GAMIFIED TOOL FOR TEACHING GDPR
RESEARCH MANUAL

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Abstract

The purpose of this research manual is to provide insight into the gamification elements used in implementing a gamification tool that teaches GDPR and highlight the most appropriate techniques that are needed to build a website to teach the knowledge of GDPR and develop the website. Gamification is defined as the use of game-style mechanics to increase the engagement of people's participation in non-game contexts and activities. (TEAM, 2021) The implementation of gamification can be done as the elements in games in a website or application. Some examples of elements in games are points, levels/ stages, leaderboards and badges.

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1. Introduction

General Data Protection Regulation (GDPR) is defined as a data protection and privacy regulation for all European Union citizens. GDPR is a very important knowledge to have. This is because, GDPR applies to an organization or entity that processes personal data as part of the activities carried out by the organization, regardless of the location of the data being processed. For example, a company have to comply with GDPR if the company processes personal data for an individual who is from an EU country. Therefore, knowing GDPR is very important and it has become a necessity for users of the internet and those who worked in a company that processes personal data to learn more about GDPR.

One of the reasons for using games as teaching material is because gamification can make the learning process more appealing and promote the desire of the users to learn using people's psychological tendency to engage in games. (Kapp, 2012)

Successful integration of gamification and learning online can result in a very positive result. For examples, students being rewarded because they had completed a task successfully has always been a technique that is used by teachers. The same method is implemented in computer games as the person is given the motivation to complete each task to keep going. Some features in games such as points and badges can really motivate the players to keep going in the games. This is because, they feel really satisfied after getting the points and badges.

This research manual is going to present an overview of implementing gamification in a website that helps players to gain knowledge about GDPR in a fun manner.

2. GDPR

2.1 What is GDPR?

The General Data Protection Regulation (GDPR) is a piece of Pan-European legislation enacted by the European Parliament and Council to considerably increase Data Subjects' rights in terms of how their data is handled. (Massey, 2017) GDPR applies to 2 types of data, which are Personal Data and Sensitive Data.

Personal Data is any information relating to an identified or identifiable Natural Person (or 'Data Subject'); (Massey, 2017) Personal Data are all the data that can be used to identify the Natural Person (or 'Data Subject') directly or indirectly. Natural Person and Data Subject have the same meaning. Both mean an EU citizen who is alive. Dead people cannot be data subjects as it is made clear by the recitals of the GDPR (Murray, 2018):

> *This Regulation does not apply to the personal data of deceased persons. Member States may provide for rules regarding the processing of personal data of deceased persons.*
>
> (Consulting, 2022)

Personal data can be divided into directly and indirectly identifiers. Directly identifiable personal data can be defined as a unique identifier. The examples of directly identifiable personal data include a passport or driving license number. One of the reasons these data are considered as directly identifiable personal data is because these identifiers are typically linked to only one person.

Meanwhile, indirectly identifiable personal data can be defined as data that can be pieced together to identify the Natural Person (or 'Data Subject'). Some examples of indirectly identifiable personal data are postcode and date of birth.

The other type of data that GDPR is applied to is sensitive data. Sensitive data can be defined as special categories of information relating to an identified or identifiable Natural Person (or 'Data Subject'). (Massey, 2017) The examples of sensitive data can be found in a diversity monitoring questionnaire such as political opinions, racial or ethnic origin, religious or philosophical beliefs, genetic data, biometric data, sex life or sexual orientation. One of the reasons this information is so sensitive is that people have been negatively targeted because of this information throughout history. For example, people may have a database full of sensitive personal data and send out hate mail or target people for physical violence, or worse.

Another area which is considered important for GDPR in the processing of data is anonymization and pseudonymization.

Anonymization is defined as a way of modification of personal data with the result that there is no connection of data with the individual. (Voigt, 2017) Anonymization can be done through a few techniques that normally fall within 2 categories, which are randomization and generalization. Randomization includes altering the accuracy of data to remove the strong link between the data and the individual. Once the data become uncertain enough, it can no longer refer to a specific individual. Another way to achieve anonymization is through generalization. Generalization includes generalizing or diluting the attributes of data subjects by modifying the respective scale or the order of the data. (Voigt, 2017) When anonymization has become

effective, GDPR does not apply. (Consulting, 2022) Anonymization is usually used for statistical or research purposes. However, if either the controller or processor can restore the anonymized information with reasonable likelihood, GDPR will be applied to the data.

