

Enhancing Maritime Safety Education through Mobile Gamification: Development and Design of an Android-Based Learning Game for Safe Working Practices on Board Ship

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Abstract--Semarang Maritime Polytechnic (PIPS) requires an Android-based English learning tool that is integrated with courses related to work safety on ships. This study aims to create an English learning tool that is integrated with courses related to work safety on ships in the form of a quiz and is Android-based. The development of this game uses the Game Development Life Cycle (GDLC) method which is a guideline that includes the game development process (Hendrick in Ramadan and Widyani, 2013). This method consists of six development phases: Initiation, Pre-production, Production, Testing, Beta testing, and Release. This application is called "Safe Working Practices on Board Ship" and is expected to be an alternative or new media for students to practice their English language skills while understanding work safety on ships.

Key words: Android-based learning game; Safe working practices on board ship.

I. INTRODUCTION

One of the higher education institutions in Semarang is the Semarang Maritime Polytechnic (PIPS) which was established in 1951 under the name Semarang Maritime School or abbreviated as SPS (PIP Semarang, 2023). This campus belongs to the Ministry of Transportation of the Republic of Indonesia and has been included in the White List at the International Maritime Organization in 2000. PIPS is tasked with educating and training young men and women who are graduates of Senior High Schools (SLTA) in the field of shipping and ports to become Chief Shipping Officers. In addition, there are also Maritime Transportation/Port Experts to meet the needs of national and international sea transportation fleets. PIPS has 3 study programs (prodi), namely D-IV Nautical, D-IV Engineering, and D-IV Maritime Transportation and Port Management (PIP Semarang, 2023). In the D-IV Nautical Study Program there are courses in Maritime English I - IV and Ship Safety and Security Management. In the D-IV Engineering Study Program there are

courses in Maritime English and Occupational Safety and Health. Ria Hermina Sari and Latifa Ika Sari, who are lecturers in the Maritime English course, stated that PIPS requires an Android-based English learning tool that is integrated with courses related to work safety on ships. Currently, there are very few games about it. Sukomardojo, Ratnaningsih, and Jama'an (2017) studied the use of game media to improve SMCP (Standard Marine Communication Phrases) vocabulary in Maritime English. Radzi, Tan, and Yusoff (2019) conducted a study on the effectiveness of using board games in the appropriateness of maritime management learning for higher education. Pernando and Kaharuddin (2022) designed motion graphics as a medium for communicating occupational health and safety for operational workers at Teluk Bayur Port at PT. Sea Asih Lines Padang. Suandi, Wibowo, and Auliasari (2020) introduced work safety tools using Android-based augmented reality. In this tool, there are several menus or buttons, namely K3 signs, mining, construction, power plants, industry and ships. This tool uses Indonesian.

On March 27, 2024, a search was conducted using the keyword ship safety game on the Play Store. The results only display games in the simulation genre. Some simulate the management, manufacture, and renewal of cruise ships such as the game My Cruise. Some simulate the management of ships and ship conglomerate empires, transporting cargo from port to dock such as Shipping Manager - 2024. Some simulate sailing around the sea such as Ship Sim 2019, and others.

On March 27, 2024, a search was also conducted using the keyword safety ship on the Play Store. The results display tracking applications such as Marine Traffic - Ship Tracking and Vessel Tracking - Ship Radar, learning applications such as Marine Safety Signs,

COLREG72: safety at sea, and Safety Tips. Not only that, this search also displays games in the simulation genre too.

In Marine Safety Signs there is a quiz but as the name implies, it only contains signs or signs. COLREG72: safety at sea is a quiz application that can be used to deepen understanding of international regulations to prevent collisions at sea. Safety Tips is an application to provide information about disasters. There are quizzes about earthquakes, weather, volcanoes, and others but not about safety on ships.

Games can create effective learning. The results of research by Yasin, Abdullah, and Syafrodin (2023) stated that the use of Arabic language learning games is effective in developing students' abilities in learning Arabic in distance learning. The Influence of Arabic Language Learning Games as a Distance Learning Tool. Rosidah, Nizaar, Muhardini, Haifaturrahmah, and Mariyati (2022) concluded that interactive game learning media based on Power Point is effective in increasing the learning motivation of fifth grade elementary school students.

