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Chemo-trail: A Look Beyond the Breast Cancer Diagnosis

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Abstrak

Hampir 1 dari 8 wanita Indonesia diperkirakan akan mengidap kanker payudara dalam hidupnya, namun ketika gejalanya mulai terlihat, biasanya sudah terlambat, karena kanker tersebut sudah mencapai stadium yang lebih tinggi. Ketidaksesuaian antara tingkat kematian akibat penyakit kanker dan persepsi masyarakat mengenai urgensi penyakit ini diperparah dengan kurangnya informasi mengenai gejala penyakit ini, adanya tabu sosial dalam masyarakat tradisional terkait kesehatan perempuan, dan rendahnya dukungan dari keluarga serta teman untuk menanggulangi penyakit ini. Oleh karena itu, terdapat kebutuhan yang jelas untuk melakukan kampanye publik mengenai kanker payudara, yang tidak hanya meliputnya secara ilmiah namun juga secara tegas. Artikel ini bertujuan untuk mengembangkan novel visual interaktif yang diberi nama *Chemo-trail*, berdasarkan tantangan yang dialami oleh kanker payudara, diceritakan melalui sudut pandang seorang wanita muda yang sedang menjalani cobaan tersebut, termasuk fitur mini-game dengan mekanik mirip *arcade* yang menirukan efek kemoterapi melawan sel kanker. Artikel ini menggunakan tinjauan literatur dan wawancara untuk sepenuhnya mengembangkan *Chemo-trail* berdasarkan realitas obyektif kanker payudara. Melalui media yang lebih interaktif, artikel ini berharap dapat memberikan insentif kepada remaja putri untuk mencari lebih banyak informasi dan menjalani pemeriksaan kesehatan secara mandiri.

Kata kunci: kanker payudara, *chemo-trail*, kesadaran, novel visual, kesehatan wanita.

Abstract

Almost 1 out of 8 Indonesian women are expected to develop breast cancer in their lives, yet when symptoms start to show, it is usually too late, as the cancer is already rising to its higher stages. This dissonance between the lethality of cancer and the public's perception of its urgency is exacerbated by a lack of information on its symptoms, existing social taboos in traditional societies on women's health, and minimal support on tackling it from family and friends. Thus, there is a clear need for a public campaign on breast cancer, covering it not only scientifically but also emphatically. This paper aims to develop an interactive visual novel, dubbed Chemo-trail, based on the challenges of experiencing breast cancer, told through the perspective of a young woman going through the ordeal, including a mini-game feature with an arcade-like mechanic mimicking the effects of chemotherapy fighting against cancer cells. This paper uses literature reviews and interviews to fully develop Chemo-trail based on the objective reality of breast cancer. Through more interactive media, this paper hopes to incentivize young women to seek more information and undergo medical screening themselves.

***Keywords**: breast cancer, chemo-trail, awareness, visual novel, women's health.*

1. INTRODUCTION

Chemo-trail is an interactive visual novel created to raise awareness of the importance of breast cancer screening and treatment, especially for teenagers and young adults. Breast cancer contributes the largest to the amount of cancer cases in Indonesia, as well as the leading cause of death from cancer. In developing countries, 1 in 27 women are diagnosed with breast cancer during their lifetime, and 1 in 48 are fatal [1]. Breast cancer contributes the largest to the amount of cancer cases in Indonesia, as well as the leading cause of death from cancer. Almost 20 percent of people with cancer in Indonesia are living with breast cancer, with 70 percent of patients detecting it in the late stages [2]. The life expectancy of stage 4 breast cancer patients is only around 31 percent, in stark contrast to the life expectancy of early stages, which is 90 percent [3]. Late-stage breast cancer treatment also demands high costs, which makes it more difficult for cancer patients with financial burdens to receive treatment, worsening their condition. Most cases of breast cancer are discovered late due to a lack of awareness in the broader community about the importance of cancer screening, a lack of attention to women's health in general, a lack of information on symptoms and treatment of breast cancer, and social stigma in society labeling breast cancer as "taboo." Chemo-trail tells the story from the perspective of a girl with breast cancer who goes through various challenges that arise because of her illness, packaged in the form of a visual novel with arcade-like mini-games that mimic the effects of chemotherapy in fighting cancer cells. This new form of breast cancer education, packaged as interactive media, hopes to educate and raise awareness of the diseases and shed light on the experiences and struggles of breast cancer patients.