Other than that, pseudonymization is defined as a common tool to avoid the possibility to identify an individual through data. (Voigt, 2017) According to Article 4 No. 5 GDPR, Pseudonymization has the meaning of processing personal data in such as manner that the personal data can no longer be attributed to a specific data subject without the use of additional information. Pseudonymization can be achieved by replacing the name or other characteristics with certain indicators. (Voigt, 2017) One of the ways to achieve pseudonymization is by encoding the information and sharing the key with only a few people. Since the risk of re-identification is higher with data which is pseudonymized than the data which is anonymized, pseudonymized data still falls within the scope of the application of GDPR.

2.2 Where Does the Regulation Apply?

This regulation applies to the processing of personal data by controllers and processors in the EU, regardless of whether the processing takes place in the EU or not. (Ireland, 2022) For example, if there is an organization which is based anywhere in the world but not in the EU, but processes personal data related to an EU citizen, the data processing activities are in the scope of GDPR. One of the reasons for that is because there is an extra-territorial applicability for GDPR. Extra-territorial applicability in GDPR means the regulation applies to the processing of EU personal data by Controllers that are not established in the EU, but in a place where Member State law applies by public international law. In short, if the organization is in the EU, or the organization has EU customers, the data processing activities are in the scope of GDPR.

2.3 Establishing lawful grounds for processing

Lawful grounds for processing personal data and prove that states that the processing is lawful must exist. Processing is considered lawful if one of the following applies:

- The Data Subject has approval for his or her data to be processed for one or more purposes. This can be done by enabling users to select the checkbox on the website where they enter their data.
- Processing is required for the fulfilment of a contract to which the Data Subject is a party or to act at the Data Subject's request before entering a contract. For example, the name and address of the user would be required to make a purchase.
- Processing is required to comply with a legal requirement imposed on the controller. For example, carrying out background checks before hiring a new employee.
- Processing is needed to protect the vital interests of the Data Subject or another Natural Person. This might be regarding medical information, when data is required to assist in the care of an unconscious person.
- Processing is needed for the performance of a task carried out in the public interest or the exercise of official authority vested in the Controller. For example, census.
- Processing is needed for the legitimate interests pursued by the Controller or by a third party, except where such interests are overridden by the interests or Fundamental rights and freedoms of the Data Subject necessitate personal data protection, particularly if the Data Subject is a kid.

2.4 Consent

The organization must be able to prove the Data Subject has provided consent for their data to be used for each specific purpose. (Massey, 2017) The processing of the data may be considered unlawful once each specific purposes does not have specific consent. Other than that, the Data Subject should be provided with the ability to withdraw consent as easy as when consent was provided. The processing may not consider lawful if there is no ability to withdraw consent.

2.5 Breach that will lead to fine

There are consequences for a business or organization if GDPR is not being applied in their business. Below is the list of breaches that will lead to fines that up to 20 million Euro or 4% of worldwide annual turnover (whichever is higher) (Massey, 2017):

1. A breach of the seven GDPR principles;
2. Issues surrounding the rights of Data Subjects;
3. Where the processing of data was found to be unlawful;
4. Where it is found consent cannot be proven or processing was continued even after the consent has been withdrawn;
5. Breaches of sensitive categories of data;
6. Transfers to countries where data privacy rights are not equal to those afforded within GDPR;
7. Issues surrounding cooperation with a Supervisory Authority during investigations;
8. Issues surrounding meeting the requirements of corrective action issued by a Supervisory Authority;

2.6 Consequences of non-compliance

The consequences of non-compliance will be due to the breaches of GDPR as listed in the previous section. Since all of them are considered the most serious of breaches, the Supervisory Authority can also impose fines of up to 10 million euros or 2% of worldwide annual turnover for lesser violations of GDPR. (Massey, 2017)

Other than that, any victims who have suffered from material or non-material damage as a result of an infringement of GDPR will now have the right to seek compensation from the Controller or Processor for the harm sustained.

