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A palm game design as a development communication strategy to increase knowledge of sustainable oil palm for gen z and millennials in Jakarta

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Abstract: Oil Palm is often associated with environmental disasters, as its cultivation leads to the destruction of primary forests and contributes to climate change. Negative perceptions about oil palm have been increasingly amplified across social media platforms. Therefore, it is crucial to promote sustainable oil palm practices and counter these negative narratives through various channels, particularly digital media. This research focuses on creating a mobile game about oil palm, targeting the millennial and Gen Z communities. The game serves as an educational tool to address growing concerns in both Indonesian and international society regarding oil palm's environmental and social impacts, including deforestation, biodiversity loss, social conflicts, and climate change. These issues are frequently discussed on platforms like Facebook, YouTube, and Twitter. By employing the ADDIE method, this research designed a game as part of a development communication strategy that blends education with entertainment. The goal is to raise awareness about sustainable oil palm practices among millennials and Gen Z in Jakarta.

Keywords: *Digital media, Education, game, Oil palm, Sustainability.*

1. Introduction

In 2015, negative perceptions of oil palm rapidly spread through social media platforms like Facebook, YouTube, and Twitter. Facebook and YouTube predominantly portrayed oil palm as a health threat, while Twitter emphasized its negative environmental impacts. Facebook and YouTube often focused on individual health concerns, whereas Twitter became a platform for discussions on environmental degradation linked to oil palm production. (Corcionali *et al.* 2016).

In response to these claims, a concerted effort is needed to promote sustainable oil palm practices and counter negative narratives, particularly through digital media. The Indonesian government, alongside the Ministry of Communication and Information, the Oil Palm Plantation Fund Management Agency, and the Coordinating Ministry for the Economy, launched a political marketing campaign in September 2019. This campaign, using the hashtag #*SawitBaik* on Twitter, was aimed at informing and educating the public while fostering global goodwill and raising awareness about the benefits of oil palm (Khairiza and Kusumasari 2020). Hashtags serve as symbols for larger movements, encouraging individuals to participate in broader advocacy efforts (Axel *et al.* 2010). Twitter, with its fast-paced information sharing, has been particularly effective for online advocacy (Burger Tobias 2015).

It is not only the government that advocates for oil palms through various media platforms; oil palm producers have also taken to social media to promote a positive image of the product. Producers aim to shape public opinion, while food manufacturers and retailers use Twitter as a marketing tool to inform consumers about their policies regarding oil palm, whether it's through listing products made with certified sustainable oil palm or responding to customer inquiries (Samoggia and Ruggeri 2017). Active engagement from oil palm industry stakeholders is crucial in maintaining a positive image for the sector. Statements from these stakeholders, especially when shared through online media and social platforms, carry significant weight and can influence policy decisions. Key issues shaping policy discussions include (1) forest fires; (2) the formation and dissolution of the Indonesia Oil Palm Pledge

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(IPOP); (3) strengthening the Indonesian Sustainable Oil Palm (ISPO) certification; (4) discussion of the Oil Palm Plantation Bill; (5) deforestation; (6) BPDP fund allocation; (7) peatland restoration; (8) moratorium the oil palm moratorium; and (9) European Union parliamentary resolutions (Ardian and Azahari 2020).

It is not only the government that advocates for oil palms through various media; oil palm producers also actively use social media to advocate for oil palms. Oil palm producers target through public opinion promotion of a positive image of oil palm. Food manufacturers and retailers aim to use Twitter accounts as a marketing instrument so as to inform consumers about their company's policy on the use of oil palm, a list of food products made with certified oil palm or free oil palm, or to react and answer to consumer requests, such as questions, doubts or complaints (Samoggia and Ruggeri 2017). The importance of participation from oil palm industry stakeholders in maintaining the positive image of oil palm. Statements or attitudes from oil palm industry stakeholders published in online media and social media carry a strong influence, representing the strategic position of certain stakeholders that are assumed to be able to influence policy formulation or the change process. Several indicators of stakeholder involvement that influence policy changes include issues regarding: (1) forest and land fires; (2) the formation and dissolution of the Indonesia Oil Palm Pledge (IPOP); (3) strengthening ISPO; (4) discussion of the Oil Palm Plantation Bill; (5) deforestation; (6) BPDP fund allocation; (7) peatland restoration; (8) oil palm moratorium; and (9) European Union parliamentary resolutions (Ardian *et al.* 2020).