Likewise with games in the form of quizzes. Wicaksono, Aprilia, and Supraptiningsih (2022) studied the application of formative assessment of physics learning with educational game quizzes and self-assessment of high school students. They stated that the results showed that the Kahoot! application in the form of a quiz game is very appropriate for providing fast and effective feedback to students. Sudana, Suyasa, and Agustini (2021) created a solar system learning media containing quizzes, measured its effectiveness, and obtained a success rate of 78.97% which is included in the high criteria. Kaonang (2023) stated that Indonesia has become the third largest mobile game market in the world. Throughout 2022, Indonesian gamers downloaded 3.45 billion mobile games, up around 320 million from 2021. Specifically for the Android game market, Indonesia ranks third, behind Brazil and India. In 2022, Indonesian gamers will spend \$370 million on mobile games, up \$50 million from 2021.

The reason why mobile games are more popular than PC or console games is because they are easy to get for free, easier to play, technological developments are increasing, and

smartphone prices are more affordable (eraspace, 2021). Gamers can install or uninstall mobile games at any time. Game content that attracts many fans is always updated by the developer. This makes gamers more interested and makes mobile games the most favorite to play via smartphones. The above matters strongly encourage the need to create English learning aids that are integrated with courses related to work safety on ships in the form of quizzes and are based on Android. This application is called "Safe Working Practices on Board Ship" and is expected to be an alternative or new media for students to practice their English language skills while understanding work safety on ships.

Instructional Media

Media is defined as a message delivery from the sender to the recipient (Lestari & Suastika, 2021). Media based on the method of delivery can be divided into 3, namely audio media, visual media, and audio-visual media (Izzah et al., 2020). Learning media is anything that can be used to channel messages from the sender to the recipient, so that it can stimulate the thoughts, feelings, attention, and interest of students to learn (Rahayuningsih, 2022). Learning media can be delivered in the form of interactive multimedia, namely those that combine images, audio, animation and user interaction (Panjaitan et al., 2020). This interactive multimedia can be applied to tutorial models (Sembiring et al., 2018) and also educational games (Saputri et al., 2018).

II. Method

Game Development Life Cycle (GDLC) is a guideline that covers the game development process (Hendrick in Ramadan and Widyani, 2013), which consists of six development phases shown in Fig. 1.

III. Result and Discussion

There are 7 levels created based on topics, namely:

- a. Workplace Safety Trivia (multiple choice).
- b. Body Parts.
- c. Common injuries.
- d. Personal Protective Equipment (PPE) (chart).
- e. Equipment Function (matching equipment with its function).
- f. Active & Passive Voice using PPE Signs.

g. Linking Words in Workplace Accident

Before level 1, a learning interface was created entitled "Common Accidents Happened on the Vessel". The challenge in this game is to answer questions in English correctly. The score

for each correct answer is 1. If wrong, there will be no deduction or zero and no display of the correct answer. The final score for each level appears after all questions have been answered.