2.7 Condition when it is mandatory to appoint a Data Protection Officer (DPO)

Data Protection Officers (DPO) have the responsibilities (Consulting, 2022):

1. To inform and advise the controller or the processor and the employees who carry out the processing of their obligations under GDPR and to other Union or Member State data protection provisions
2. 2. To monitor compliance with this Regulation, other Union or Member State data protection provisions, and the controller's or processor's policies relating to personal data protection, including the assignment of responsibilities, awareness-raising, and training of staff involved in processing operations, as well as the related audits.
3. To give guidance on data protection impact assessments as needed and to monitor their effectiveness following Article 35.
4. To cooperate with the supervisory authority
5. To serve as the supervisory authority's point of contact on processing concerns, including the previous consultation referred to in Article 36, and to consult as necessary, about any other matter

2.8 The seven principles

There are seven principles in GDPR that state how a person or an organization should control or process personal data. The seven principles of data protection in GDPR are:

2.8.1 Lawfulness, fairness and transparency

Lawfulness means having a good reason to process personal data. Some examples of processing data with lawfulness include:

a) Consent to process the person is given by the user
b) Personal data must be processed to fulfil a contract.
c) It is required to satisfy a legal responsibility
d) For the protection of vital interests of a natural person.
e) It is a public task carried out in the public interest.
f) You can demonstrate that there is a legitimate interest that is not outweighed by the rights and interests of the data subject.

Fairness is defined as you will not mishandling or abusing the information collected. In fairness, you should not keep information about what or why you are collecting data on purpose. Users also wouldn't be surprised if they knew the way you were using their data. Transparency is naturally linked to fairness. It has the definition of being clear, open and honest with data subjects about who you are, and why and how you're processing their data.

2.8.2 Purpose limitation

The GDPR's second principle restricts the use of data for certain activities. This purpose of limitation ensures that data is only "collected for stated, explicit, and lawful purposes." The data processing purposes must be clearly defined. Finally, the data processing purposes should be strictly adhered to, restricting data processing to the indicated reasons only. The consent to process the data should be asked again if the data collected wanted to be used for a new purpose that is incompatible with the original purpose, unless there is a clear obligation or function set out in law.

2.8.3 Data minimization

Data minimization is defined as collecting only the smallest amount of data needed to complete the purposes. For instance, if the organization or the person wanted to gather subscribers for the email newsletter, only the information necessary should be asked to send out the newsletters. Personal data that are not directly related to the purpose such as home addresses, phone numbers or age should not be collected.

2.8.4 Accuracy

This principle requires that the controllers make sure the personal data are accurate and where needed, kept up-to-date. All reasonable steps should be taken by controllers to make sure that the personal data that inaccurate personal data are erased without delay. All personal data collected, stored, or processed by a controller must be accurate and up to date. The controller should take all reasonable steps to correct any inaccuracies promptly.

2.8.5 Storage limitation

By GDPR, how long each piece of data will be kept must be justified. Under GDPR, personal data in a form which permits the identification of individuals should be held no longer than necessary for the purposes. Personal data may be stored for longer periods only when they will process solely for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes. Therefore, controllers should delete personal data as soon as it stops being needed for the purposes for which it was originally collected.

2.8.6 Integrity and confidentiality (security)

In this integrity and confidentiality principle in GDPR, personal data must be processed in a manner that ensures the appropriate level of security and confidentiality for the personal data. The protection includes those against unauthorized or unlawful processing and accidental loss, destruction or damage. (Commission, 2019)

2.8.7 Accountability

Accountability is a new principle that existed to prevent the organization from saying that they are following all the rules without actually doing it. The organization or a person must have appropriate measures and records in place as proof of compliance with the data processing principles.

One of the examples of achieving accountability is compliance with the other principles of data protection. Besides, another approach to show compliance with the principles of data protection includes adopting internal policies, following codes of conduct or certification schemes, recording and, where necessary, reporting personal data breaches, and suitable privacy rules and notifications must be implemented.

2.9 The eight rights

There are rights for the natural person or data subject when their data is being processed. All eight rights can be found in Articles 13 and 14 of the GDPR. The information that must be provided when collecting personal data can be found in Article 13. Meanwhile, the responsibilities when obtaining data about the data subject from a third party or indirectly can be found in Article 14. Any breach of these rights can result in a maximum fine. (Olsen, 2022)

The rights are:

2.9.1 The Right to Information

According to Article 13 of GDPR, the following information needed to be provided when personal data is being collected:

a) The identity and contact details of the controller and those of the controller's EU representative (if applicable)
b) The contact details of the Data Protection Officer (if a DPO was appointed)
c) Legal basis for processing and the purposes of the processing
d) Country where the processing of data occurs
e) Legitimate interests of the processor and third parties
f) Any recipients of personal data

g) Any intention to transfer personal data outside the specified processing place and to a third country (especially if the country is a non-EU country)
h) Data retention policy (the information on how long the data is stored)
i) Explanation of rights to rectification, erasure, restriction of processing and portability
j) Explanation of the right to withdraw consent
k) Explanation of the right to complain to the relevant supervisory authority
l) If the collection of data is a contractual requirement and the consequences of the collection
m) Existence of profiling and other types of automated decision-making and information about the logic behind them

From Article 14 of GDPR, the same information needs to be provided even if the data are not directly collected from a data subject.