This research focuses on creating a mobile game about oil palm, targeting the public, particularly millennials and Generation Z. The increasing prevalence of negative environmental and social issues surrounding oil palm—both domestically and internationally—has prompted researchers to develop a campaign model centered on mobile games. Oil palm is often blamed for deforestation through land burning, biodiversity loss, social conflict, and climate change. These negative perceptions are widely propagated on social media platforms such as Facebook, YouTube, and Twitter (Corcionali *et al.* 2016). This study develops an oil palm game model using Social Cognitive Theory and Multiple Intelligence Theory as its foundational frameworks.

Albert Bandura's Social Cognitive Theory has proven effective in driving behavioral change through video games. Games based on this theory have shown positive outcomes, as seen in studies where gaming participants demonstrated increased self-efficacy in changing behaviors (Brown *et al.* 1997). In this research, game elements are also integrated with Howard Gardner's Multiple Intelligences Theory (Gardner 2004), which emphasizes a multifaceted approach to learning. This theory acknowledges unique patterns of thinking—referred to as intelligences—and suggests that learning is more effective when activities are tailored to engage these various intelligences. Several aspects of this theory are incorporated into the design of the oil palm mobile game. The game also adopts an edutainment approach, blending entertainment with education to enhance public knowledge. Entertainment education is the deliberate design and delivery of media messages that simultaneously entertain and educate (Singhal and Rogers 1999). This strategy aims to increase audience knowledge on specific topics, foster positive attitudes, shift social norms, and promote behavioral change. While not a communication theory in itself, entertainment education is a powerful strategy for facilitating social and behavioral transformation at the individual, community, and societal levels. It contributes to social change by raising awareness and influencing attitudes and behaviors toward socially beneficial goals. Traditionally, entertainment education has utilized mass media formats like television, radio, film, and print media, but it has also expanded to include crafts, art, textiles, toys, and other creative expressions (Singhal *et al.* 2003). This research specifically designed a mobile game about sustainable oil palm to increase knowledge and awareness among millennial and Gen Z audiences.

2. Research Method

The game design follows the ADDIE model, a widely used framework in the development of game-based learning. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation, and it provides a structured approach to game development. In the context of this project, the ADDIE

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model guided the entire development process of the oil palm game. Each phase contributed to ensuring the game was both educational and engaging for its target audience.