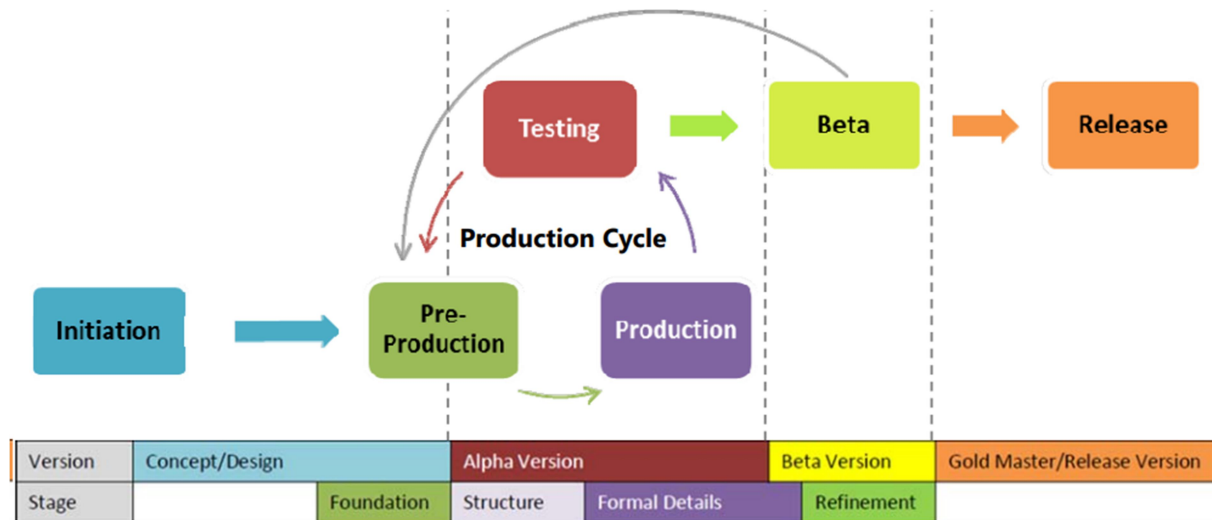


Fig. 1. The GDLC method developed by Ramadan and Widyani (2013)

The character in this game is a man wearing a typical shipping officer's uniform with a dominant orange color and some white variations on the shoulders, arms, and legs. Fig. 2 shows the appearance of the character at level 1 (Workplace Safety Trivia or multiple choice).



Fig. 2. Character Display at Level 1

The character at level 1 wears flip-flops because it is related to the work safety story in the learning interface. The environment, user interface (UI), and user experience (UX) in this game are also made with clip art style and bright colors so that it is fun to look at and play. Fig. 3 - 5 respectively show the appearance of the character at levels 2, 4, and 7.



Fig. 3. Character View at Level 2
(Body Parts)



Fig. 4. Character View at Level 4
(Personal Protective Equipment or PPE)



Fig. 5. Some Character Views at Level 7
(Linking Words in Workplace Accident)

In addition to characters, there are other assets to form the game. All the corresponding assets are combined in the Unity game engine and produce displays as in Fig. 6 – 37.