The data subject has the right to ask about the type of personal data collected generally, what processors the controller works with and the way how the data gets used. (Olsen, 2022)

2.9.2 The Right of Access

According to Article 15 of GDPR, the data subject has the right to access the processed personal data belonging to them.
According to GDPR, the data subject or the natural person not only can ask specifically about their personal data file, but they can also ask questions like:

a) Why and how their personal data is being processed
b) Categories of personal data involved
c) The person that can see the data (especially in non-EU countries)
d) How long the personal data is intended to be stored
e) Any information available to the source of data when the data are not collected from the data subject
f) The use of profiling and automated decision-making

Since the right to access data allows data subjects to confirm the data that you have compared to the data you say you have, the right adds an extra layer of transparency to the processing activities. It also sets them up to exercise the right to rectification and the right to erasure.

According to GDPR, the data subject is allowed to request a copy of the data at no cost to them. However, a reasonable fee based on administrative costs will be charged to the data subjects if they request multiple copies.

2.9.3 The Right to Rectification

According to Article 16 of GDPR, data subjects have the right to change or modify the data they provide when the data is inaccurate or out-of-date. This right needs to be obtained by the data subjects without undue delay.
One of the reasons holding accurate data is so important for the organization and the data subject is because incorrect data threatens the privacy of other individuals.
For example, if the phone numbers of the data subject are held by the organization, the organization should acknowledge the data subject to change their phone numbers from time

to time. If the old phone numbers were given away to the new customers, the organization is a risk of contacting a customer whose consent is not given.
The organization need to have a way for the data subjects to come to you with requests to update the data held about them. For many companies, the data subjects can update their information on their own time through a customer account and profile.

2.9.4 The Right to Erasure

According to Article 17 of GDPR, the user has the right to erasure or the right to be forgotten. In the following circumstances, the data subject has the right to ask a data controller to erase their data without undue delay (Olsen, 2022):

a) Personal data is no longer required for the purposes for which it was collected or otherwise processed.
b) The personal data have been unlawfully processed

When the decision to erase a data subject's data according to the right to erasure is made, the request must also be shared. This means that all other controllers or processors with whom the organization have a contract need to be aware of the erasure and they should also erase the data that are linked, copies of the data and the replication of the personal data.

2.9.5 The Right to Restriction of Processing

According to Article 18 of GDPR, the data subject has the right to restriction of processing under certain conditions.

According to the Law, a data subject shall have the right to obtain from the controller restriction of processing where one of the following applies:

a. The data subject contests that his or her data are inaccurate
b. The controller no longer needs them for purposes for which their processing is carried out but they are required by law for continued storage where processing is unlawfully but not willfully carried out.

The complete restriction of processing, including deletion, may be required where the personal data will be used for processing that is to have no effect or discloses sensitive information. If a data subject has the right to restriction of processing and the controller wishes to continue processing, then they will need to prove that there is a legitimate reason for continuing to process the data.

2.9.6 The Right to Data Portability

According to Article 20 of GDPR, users have the right to data portability. This right can be exercised in several ways, including the right to have personal data transferred directly from one controller to another.
This right enables a user to reuse their data for the purpose to transfer it to another controller. This right is granted to the user to re-use the data for their purposes.

2.9.7 The Right to Object

Article 21 of GDPR states the process for data subjects to object to their data being processed. An objection can be made in one of two ways; by contacting the controller and requesting a restriction on processing or by notifying them that they object to the processing in general.

The data subject shall have the right to object at any time to the processing of personal data concerning him or her for one or more of the following reasons:

a) processing is unlawful
b) processing is carried out for purposes other than those for which it was originally collected or subsequently authorised

In short, objections may be successful, but if they are not then the controller must still have sufficient legal grounds to continue using or processing the data.

2.9.8 The Right to Avoid Automated Decision-Making

The right for a data subject to avoid automated decision-making is stated in Article 22: where the Article 22 says:

> *"The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly affects him or her"*
> (Consulting, 2022)

There are 3 conditions when the right to avoid automated decision-making cannot be implemented:

a) When automated decision-making is needed to enter into or complete a contract
b) When the control has authorization from the EU or a Member State and uses safeguards to protect the subject's interests and freedom
c) When the profiling or decision-making occurs with the subject's explicit consent

The most common example that GDPR applies is the right supports tend to be financial. For example, if the customer is an EU resident who applies for a loan using a bank's online application, then the decision can be appealed because the outcome impacts legal rights and freedoms.