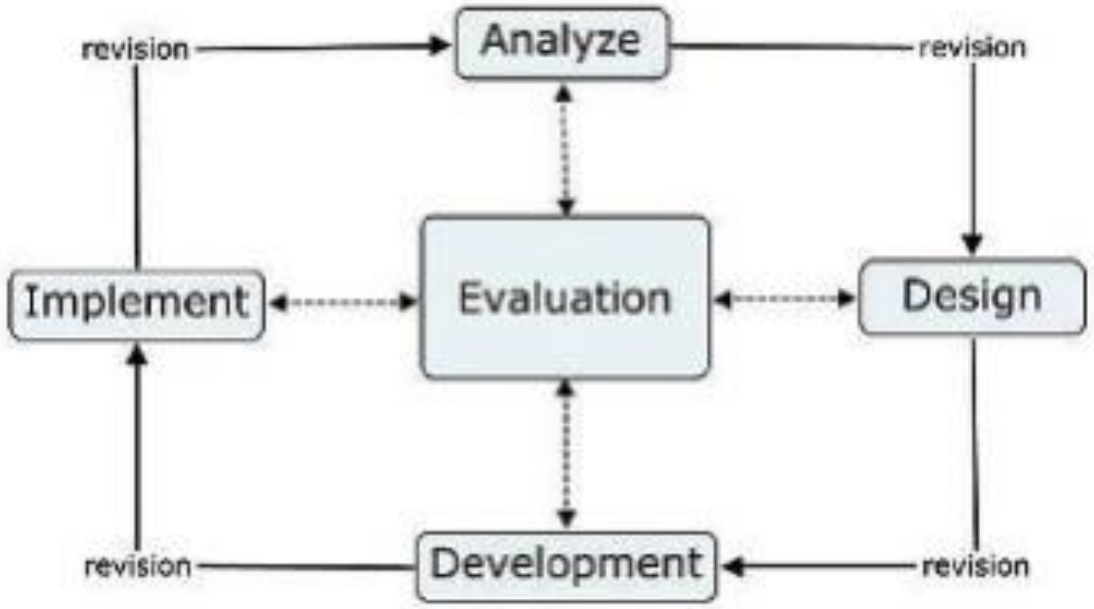

Figure 1.
ADDIE Model.

This section outlines the design and implementation outcomes for the oil palm game. The design phase began after extensive field observations, interviews, literature reviews, and analysis of similar research and applications.

3. Discussion

Oil palm games, as educational media, are specifically designed to promote sustainable oil palm practices. These games fall under the category of educational games, which aim to spark interest in learning by incorporating enjoyable activities into the subject matter. The goal is to make learning more engaging and accessible, allowing users to better understand the content in a fun and interactive way. Educational games have been shown to improve learning outcomes, as seen in research by (Wulandari *et al.* 2017) which found that using interactive multimedia with educational games can significantly enhance elementary student engagement and performance. Their study revealed that learning activities saw an 85.05% improvement, categorized as "very good."

game development with the consideration that this model has been successfully applied in several similar studies

To identify the core challenges, an analysis was conducted using Google Forms to distribute questionnaires to various respondents. The results showed that the use of media for accessing information about oil palm was still limited. Among the respondents, 72.5% of undergraduate students, 52.3% of high school students, and 52.6% of junior high school students agreed that games could be an effective medium for educating people about oil palm. These findings highlighted the gap in oil palm education and served as one of the key motivations for designing the oil palm game.

Design. The design phase marks the initial step in developing the oil palm educational game. During this stage, the focus is on designing the game's content, story, naturalistic flow, and mechanics. The design process was informed by direct observations in the oil palm industry, interviews with oil palm

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experts, and a thorough review of literature, including books and academic journals. The game design is rooted in the understanding that video games have become a powerful educational tool with a unique ability to motivate and challenge players intellectually. Their potential to inspire learning has attracted educators, psychologists, political activists, and health experts who use serious games—games with a purpose beyond entertainment—as a means to foster learning, growth, and positive change. Creating games that are both educational and entertaining presents challenges (Prensky 2001; Van Eck 2006; Schrand 2008). In the health research sector, (Bandura 2006) has been successfully applied to video games, resulting in positive behavioral outcomes, such as increased fruit and vegetable consumption, reduced calorie intake, and improved asthma self-management (Baranowski *et al.* 2008). The design of this oil palm game draws on a new framework called Cognitive Behavioral Game Design (CBGD). This framework integrates SCT, multiple intelligences theory, and game design elements to create a cohesive model aimed at fostering learning and behavior change, particularly among millennials and Generation Z. The goal is to educate these audiences about sustainable oil palm practices in Indonesia through an engaging gaming experience.