Breast cancer continues to pose a significant challenge for middle-income countries. One of the primary reasons for this is the diagnosis of cancer in its later stages. This issue can be alleviated through early detection. Published research on the effects of diagnostic delays links adverse survival outcomes with more advanced-stage cancers at diagnosis. Patients experiencing delays of 12-26 weeks showed notably poorer survival rates than those with delays of less than 12 weeks [4][5]. When cancer is detected at an advanced stage, patients typically face more intense and comprehensive treatments, which can take a more significant toll on both their physical and emotional well-being. Early detection can lead to earlier intervention and a better prognosis [6].

One of the factors that hinders early detection of breast cancer is a lack of education regarding this matter. A study stated that low levels of education were significantly associated with low breast cancer screening rates due to a lack of awareness about the importance of early detection [7]. Limited education also causes misconceptions about breast cancer, such as the belief that the only solution is a mastectomy. Additionally, from a financial perspective, early detection, such as mammography, is expensive, and not all health facilities provide this service at an affordable cost. In several community health centers, JKN (National Health Insurance) no longer covers early detection services, which previously helped cover examination costs [8]. Mammography is the only screening the World Health Organization (WHO) recommends. However, mass usage of this screening method is tough due to its relatively high cost, especially in developing countries, including Indonesia [9].

A recent study developed a 15-point stigma scale for female patients with breast cancer. It listed four categories of stigmatization: self-image impairment, social isolation, discrimination, and internalized stigma [10]. Worrying about the examination results makes them feel like they have lost control of their lives, so many are reluctant to undergo an early examination. Moreover, women diagnosed with breast cancer often face self-doubt and societal views that they are “not perfect” or that this cancer is incurable and feel pressure and judgment from their families, partners, and coworkers to conceal their diagnosis or go through breast reconstruction surgery [11][12][13]. This can cause stress and make

patients reluctant to undergo treatment or early examination [14][15].

Hence, the status quo necessitates a new form of education, tailored to solve the specific problems plaguing the information dissemination of breast cancer. There are several factors to consider when developing new learning media, such as computer games [16]:

1. the dual-channel principle, which states that people have separate channels for processing visual and verbal material;
2. The limited capacity principle states that people can only process a small amount of material in each channel at any one time; and
3. The principle of active processing states that deep learning occurs when people are engaged in active cognition while learning occurs.

To better understand game-based learning, two critical elements need to be added to the cognitive model of multimedia learning: motivation and metacognition. First, motivation refers to the willingness to exert effort to learn the material and is defined as an internal state that initiates and maintains goal-directed behavior [17][18]. The advantage of educational computer games is the motivational power they are supposed to have. Educational games motivate people to the extent that they choose to play them, continue to play them, and exert effort to master them.

encourages players to follow the plot and immerse themselves in the character's predicament, increasing player sympathy and deepening their understanding of a topic. Story and aesthetics determine the market demographic of a particular game. Hence, it is pivotal that these visual novels have a proper target segment to ensure a cohesive storyline that elicits sympathy [16].

The concluding evidence implies that currently there exists few accurate nor deep-cutting information on breast cancer, leading to societal stigma and little incentive to spend on early detection methods. Exacerbated by conventional passive health information systems, this study aims to fulfill the need for a more emotionally charged awareness campaign.

2. METHOD

2.1. Materials

Materials needed to develop Chemo-trail are as followed: Unity 6 Engine, Ibis Paint, and FL Studio 2024.