Fig. 6. Game Start Screen



Fig. 7. Main Menu

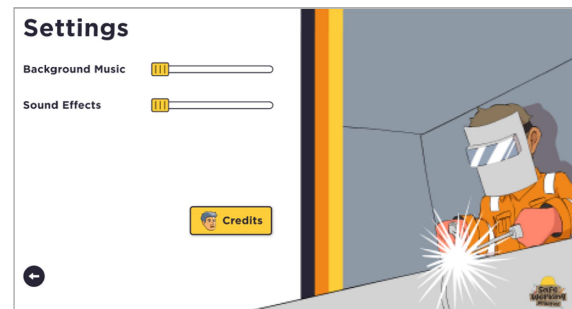


Fig. 8. Settings

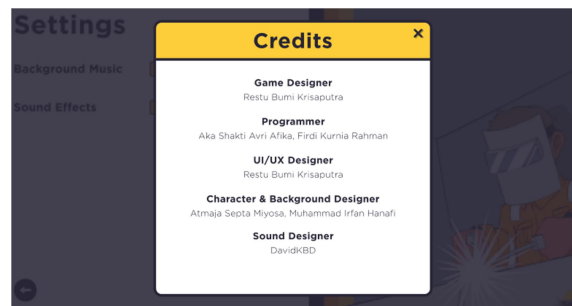


Fig. 9. Credits

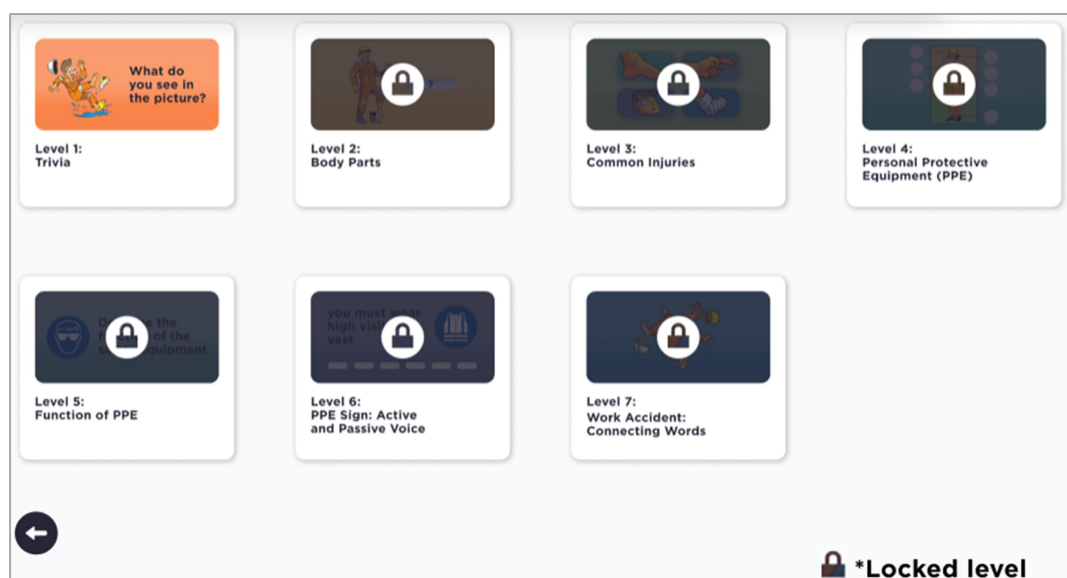


Fig. 10. Levels

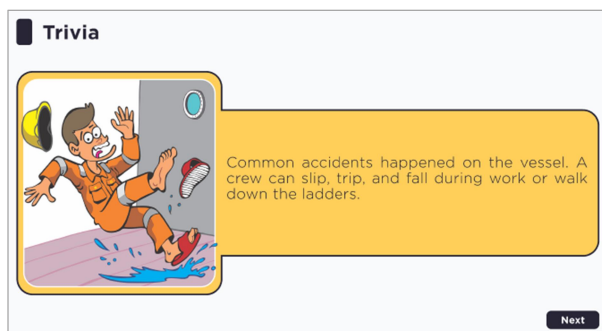


Fig. 11. The first view of the Learning Interface

In addition to the display in Fig. 10, there is another interface about learning that explains things that can cause the accident (shown in Fig. 11). The review of the answer is shown in Fig. 15.

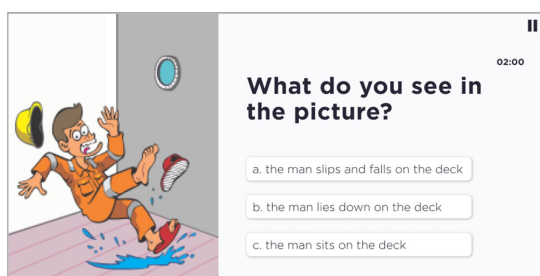
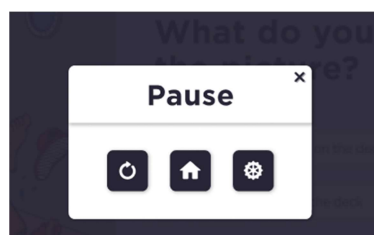
Fig. 12. The first question of Level 1 Interface View (*Workplace Safety Trivia*)

Fig. 13. Display to pause the game

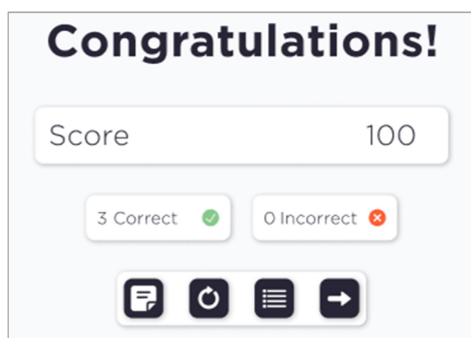


Fig. 14. Score

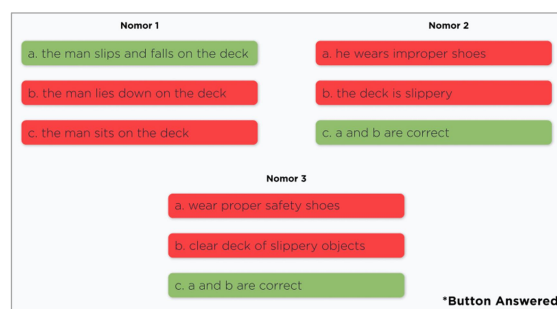


Fig. 15 Answer Review

Fig. 16 show how to play in level 2. In addition to the body parts as in Fig. 17, there are 5 other interfaces that contain questions to train competency regarding the names of more detailed parts of the face, ears, hands, palms, feet, and soles of the feet in English (shown in Fig. 18 - 22).