2.10 The area of GDPR that will be related to this project

The area of GDPR that will be related to this project is going to be:

- What is GDPR?
  One of the reasons why this area (What is GDPR?) will be included in this project is because all the employees in an organization or people who run a business should have an overview of the definition of GDPR. The definition or meaning of this law gives everyone a guideline about what GDPR is in general.
- Where does the regulation apply
  It is very important for all the organizations and people who run a business to know where GDPR applies. This is because, an organization or business must adhere to the rules of GDPR if they have customers from the EU, even if the company is not based in the EU. If the company is found breaching GDPR, there will be fines

imposed up to 10 million euros or 2% of worldwide annual turnover for lesser violations of GDPR. (Voigt, 2017)

- The seven principles
  The seven principles are one of the areas that will be related to this project. This is because, the seven principles describe how GDPR should be implemented in an organization or business. Understanding the seven GDPR principles allows the organization or people who run the business to understand how to safely secure personal data while also providing documentation of how the data is protected.
- The eight rights
  Another area that will be related to this project is the eight rights. One of the reasons why this area is being included is because customers should understand the choice and the control they have over how their data is being handled.

After this section about GDPR, the next section of this research manual will be on gamification, where there will be sub-sections about what is gamification, how gamification works and the game design elements of gamification.

3. Gamification

3.1 What is Gamification

Gamification is defined as the process of engaging people and solving issues by employing game mechanics and game thinking. (Fiona Fui-Hoon Nah, 2013). It is the use of game-design elements in non-game contexts to achieve objectives. In other words, gamification is a way to help people do something they want to be doing but find difficult or boring by making it more fun.

Gamification works by making technology more appealing and promoting desirable actions, using people's psychological tendency to engage in games. (Kapp, 2012)

Some elements are combined to become this definition and they are listed below: (Kapp, 2012)

a) **Game-based**
The objective of game-based is to design a system in which learners, players, consumers, and workers participate in an abstract task defined by rules, interaction, and feedback that results in a quantifiable conclusion generating an emotional response. The idea is to design a game in which players are willing to commit their brainpower, time, and energy.

b) Mechanics
Levels, badges, point systems, scores, and time constraints are part of the game mechanics. These are the elements found in many games. Mechanics alone are insufficient to transform a dull boring experience into a fun, game-like one, but they are important building blocks in the gamification process.

c) Aesthetics
Gamification cannot be successful without attractive graphics or a well-designed experience. The user interface, or the look and feel of an experience, is an important component in the gamification process. A person's readiness to adopt gamification is heavily influenced by how an experience is viewed visually.

d) Game Thinking
This is maybe the most significant aspect of gamification. It is the concept of taking a commonplace experience, such as jogging or running and transforming it into an activity that incorporates aspects of competition, exploration, and narrative. This is how running becomes a social activity.

e) Engage
An explicit purpose of the gamification process is to capture a person's attention and engage him or her in the procedure you've designed. Gamification is primarily concerned with individual engagement.

f) People
These might be students, customers, or players. These are the people who will be involved in the creation process and inspired to take action.

g) Motivate Action
Motivation is the process through which behaviour and actions are energized and given direction, purpose, or meaning. Individuals must be inspired by a challenge that is neither too difficult nor too simple. Gamification relies heavily on encouraging people to participate in an action or activity.

h) Promote Learning

Gamification can promote learning. This is because many gamification aspects are based on educational psychology and tactics that instructional designers, instructors, and academics have been using for years. Many educational practitioners' mainstays include allocating points to exercises, providing corrective criticism, and fostering cooperation on projects. The difference is that gamification adds another layer of appeal and a new approach to blend those aspects into an engaging game area that both motivates and teaches learners.

i) Solve Problems

Gamification has a high potential to aid in issue-solving. Because of the cooperative nature of games, more than one person can be focused on solving a problem. The competitive aspect of games motivates many people to do their best to win.

3.2 How does gamification works?

Gamification aims to capture the motivating power of games and apply it to real-world situations, such as student motivation in schools. Gamification works according to the gamification framework. The gamification framework was created to assist software designers and researchers in gamifying their educational applications, whether for general use or in the field of cybersecurity.