2.2. Methods

Based on the hypothesis of the existing dissonance of the dangers of late-detected breast cancer and societal stigma, supported by a literature review and interviews with real actors, develop a visual novel-styled game with diverse alternate endings on the story of a young woman

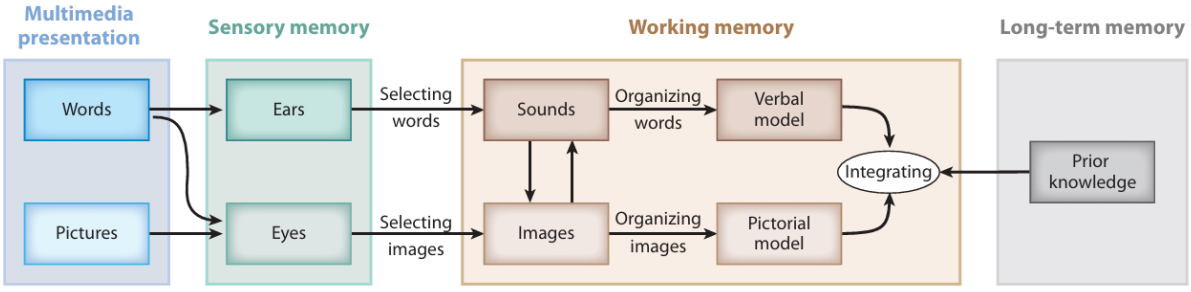

Figure 1. Cognitive model of multimedia learning. This model summarizes the cognitive processes involved in multimedia learning [16]

The conventional method of relaying health information is theoretical, which risks leaving the recipient not fully understanding or aware of the importance of the information provided. Conversely, interactive visual novel gameplay facing a breast cancer diagnosis and going through chemotherapy. Collaborating with experienced game developers, this paper utilized tools such as the game development software Unity 6 Engine and Adobe Photoshop.

Development was separated into three parts: preliminary drafting of the plot, developing the prototype and conducting functionality checkups.

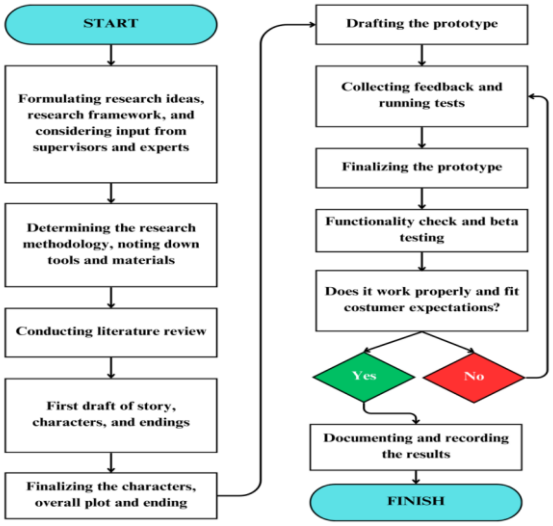

Figure 2. Illustration showing the step-by-step process of Chemo-trail

Figure 2 above depicts the step-by-step process on how to create Chemotrail as an adventure game to provide insight about the reality of breast cancer. The first step starts from collecting ideas, developing a research framework and discussing with experts and supervisors. The next step is to prepare the methodology and research design as guidance to start compiling stories and characters. After the prototype is finished, then validation and beta testing will be conducted, to ensure Chemotrail is in line with current customer standards.

3. RESULTS AND DISCUSSION

The final version of Chemo-trail is a Unity-powered, interactive visual novel with a clicker mini game representing a simplified version of chemotherapy.

3.1. User Interface

The UI (User Interface) of Chemo-trail is outlined below. Figure 3. is a snippet of Chemo-trails story mode, available in both English and Indonesian. The dialogue is placed in front of a colorful backdrop of characters and scenery. In the Unity engine there are 4 main parts, namely Hierarchy, Scene, Inspector, and Project.

Figure 3. Illustration of Chemo-trail's story mode in Indonesian

a. Hierarchy is a window for organizing game objects in the scenes.
b. Scenes are windows that represent visualization in games including setting the location of game objects in one scene.
c. Inspector is likened to the properties of each object selected in the scene or scene project.
d. Project is a window that contains all the files in the game project.