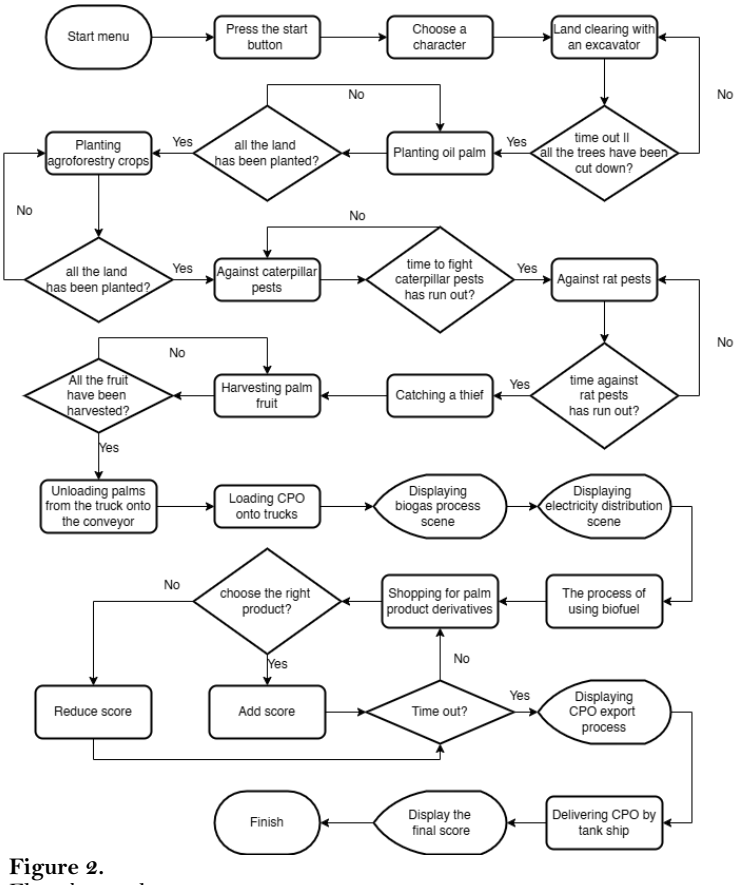

Figure 2.
Flowchart palm game.

The game's flowchart has been designed with simplicity in mind, making it easy for players to navigate. Currently, the game is single-player and focuses on the entire process of cultivating sustainable oil palm, from upstream to downstream. While educational at its core, the game also includes elements of entertainment to keep players engaged.

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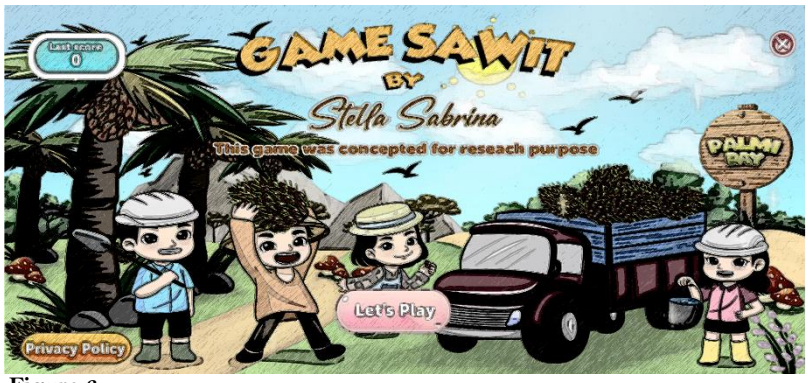

Figure 3.
Menu.

Video game covers selectively highlight specific characteristics and values of a game, thereby shaping a unique discourse for each title. (Oliva *et al.* 2018). For the oil palm-themed game, the cover should reflect the core values of the game's content. It should be visually appealing to attract young players, utilizing a naturalistic art style that aligns with the game's theme. An engaging and visually captivating cover featuring nature-inspired animations will resonate with the game's audience and spark interest in playing.

Figure 4.
Land clearing content.

The practice of burning land by oil palm farmers is influenced by social factors, such as low levels of education and community participation in preventing fires (Syukri *et al.* 2015). The land clearing content in this game aims to educate players on sustainable oil palm cultivation by promoting zero-burning methods. It demonstrates the use of heavy machinery as an environmentally friendly alternative to traditional land-burning practices, raising awareness about responsible land management.