A framework of gamification is evolved around five principles (Fiona Fui-Hoon Nah, 2013):

a) **Goal orientation**

Educational games must be constructed in such a manner that there are several layers of goals. For example, to complete the long-term goal of completing an educational or cybersecurity game, the player is given the medium-term goal of completing the levels in the game, and to complete each of these levels, the player is given the short-term goal of completing the missions in each level. Each mission can be further subdivided into many assignments. The instructional game becomes more difficult as the player progresses through the tasks and stages. Maintaining player involvement requires balancing the player's knowledge and abilities with the difficulty necessary to progress in the game.

b) Achievement

Here, the terms achievement and accomplishment are being used interchangeably. When players are acknowledged for their accomplishments, their sense of fulfilment grows, which boosts their drive and engagement. Acknowledgement of accomplishment may be used in educational or cybersecurity games to boost student engagement and, as a result, learning achievement. Achievements can be acknowledged with badges or other types of recognition such as trophies, rankings, stars, and awards.

c) Reinforcement

According to the behavioural learning model, learning occurs through reinforcement such as vocal praises, compliments, or physical or intangible rewards. As a result, it is typical for games to include a reward structure depending on player performance as well as a feedback system to encourage reinforcement. Positive reinforcement, in the form of points or virtual cash, provides enjoyment to players and can be used to enhance learning from the game in the context of educational games. Negative feedback or reinforcement, on the other hand, might provide players with corrective information, knowledge, or abilities to assist them to reach their learning objectives more rapidly.

d) Competition

Competition is not only an important aspect of most games, but it is also a given. Competition is vital in maintaining or enhancing one's attention and focus on the work in the setting of an educational game. The game's rules should be properly defined, unambiguous, and firmly enforced for players to establish an internal sense of control, which helps in increasing their level of participation. An educational game may allow players to establish rules inside the game to increase player motivation and engagement as well as possibilities for learning. The development of rules by players can aid in discovery learning, which is a crucial component of active learning.

e) Fun orientation

Fun or enjoyment is strongly linked to involvement. When playing a game, one might become so engaged in the work that one loses track of time. As a result, having a fun component or orientation is critical for an educational game to be effective in motivating and engaging learners.

3.3 Game Design Elements

There are eight game design elements that are normally used widely in educational or learning contexts in general or in the field of cybersecurity. (Fiona Fui-Hoon Nah, 2014)

a) **Points**

The point system is used to assess performance or achievement. These points can be utilized as prizes, as a sort of investment for further advancement toward the goals, or to represent one's position. There are several categories of points, and they are different from game to game. For example, Experience Points (XP) is defined as points get after completing tasks. One of the examples of games that use the game design element of Experience Points (XP) is Duolingo. Figure 1.0 below shows the Experience Points (XP) that players get after they complete a level in Duolingo.