Fig. 23 shows how to play level 3 (common injuries). Player has to play an interface in Fig. 24. Fig. 25 shows learning about Personal Protective Equipment or PPE. Player has to play an interface in Fig. 26 and 27. In Fig. 28 - 30, player can learn about the function of PPE. Fig. 31 shows the learning in level 6 (active and passive voice using PPE signs). Player must drag and drop some words to the right position and make the correct sentences.

In addition to the 2 examples in Fig. 31, there are 2 other questions in the next interface, if the button in the bottom right corner of Fig. 31 is clicked. In addition to the 2 questions in Fig. 32 and 33, there are 16 other question displays associated with 8 different symbols. Fig. 34 and 35 shows learning in level 7 (connecting words in workplace accident). Player has to arrange some words to describe some picture about accident which could happen in the vessels. The example is shown in Fig. 36. Besides that, there are 6 other problems.

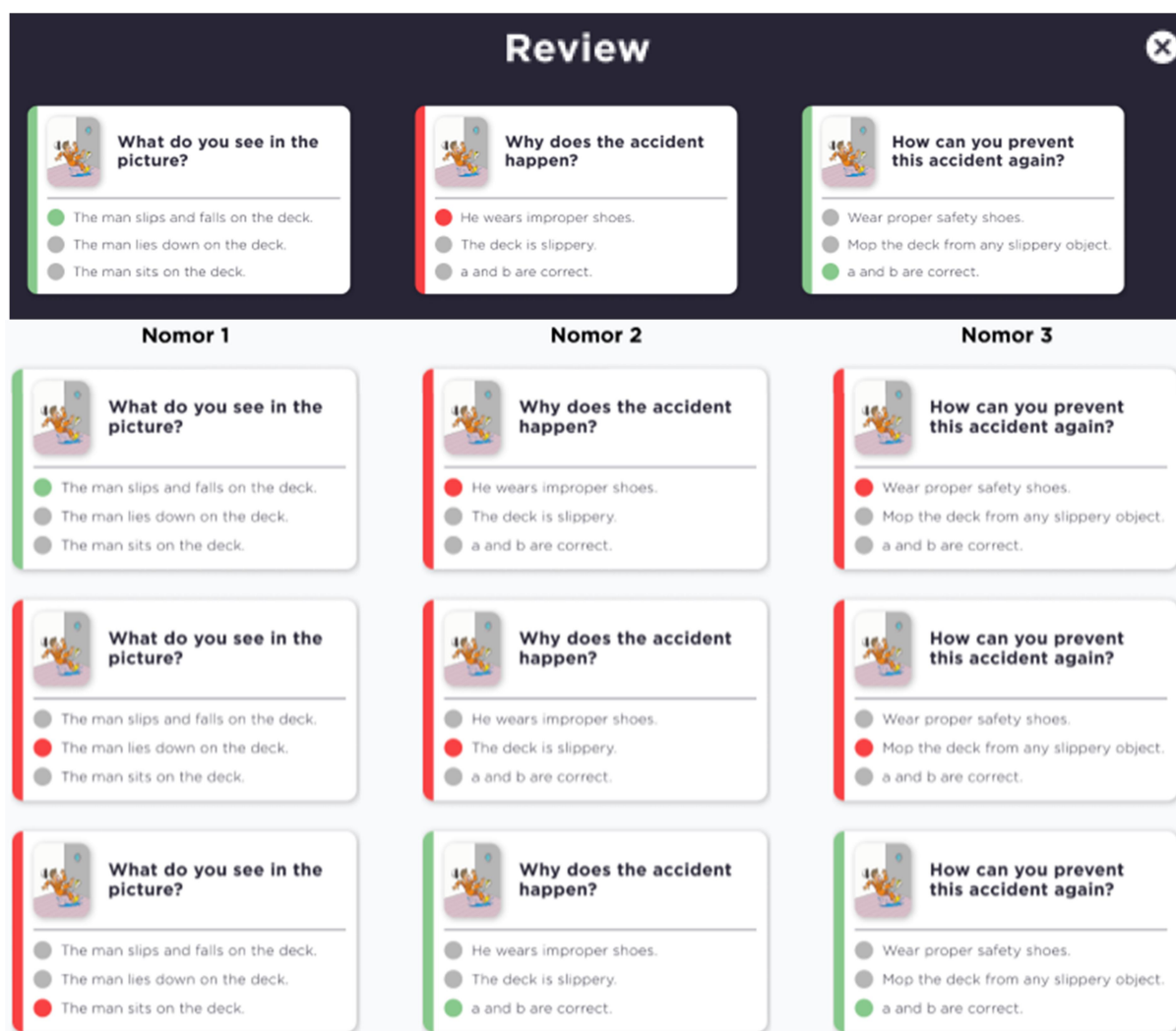


Fig. 16. Correct Answer Review

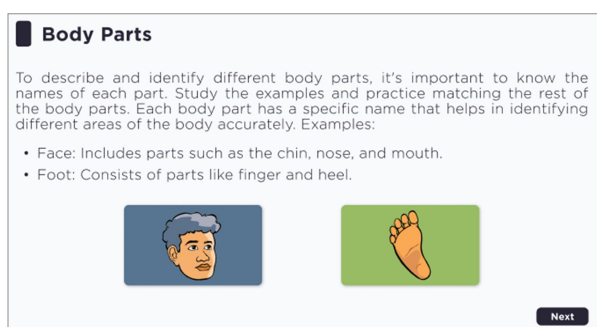


Fig. 17. How to Play Level 2 (Body Parts)

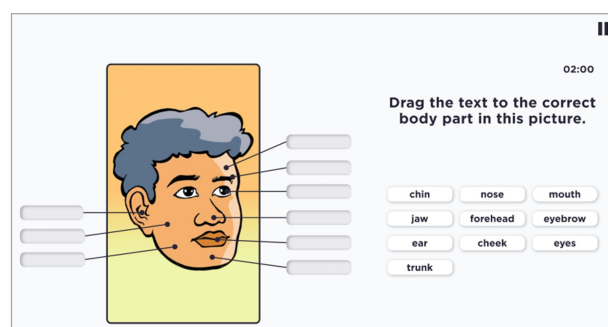


Fig. 19. Parts of the head

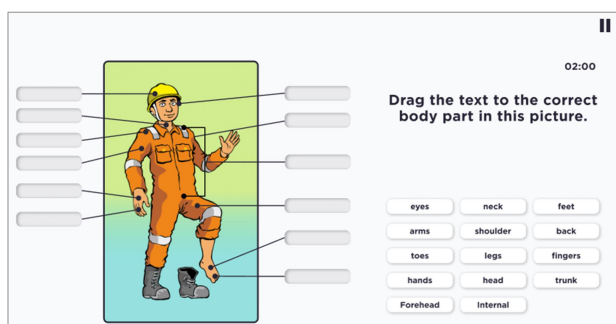


Fig. 18. Level 2 (Body Parts)