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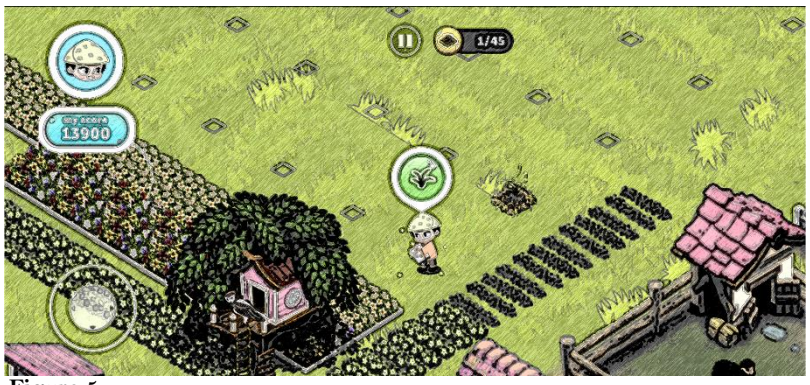

Figure 5.
Oil palm planting content.

Oil palm trees begin to bear fruit approximately three years after planting. They reach peak productivity within 15 years, after which their yield gradually declines, making the plantations economically unfeasible after about 25 years (Ferwerda 1955; Ismail and Mamat 2002; Corley and Tinker 2015). Proper fertilization is crucial for optimizing palm growth and minimizing farming costs. Training programs have proven effective in increasing smallholder knowledge of best management practices (Syahza 2007; Mohd Ishak *et al.* 2020) . Educating farmers about the correct use of fertilizers can greatly enhance productivity and decision-making (Moser and Barrett 2006). Currently, around 50% of small-scale oil palm plantations in Indonesia require replanting within this decade. Replanting offers a sustainable solution to rejuvenate older plantations without expanding into new land, utilizing areas where trees are over 25 years old. This strategy can prevent environmental degradation, which might otherwise occur if new land is cleared or old plantations are burned to reduce costs. Despite the benefits, smallholder farmers face various challenges in replanting, such as financial constraints and lack of support, which have not been sufficiently addressed in previous research. With appropriate assistance, farmers can overcome these obstacles, increasing their income, securing their livelihoods, and promoting environmental sustainability (Petri *et al.* 2023). Therefore, replanting without land expansion is a viable way to demonstrate that oil palm can be cultivated sustainably, affirming its potential as an environmentally friendly crop.

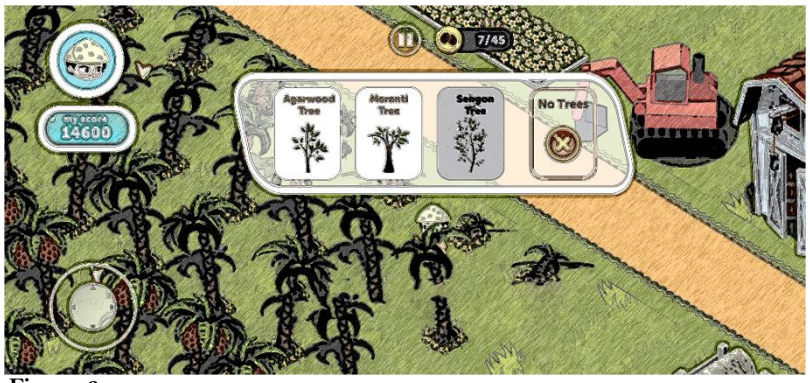

Figure 6.
Agroforestry content.

Oil palm plantations have significant potential for developing intercrops alongside oil palm trees as part of an agroforestry system. Agroforestry is a land management approach that integrates tree species with agricultural or plantation crops to enhance productivity and promote environmental sustainability (Rojidin *et al.* 2018).

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According to (Jose 2009), agroforestry offers four main ecological and environmental benefits: carbon sequestration, soil fertility enhancement, biodiversity conservation, and improved air and water quality. (Dresner *et al.* 2007; Freer-Smith *et al.* 2007) further emphasize that land planted with woody species plays a vital role in preserving natural resources by preventing floods and controlling soil erosion. Despite these benefits, many people, especially in remote areas with limited access to information and transportation, are not fully aware of the advantages of agroforestry. However, as global warming and climate change issues gain more visibility in mass media, such as television and newspapers, public awareness is growing. People are beginning to recognize the negative impacts of climate change and the importance of environmental conservation through tree planting (Lestari and Tejo Premono 2014). The purpose of this agroforestry content is to educate communities on how oil palm trees can be cultivated alongside other crops to support environmental sustainability. By integrating various plant species, agroforestry can help maintain ecosystem balance while enhancing the productivity and resilience of oil palm plantations.