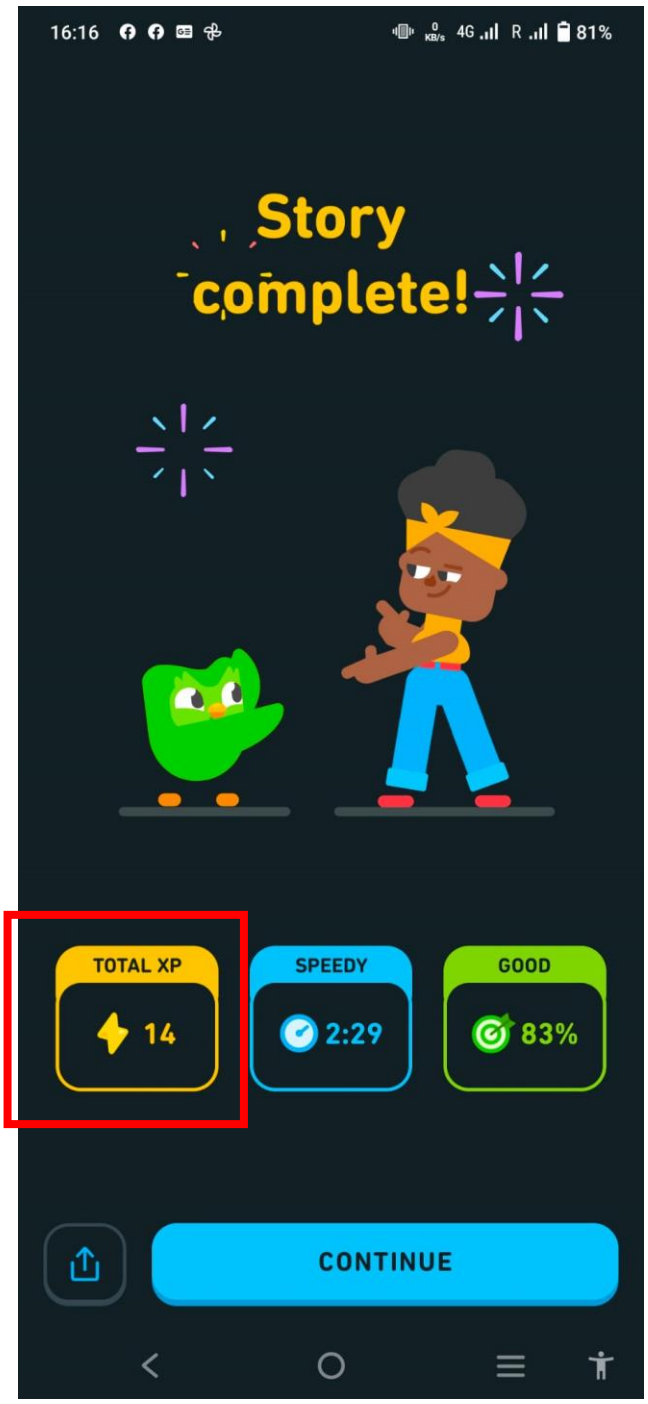

Figure 1.0: The Experience Points (XP) that players get after they complete a level in Duolingo

Another category of point is steam points. Steam points are a type of point earned by a player when they shop on Steam or contribute to the Steam Community. (Steam, 2022) Steam is the ultimate destination for gamers to play, discuss, and create games. (Steam, 2022) Steam Points can be obtained by purchasing content on Steam. The player cannot exchange them for cash, but they can spend them on items in the Steam Points Shop. (JAEHNIG, 2022) Figure 1.1 below shows the Steam Points that can be used in Steam Points Shop. The points marked in Red Square is the Steam Point that the players need

to spend to buy the game. Meanwhile, the points marked in the blue square is the Steam Point that the players currently have in their account.