Figure 4. Illustration of Chemo-trail's mini game mimicking the effects of chemotherapy

Figure 4. showcases the workings of the mini-game. The main object is the lifebar which represents total life/health, if it is still full (originally represented in pink) means it is still safe, however if it is worn out and fully replaced with gray then it signals game over for the player. The player has 90 seconds to maintain at minimum 1 pink ribbon by clicking on the mutating "evil" cancer cells before they overrun the scene and chip at the player's health by attacking continuously.

Overall, Chemo-trail fits with the modern genre of relatable story-driven games with a diverse cast and built-it minigames to attract the

growing market segment of young girls and women.

3.2. Procedure

Chemo-trail was developed using Unity 6 Engine, with objects being imported from outside tools such as in the procedure outlined below.

1. Creating a new game project via Unity Hub, and selecting Universal 2D.

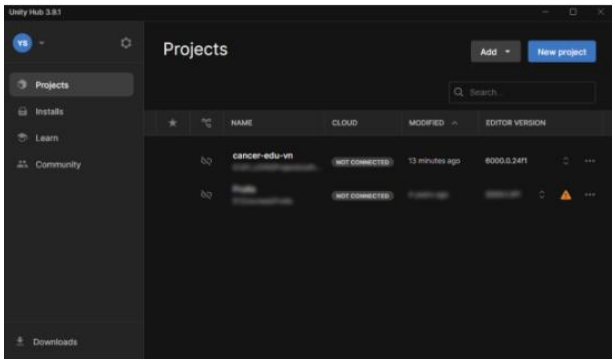

Figure 5. Creating a new game project

2. Filling in the project settings as needed.

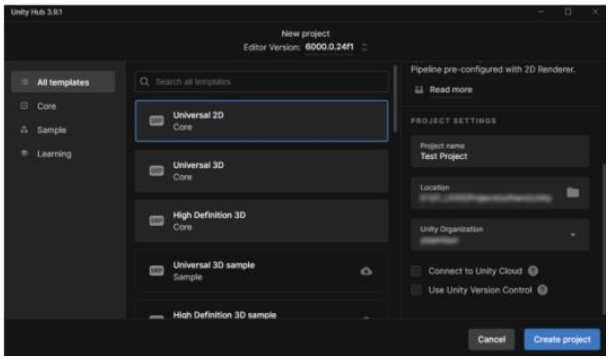

Figure 6. Project setting

3. Each development project has different scene requirements. In this visual novel development, at least four scenes are needed: the main menu, credit, VN dialogue, and mini-game scene.

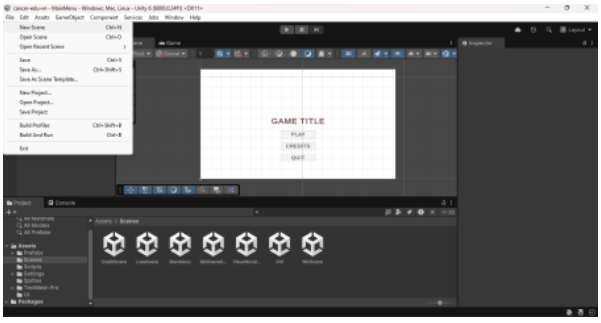

Figure 7. Visual novel development

4. Adding a new scene.

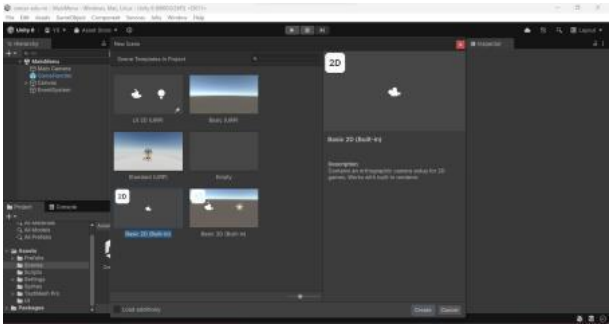

Figure 8. Adding new scene

5. Initial project view of the mini-game. If the pink life bar runs out and is replaced by gray, the condition of the player is deteriorating. In the game, it signals game over.