Figure 7.
Fire caterpillar pest content.

The fire caterpillar (*Setothosea asigna*) is one of the most common leaf-eating pests in oil palm plantations, with the highest rate of infestation among pest species. Natural predators like *Sycanus annulicornis* help control fire caterpillar populations, minimizing their impact and reducing the need for chemical pesticides that can harm the environment (Guntoro *et al.* 2024). One of the main challenges faced by oil palm farmers is the threat of plant pest organisms (PPO), such as the fire caterpillar, which can cause damage to both immature and mature plants, with attack rates reaching up to 100%. (Lukmana and Elafia 2018) noted that *S. asigna* is frequently found in plantations and is responsible for the most severe pest attacks.(Priwiratama *et al.* 2019) reported that infestations by *S. asigna* larvae can lead to a 40% decrease in production due to extensive leaf damage. Furthermore, (Priwiratama *et al.* 2019) highlighted that *S. asigna* outbreaks can occur periodically, posing ongoing challenges for plantation management. To combat these pests, farmers often resort to chemical pesticides, which offer quick and effective results. However, the frequent use of synthetic insecticides can lead to environmental issues such as pollution, pest resistance, and resurgence. Therefore, adopting environmentally friendly pest control methods is crucial to maintaining the ecological balance of plantations. (Ngapiyatun *et al.* 2017) The fire caterpillar content in oil palm-themed games serves to educate the public on sustainable plantation practices. It emphasizes the importance of preserving biodiversity by maintaining natural predators around oil palm plantations, thereby reducing the reliance on harmful chemicals. This approach not only protects the environment but also highlights the role of oil palm plantations in promoting ecological sustainability.

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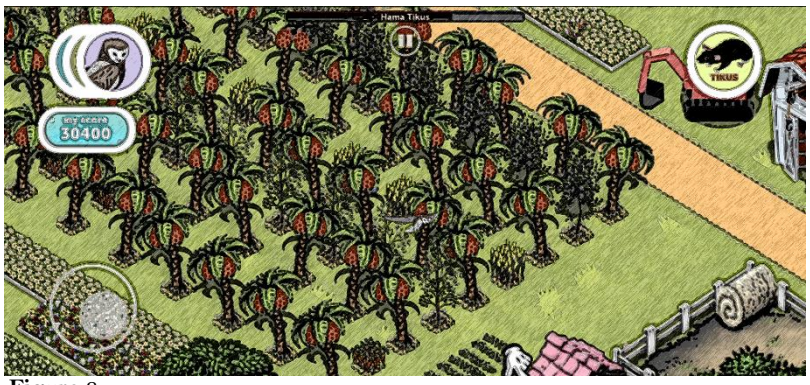

Figure 8.
Rat pests.

Rat infestations in oil palm plantations can significantly impact productivity by feeding on post-anthesis male flowers, which serve as breeding sites for the pollinator beetle *Elaeidobius kamerunicus*. A decline in the population of these beetles due to high rat activity can disrupt pollination and reduce fruit production in oil palms (Budihardjo *et al.* 2019). Biological control methods, such as utilizing the barn owl (*Tyto alba*), have proven effective in managing rat populations (Fadilla *et al.* 2022). *Tyto alba*, also known as the barn owl, is a bird of prey that plays a crucial role in the ecosystem as a top predator in the food chain (Harjanto *et al.* 2016). A single barn owl can prey on 2-5 rats daily, making it a highly effective natural predator for controlling rat populations (Rajagukguk 2014). Using *Tyto alba* not only helps reduce the reliance on chemical rodenticides but also provides a safer and more sustainable pest management solution. For instance, Bumitama Agri Ltd reported a 45% decrease in rodenticide use in 2020 compared to 2019 after implementing biological control methods with barn owls (Ardiyanto *et al.* 2022). Incorporating content on rat control using owls in oil palm plantation-themed games can educate the public about the benefits of reducing rodenticide use. This approach highlights the importance of sustainable pest management practices that safeguard the environment and promote ecological balance.