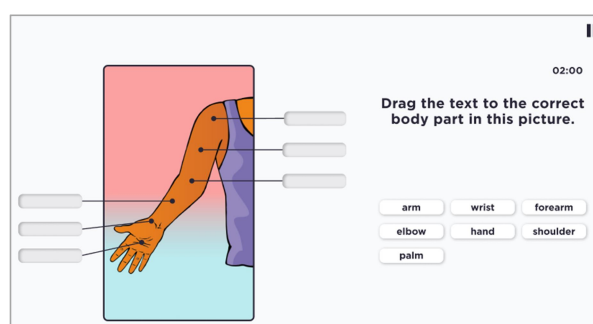


Fig. 20. Parts of the Hand

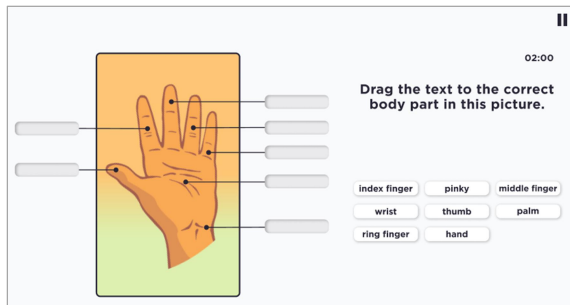


Fig. 21. Parts of the Palm

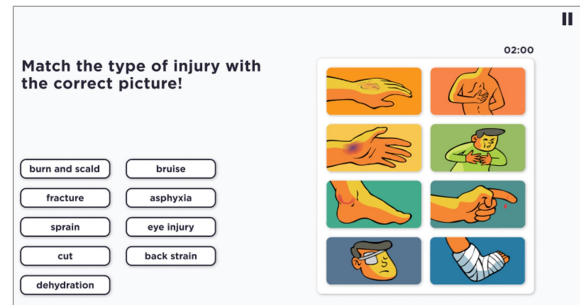
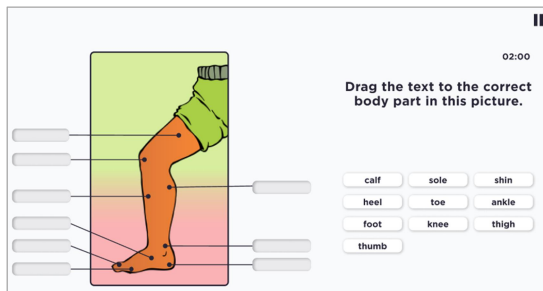
Fig. 25. Level 3 (*Common injuries*)

Fig. 22. Parts of the Leg

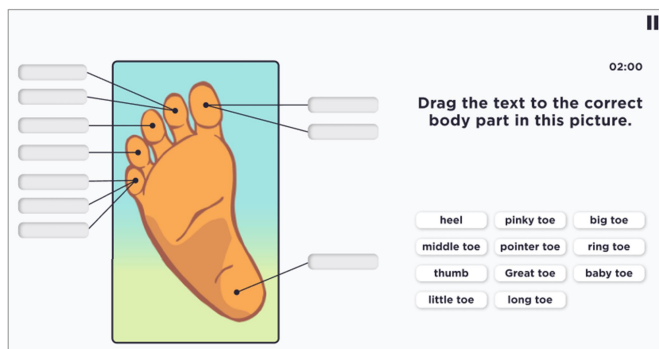
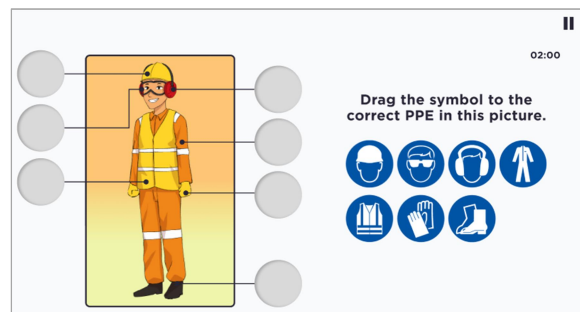
Fig. 26. Level 4
(Personal Protective Equipment or PPE)

Fig. 23. Parts of the Sole

Fig. 27. Level 4
(Personal Protective Equipment or PPE)Fig. 24. Level 3 (*Common injuries*)

Drag the text to the correct PPE category.

02:00

Hand and Foot Protection	Face and Eye Protection	Hearing Protection

Head Protection	Body Protection	Respiratory Protection

- safety harness
- ear plugs
- wellington boots
- safety gloves
- welding shield
- overall
- dust mask
- safety goggles
- ear defender
- safety shoes
- helmet

Fig. 28. Level 4 (*Personal Protective Equipment* or PPE)

Function of PPE

To match the functions of different types of Personal Protective Equipment (PPE), understand the purpose of each item. Practice matching the equipment with its correct function to ensure proper protection.

Now, continue by matching the remaining PPE with their functions.


→


Next

Fig. 29. Level 5 *Equipment Function* (match equipment with its function)

Match the parts of the sentence to form the correct description of the safety equipment.

02:00

Safety shoes are used	when performing welding to protect the eyes, face, and neck
The safety harness is checked	to protect the feet from being injured
A welding mask is worn	to protect the head of seafarers
A safety helmet is used	to prevent seafarers from accidentally falling when they are working aloft

Fig. 30. Level 5 *Equipment Function* (match equipment with its function)

Match the parts of the sentence to form the correct description of the safety equipment.

02:00

Safety shoes are used	when performing welding to protect the eyes, face, and neck
The safety harness is checked	to protect the feet from being injured
A welding mask is worn	to protect the head of seafarers
A safety helmet is used	to prevent seafarers from accidentally falling when they are working aloft

Fig. 31. Level 5 *Equipment Function* (match equipment with its function)

PPE Sign: Active and Passive Voice

To describe the meaning of mandatory action signs, we can use active sentence or passive sentence. Study the examples and practice to describe the rest of the signs.

