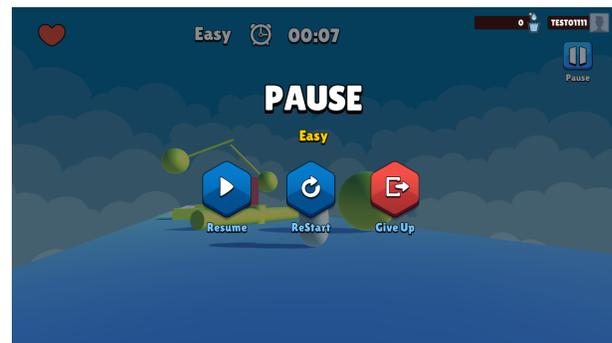
To access your "Profile" page after logging in, simply click on the avatar located in the top right corner. In the "Badges" section, you can view the achievements you need to complete and the corresponding skin rewards. Additionally, the "Shop" section allows you to browse and purchase different skins. If you want to play game levels of varying difficulty, you can select "Easy," "Medium," or "Hard." Once you successfully pass a level, a new instance with the difficulty level you selected will be loaded.



Specific Gameplay Instructions:

- To control the character's movement, use the arrow keys on your keyboard. Press up for moving forward, down for moving backwards, left for moving leftward, and right for moving rightward. To make the character jump, press the space bar.

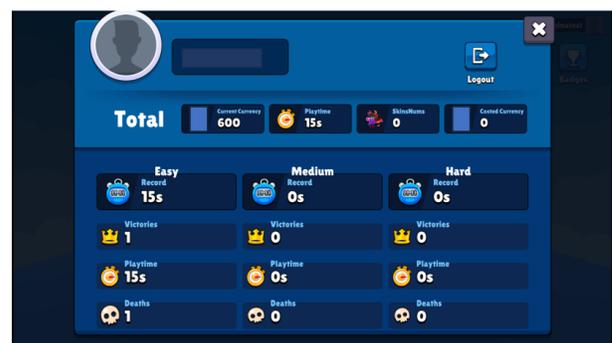
- To adjust the character's perspective, move your mouse.
- If you need to pause the game, choose "Pause" using your mouse. You can then select a new game state (Resume/Restart/Give Up).



Win/Lose Conditions: In this game, the goal is to lead the character to the finish line and successfully complete the level. However, if the character falls off the track more than once, the level will be considered a failure. In the event of the character's first slip, they will be returned to their initial position where they slipped.

Exiting the Game: To exit the game, simply close the .exe file. However, it is important to use the same username to retain progress and achievements.

Step 4: Participate in the Game Experiment. Active participation is required for the game experiment, which includes completing achievements in the Badges section and purchasing game skins from the Shop. We strongly encourage you to engage with the game as much as possible. Additionally, we kindly suggest that you log into the game for three consecutive days. The post-test questionnaire will be available on Day 3 of the participant recruitment phase.





Please note that the link to the post-test questionnaire will only be accessible from your Profile page after you have purchased at least three skins from the Shop and passed all the achievements in Badges. Your engagement and feedback are highly valuable to our research.

Thank you for your dedication and active participation in the game experiment. If you have any questions or concerns, feel free to contact us. Happy gaming!

A.3 Pre-test Questionnaire

Consent Form.

Consent form for participation in the research project "Enhancing Sustainable Fashion Awareness through A Game Skin Acquisition Model" Please read the statements below and tick the final box to confirm you have read and understood the statements and upon doing so agree to participate in the project.

- I confirm that I am 18 years of age or over.
- I confirm that the research project "Enhancing Sustainable Fashion Awareness through A Game Skin Acquisition Model" has been explained to me. I have had the opportunity to ask questions about the project and have had these answered satisfactorily. I had enough time to consider whether to participate.
- I consent to the material I contribute being used to generate insights for the research project "Enhancing Sustainable Fashion Awareness through A Game Skin Acquisition Model".
- I understand that my participation in this research project is completely anonymous.
- I understand that my participation in this research is voluntary and that I may withdraw from the study at any time without providing a reason, and that if I can request any data collected from me to be deleted by providing the username I used in the test game.
- I understand that fully participating in the research project will take around 1 hour to finish the pre-test questionnaire, download and play the test game, and finish the post-test questionnaire.
- I consent to allow the fully anonymized data to be used in future publications and other scholarly

means of disseminating the findings from the research project.

- I understand that the data acquired will be securely stored by researchers, but that appropriately anonymized data may, in the future, be made available to others for research purposes. I understand that the University may publish appropriately anonymized data in appropriate data repositories for verification purposes and to make it accessible to researchers and other research users.

I confirm that I have read and understood the above statements, and agree to participate in the study.

Demographics.

Username: (Please enter the username that you intend to register in the test game. Your username should ideally consist of a combination of letters and numbers, limited to a maximum of nine characters, e.g., John123.) Please remember this name, as it will be needed when filling out the post-test questionnaire to categorize it with the pre-test questionnaire completely anonymously.

Age:

- Below 18
- 18-25
- 26-35
- 36-45
- 46-60
- Above 60

Gender:

- Male
- Female
- Non-binary / third gender
- Prefer not to say

Awareness and Attitudes.