Figure 9.
Biogas.

Oil palm Mill Effluent (POME) is a byproduct of oil palm processing that can be converted into methane gas, which serves as fuel for biogas power plants (PLTBGS). This methane is produced by

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treating liquid waste collected in a homogenization pond. The pond is equipped with a mechanical filter to reduce solid waste, such as fibers and debris, and an agitator to ensure the quality and uniformity of the POME before it enters the reactor. (Butar-butar *et al.* 2013). This process illustrates how methane gas derived from oil palm waste can be harnessed as a renewable energy source for electricity generation.

Figure 10.
Supplying electricity to the community.

Transforming oil palm liquid waste into energy is part of Indonesia's strategy to reduce global greenhouse gas emissions by 29% by 2030 (ESDM 2016). Biogas from oil palm waste not only optimizes waste management but also contributes to sustainable energy production.

This initiative demonstrates how oil palm plantations play a significant role in environmental conservation by providing a clean energy source that benefits local communities. Incorporating this content into educational platforms can raise awareness about the positive environmental impact of utilizing oil palm waste for electricity generation.

Figure 11.
Biofuel.

Oil palm is a vital commodity with numerous applications. Beyond its use in food products, processed oil palm derivatives are valuable in cosmetics, biodiesel, and bioethanol production (Director General of Plantations, 2020). Indonesia, with its abundant oil palm resources, has the potential to leverage this commodity for long-term sustainable needs. As fossil fuel reserves dwindle, alternative

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energy sources become increasingly critical. By optimizing oil palm for biofuel production, Indonesia can enhance its energy security and reduce reliance on diesel imports(Sudjoko *et al.* 2022).

Figure 12.
Oil palm derivative products quiz.

Many young people are unaware of the diverse derivative products that come from oil palm beyond just cooking oil. The two primary products from processing fresh fruit bunches (FFB) at oil palm mills are crude oil palm (CPO) and palm kernel oil (PKO). These derivatives play a crucial role in the chemical industry, significantly influencing our daily lives. CPO and PKO are used to produce a wide range of downstream products, such as cooking oil (olein), butter, soap, detergent, and even biodiesel. To simplify classification, these downstream products are grouped into categories like oleochemicals, oleo foods, and bioenergy. Oleochemicals, derived from fats and oils, are used in non-food organic chemicals like soap and cosmetics. Oleo foods refer to products like cooking oil and butter that are used as food sources. Biofuel, another important category, is derived from CPO/PKO and used as a raw material for fuel production, such as biodiesel (Indonesian Oil palm 2023).

Figure 13.
Crude oil palm (CPO) export.

This section highlights the economic potential of oil palm exports. According to the latest report from Indonesian Statistics, the nation's oil palm export volume in 2023 reached an impressive 27.49 million tonnes, generating a total value of US$23.97 billion. India emerged as the largest importer, receiving 5.4 million tonnes, which accounted for 19.65% of Indonesia's total oil palm exports, valued at US$4.51 billion. China followed closely with 4.81 million tonnes, worth US$4.1 billion. Pakistan ranked third with imports of 2.5 million tonnes, valued at US$2.17 billion, while the United States imported 1.97 million tonnes, worth US$1.74 billion. Bangladesh received 1.36 million tonnes, valued at US$1.16 billion, and Egypt imported 962.6 thousand tonnes, with a value of US$826.5 million. Spain imported 654.5 thousand tonnes, worth US$587 million, followed by Italy, with 401.3 thousand tonnes, valued at

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US$369.4 million. The Netherlands received 373.3 thousand tonnes, valued at US$343.6 million, and Singapore imported 22 thousand tonnes, worth US$20.8 million. n addition to these top ten destinations, Indonesia exported 9.01 million tonnes of oil palm to other countries, bringing in an additional US$8.12 billion.

Development. After the design stage, the project moves into the development stage, which consists of two key processes: game asset development and game coding. Game assets are created using the Unity application, a powerful tool for developing interactive 3D and 2D games.