We use active verb to say what the subject does. Meanwhile, we use passive verbs (be + past participle) to say what happens to the subject.

 →

Active: You must wear welding shield

Passive: welding shield must be worn

Next

Fig. 32. Level 6 (Active and Passive Voice using PPE Signs)

Word shuffle: Drag and drop the words to make the correct sentences (Passive).

02:00



must worn be high vest visibility

International Maritime Organization (IMO)

Fig. 34. Level 6 (Active and Passive Voice using PPE Signs)

Word shuffle: Drag and drop the words to make the correct sentences (Active).

02:00



must wear you high vest visibility

International Maritime Organization (IMO)

Fig. 33. Level 6 (Active and Passive Voice using PPE Signs)

Connecting Words

because We use this for giving reasons.
e.g. The crew broke his leg because he fell off the ladder.

so We use this to talk about results.
e.g. The rating forgets to wear safety shoes, so he slips on deck.

and We use this to connect two ideas.
e.g. The cook has just burned his finger and it is still hurting now.

Next

Fig. 35. Level 7 (Connecting Words in Workplace Accident)

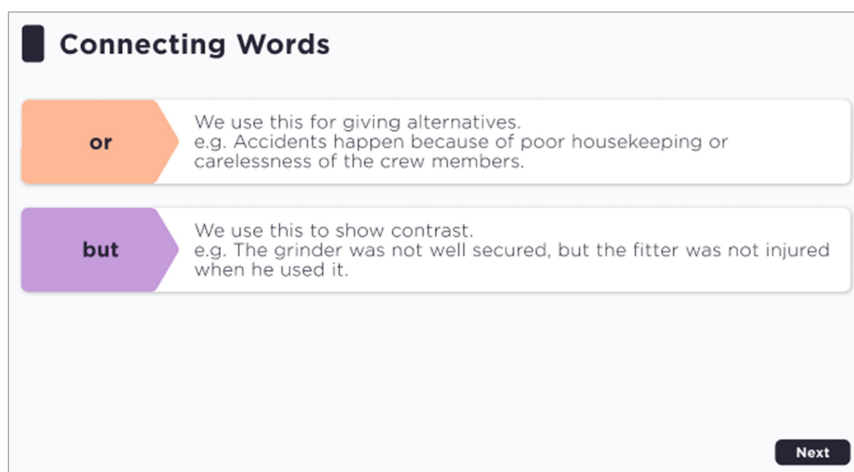


Fig. 36. Level 7 (Connecting Words in Workplace Accident)

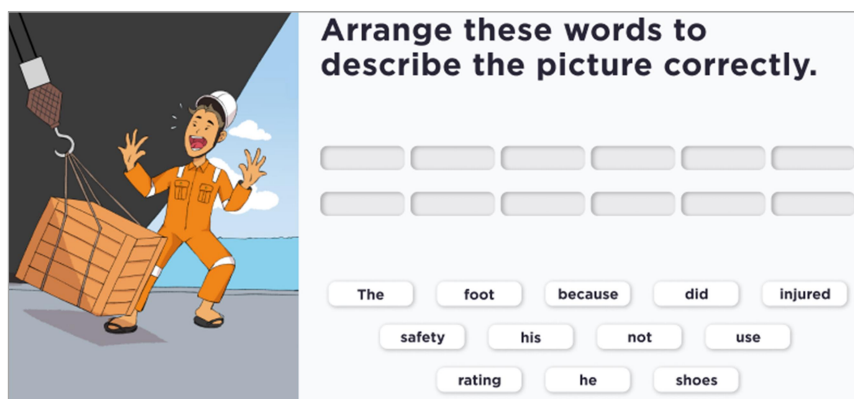


Fig. 37. Level 7 (Linking Words in Workplace Accident)

In addition to the questions above, there are 6 other questions displayed in this level. The BGM and SFX of this game are obtained for free from DavidKBD (<https://davidkbd.itch.io/>).

IV. Conclusion

The development of the Android-based “Safe Working Practices on Board Ship” learning game was carried out following the phases in the Game Development Life Cycle or GDLC, but only the initiation, pre-production, and production phases. The initiation phase produces a game concept and a simple game description. The pre-production phase produces character designs and game interfaces. The production phase produces game levels 1-4. The production phase playtest will be carried out in the next study. The score in this game can be developed so that it can be used to buy something in the game.

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