I would be willing to accept cuts in my standards of living, if it helped to protect the environment

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I would be willing to pay higher prices for goods and services, if it helped to protect the environment

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I would be willing to support higher taxes, if it helped to protect the environment

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree

- Somewhat agree
- Strongly agree

I would be willing to sacrifice some personal comforts, in order to save energy

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I feel my own personal behaviour can bring about positive environmental change

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Have you ever considered the resource consumption (e.g., water, energy, materials) of a clothing product before purchasing it

- No
- Maybe
- Yes

Would you be willing to change your purchasing decisions on clothing towards more sustainable choices if provided with information on the environmental impact and resource consumption involved in production?

- No
- Maybe
- Yes

Clothing should be made to last longer

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Clothing should only be made from materials that can be recycled

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Second-hand clothing should be promoted more (e.g., through tax cuts)

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Clothes labelling should provide information on their environmental impacts

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree

- Strongly agree

In this section, please choose the options that you are knowledgeable about regarding the environmental impact of the clothing production industry. All options listed are accurate.

How many facts listed below do you know?

- Around 20% of industrial wastewater pollution worldwide originates from the fashion industry
- Approximately 60% of all materials used by the fashion industry are made from plastic
- 500,000 tons of microfibers are released into the ocean each year from washing clothes
- The fashion industry is responsible for 8-10% of humanity's carbon emissions
- People bought 60% more clothes in 2014 than in 2000, but they only kept them for half as long.
- Water-based dyes have been shown to reduce chemical pollution in water bodies by 40% compared to traditional dyeing methods
- Deforestation caused by the fashion industry has led to the loss of 80 million acres of forest
- Approximately 60% of textile waste is incinerated, contributing to air pollution
- Textile manufacturing processes currently consume an average of 2,500 litres of water per kilogram of fabric produced
- Over 75% of textile trash is disposed of in landfills globally

A.4 Post-test Questionnaire

Demographics.

Username: (Enter the username you used to register in the test game and pre-test questionnaire.)

Which game did you test?

- Game A
- Game B

Game Experience.

Playing the game was meaningful to me.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I wanted to explore how the game evolved.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I felt I was good at playing this game.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I felt free to play the game in my own way.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I was fully focused on the game.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

The game gave clear feedback on my progress towards the goals.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I liked the look and feel of the game.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

The game was not too easy and not too hard to play.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

It was easy to know how to perform actions in the game.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

The goals of the game were clear to me.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I had a good time playing this game.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

What improvements, if any, would enhance your gaming experience?*open question*

To complete the questions below, please refer to the game information on your Profile page within your test game.

- Total Playtime
- Playtime of Easy Level
- Playtime of Medium Level
- Playtime of Hard Level
- Current Currency
- Costed Currency

How many game skins have you purchased?

- 3
- 4
- 5
- 6
- 7
- 8
- 9

How many days have you played for this test game?

- 1
- 2
- 3
- >3

Are you satisfied with the rewards you receive based on your in-game performance, such as winning or losing each level?

- Strongly dissatisfied
- Somewhat dissatisfied
- Neither satisfied nor dissatisfied
- Somewhat satisfied
- Strongly satisfied

Do you feel satisfied with the price settings of the game skins in the game shop?

- Strongly dissatisfied
- Somewhat dissatisfied
- Neither satisfied nor dissatisfied
- Somewhat satisfied
- Strongly satisfied

Based on your experience with the test game, do you believe that the strategy used for setting the prices is reasonable?

- No
- Maybe
- Yes

Based on your understanding of the pricing strategy in the game you tested, would you be willing to search for some information to support your idea?

- No
- Maybe
- Yes

Have you searched for any information that can support your idea yet?

- No
- Yes

Could you share your understanding of the pricing strategy in the game you tested?*open question*

Awareness and Attitudes.

I would be willing to accept cuts in my standards of living, if it helped to protect the environment

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I would be willing to pay higher prices for goods and services, if it helped to protect the environment

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- Strongly agree

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- Neither agree nor disagree
- Somewhat agree
- Strongly agree

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- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

Clothes labelling should provide information on their environmental impacts

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

In this section, please choose the options that you are knowledgeable about regarding the environmental impact of the clothing production industry. All options listed are accurate.

How many facts listed below do you know?

- Less than 1% of textiles are recycled back into clothes
- Pyrolysis is a desirable substitute for incineration in textile waste treatment
- Textile industry amount for 35% of microplastic pollution in the ocean.
- Producing polyester releases two to three times more carbon emissions than cotton
- Fashion companies went from an average offering of two collections per year in 2000 to five in 2011.
- Textile dyeing is the world's second-largest polluter of water since the water leftover from the dyeing process is often dumped into ditches, streams, or rivers
- Deforestation caused by the fashion industry has led to the loss of 80 million acres of forest
- The fashion industry is also the second-largest consumer of water worldwide
- Textile manufacturing processes currently consume an average of 2,500 litres of water per kilogram of fabric produced
- 25% of textile waste is reused or recycled