Implementation. The implementation stage involves testing and deploying the game with real users. The primary target audience for this game includes the Millennial and Gen Z generations. According to the Central Bureau of Statistics (BPS, 2021), Gen Z—also known as Zillennials—were born between 1997 and 2012 and are currently aged 8-23 years. Millennials, on the other hand, were born between 1981 and 1996, making them 24-39 years old today. To assess the game's effectiveness, an experimental test was conducted with a sample of 120 respondents from the DKI Jakarta area.

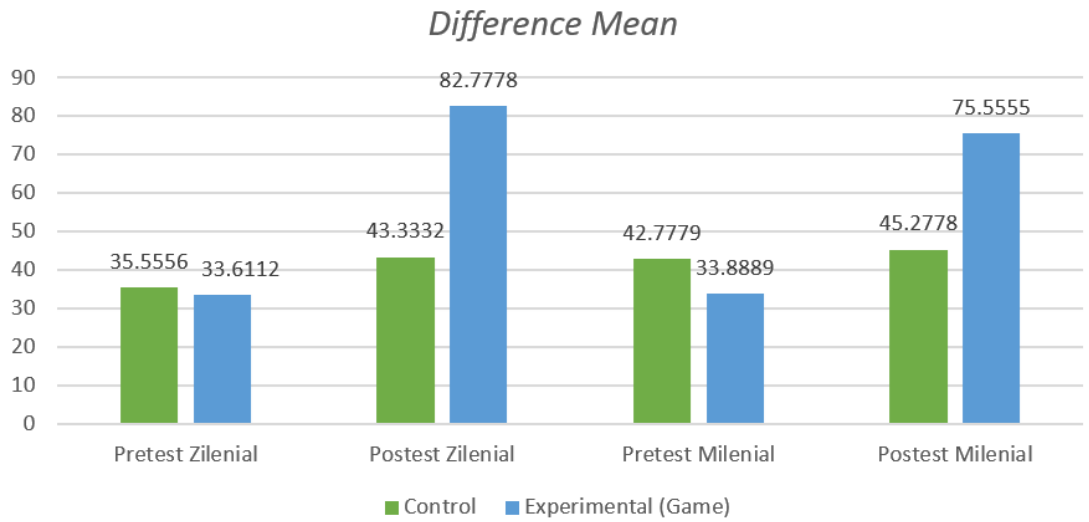

Figure 14.

The data processing results, as shown in the above score, indicate that the Zillennial group who received the oil palm game treatment experienced a significant improvement in knowledge. For both the control group (30 participants) and the treatment group (30 participants), the Zillennial post-test score was notably higher in the treatment group, with an average score of 82.7. This highlights the effectiveness of the oil palm game in enhancing the knowledge of sustainable oil palm among Zillennials compared to the control group, which did not receive the game treatment. Similarly, the Millennial group showed a substantial increase in knowledge after participating in the oil palm game. The pre-test scores for both the control group and the treatment group (each with 30 participants) were relatively low. However, the post-test scores for the Millennial group that received the game treatment increased significantly, with an average score of 75.5. This demonstrates that the oil palm game effectively boosted knowledge about sustainable oil palm in both Zillennials and Millennials, compared to those in the control groups who did not engage with the game.

Evaluation. The evaluation stage is the final phase in the development of the oil palm game using the ADDIE model. This stage is crucial for determining whether the learning media meets the intended objectives and expectations. By comparing the pre-test and post-test results from the experimental test, the effectiveness of the oil palm game can be assessed. Continuous evaluation is essential to identify the strengths and weaknesses of the developed product. This allows researchers to make necessary improvements and enhance the game's advantages, ensuring its overall feasibility and success.

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4. Conclusion

In an era of rapid advancements in information and communication technology, oil palm faces widespread negative campaigns across various media platforms. To counteract these efforts, it is essential to develop educational media that effectively informs the public about oil palm. The oil palm game serves as an innovative edutainment tool designed to educate Millennials and Gen Z about sustainable oil palm practices. By increasing their knowledge, this game helps fortify the younger generation against the influence of negative campaigns, fostering a more informed and resilient perspective on oil palm.

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