Figure 9. Initial project view

6. Code snippets for the variables in the minigameplay.
   a. mainCamera to access the camera object in the scene.
   b. lifeUITransform to access the life bar object.
   c. timerText to access the timer text object.

```
public Camera mainCamera;
public RectTransform lifeUITransform;
public TextMeshProUGUI timerText;
```

Figure 10. Variables in the minigameplay

7. Functions of evil cells when attacking the life bar/health. In general, when a cell attacks, it will reduce the number of life bars by 50.

```
public void AttackLife()
{
    life -= 50;
    lifeUITransform.SetSizeWithCurrentAnchors(RectTransform.Axis.Horizontal,
life);
    if (life <= 0 && timeRemaining > 0) {
        Debug.Log("Game over");
    }
}
```

Figure 11. Functions of evil cells

8. Code snippet to calculate the coordinates of the evil cell's location in the scene randomly.

```
// Function to get a random point within the camera's view
Vector3 GetRandomPointInCameraView()
{
    // Get the camera's viewport dimensions
    float viewportWidth = mainCamera.pixelWidth;
    float viewportHeight = mainCamera.pixelHeight;

    // Generate random normalized coordinates within the viewport
    float randomX = Random.Range(0f, 1f);
    float randomY = Random.Range(0f, 1f);

    // Convert normalized coordinates to world space
    Vector3 worldPoint = mainCamera.ViewportToWorldPoint(new Vector3(randomX,
randomY, mainCamera.nearClipPlane));

    return worldPoint;
}
```

Figure 12. Calculate the evil cell's coordinates

9. Code snippet to bring up evil cells.

```
IEnumerator SpawnObject()
{
    while (true) // Loop forever
    {
        // Generate random spawn point within the camera's view
        Vector3 spawnPosition = GetRandomPointInCameraView();
        // Generate random Euler angles
        Quaternion randomRotation = Quaternion.Euler(0f, 0f, Random.Range(0f,
360f));
        // Instantiate the object at a specific position
        Instantiate(cellToSpawn, spawnPosition, randomRotation);

        // Wait for the specified interval
        yield return new WaitForSeconds(spawnInterval);
    }
}
```

Figure 13. Bring up evil cells code

10. Code snippet of the update function, which will detect if a click hits a malicious cell object.

```
// Update is called once per frame
void Update()
{
    if (Input.GetMouseButtonDown(0))
    {
        // Get mouse position in screen coordinates
        Vector3 mousePos = Input.mousePosition;

        // Convert screen position to world position (2D)
        Vector2 worldPos = mainCamera.ScreenToWorldPoint(mousePos);

        // Perform the raycast
        RaycastHit2D hit = Physics2D.Raycast(worldPos, Vector2.zero);

        if (hit.collider != null)
        {
            // Do something with the hit object
            if (hit.collider.gameObject.CompareTag("badcell"))
            {
                hit.collider.gameObject.GetComponent<ScaleOverTime>().StopScalin
gAndShrinkDown();
                score += 1;
                scoreTMP.text = "Score = " + score;
            }
        }
    }
}
```

Figure 14. Update function

3.3. Functionality Test

Furthermore, the indicators and results of the functionality check-up are listed below.

Table 1. Results of the functionality test

Indicators	Validation Results
Story mode is smooth and easy to navigate	Valid
Mini-game is smooth and easy to navigate	Valid
User Interface is aesthetically pleasing	Valid
Suitability of sound and other supporting elements	Valid

Based on the results of the functionality test, Chemo-trail is fully functional and able to deliver its intended story and message through the use of its story mode and arcade mode.

4. CONCLUSION

In conclusion, Chemo-trail as an interactive visual novel fulfills the research hypothesis as a media to reflect the reality of breast cancer in a novel and emotionally-driven way. Through telling the story of a young woman suffering from breast cancer, Chemo-trail is able to form a deeper connection with its players, mostly young women who are most affected by the current stigma and uncertainty. Hence, Chemo-trail's effectiveness correlates positively with higher awareness of the reality of breast cancer and a decrease in social stigma for those living with it.

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