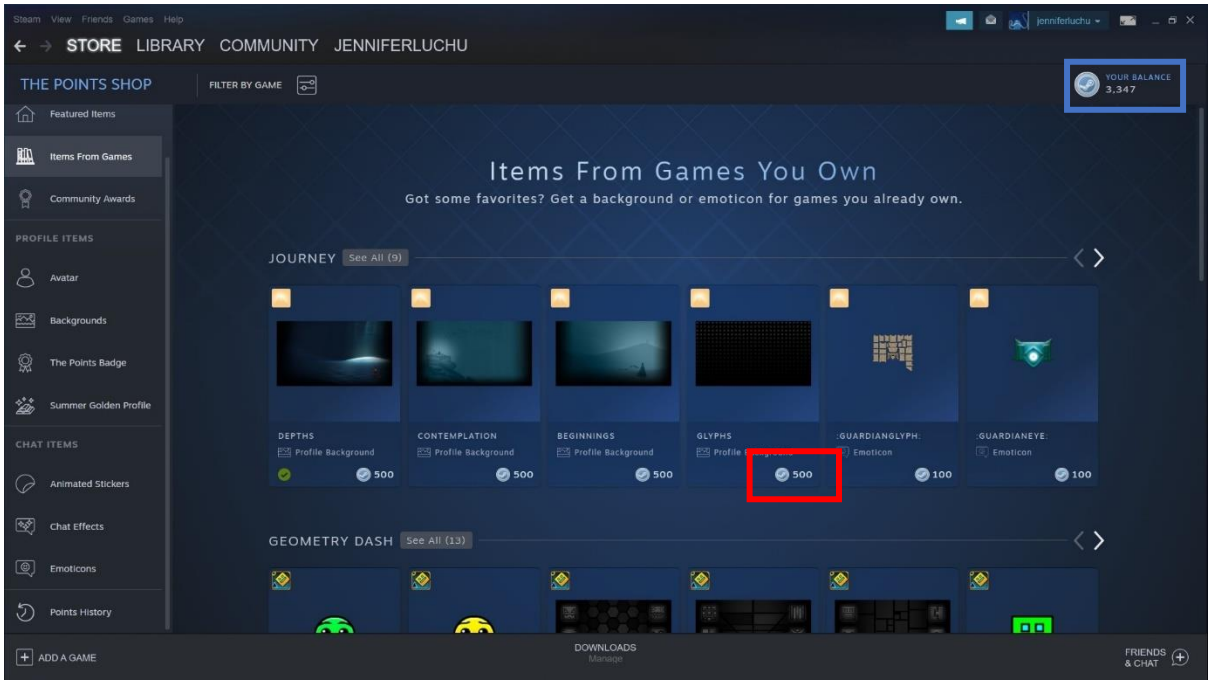

Figure 1.1: The Steam Points that can be used in Steam Points Shop

b) **Levels/ Stages**

Levels in games are defined as a section of a game. Most games are divided into levels because the size of the games is too large. Dividing games into levels can enable only one section of the game needs to load at a time. (Beal, 2005) The level system is implemented in many game designs to provide players with a sense of accomplishment. The lower levels need less work and are easier to reach, but the higher levels need more effort and abilities. Even though levels/stages are a common and popular gamification approach that serves as a type of reward for task or assignment completion. One example of game that uses the gamification feature of levels or stages is Candy Crush. Figure 1.2 below shows the screenshot of the gamification feature of levels/ stages that are used in Candy Crush.

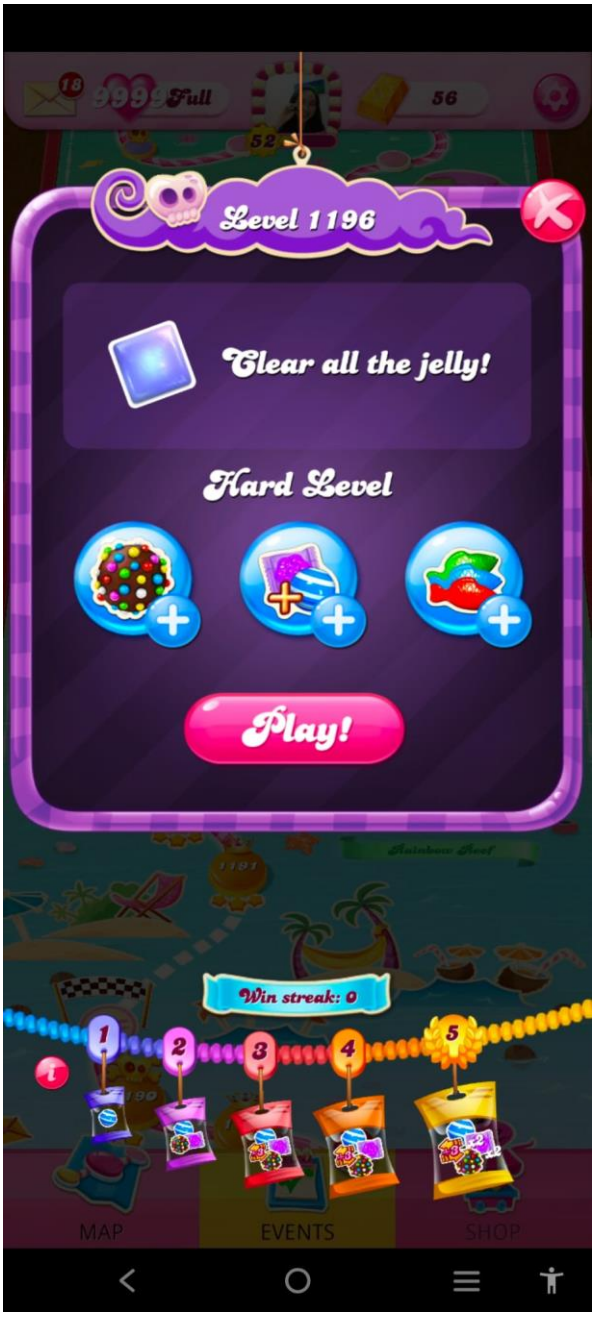

Figure 1.2: The screenshot of the gamification feature of levels/ stages that are used in Candy Crush

c) **Badges**

A badge is defined as a reward that a user receives after completing a challenge, which is made up of a series of smaller tasks. A badge can be used to remind and celebrate a user's progress toward achieving a larger goal. (Banus, 2022) During the goal-achieving process, badges are recognized as a mark of appreciation or task completion. The usage of badges is beneficial for engaging learners in the next learning assignments to sustain learners' motivation. Badges are useful in motivating students to strive toward future goals. One of the examples of games that use the gamification feature of badges is Duolingo. Figure 1.3 shows an example of the badge feature used in Duolingo.

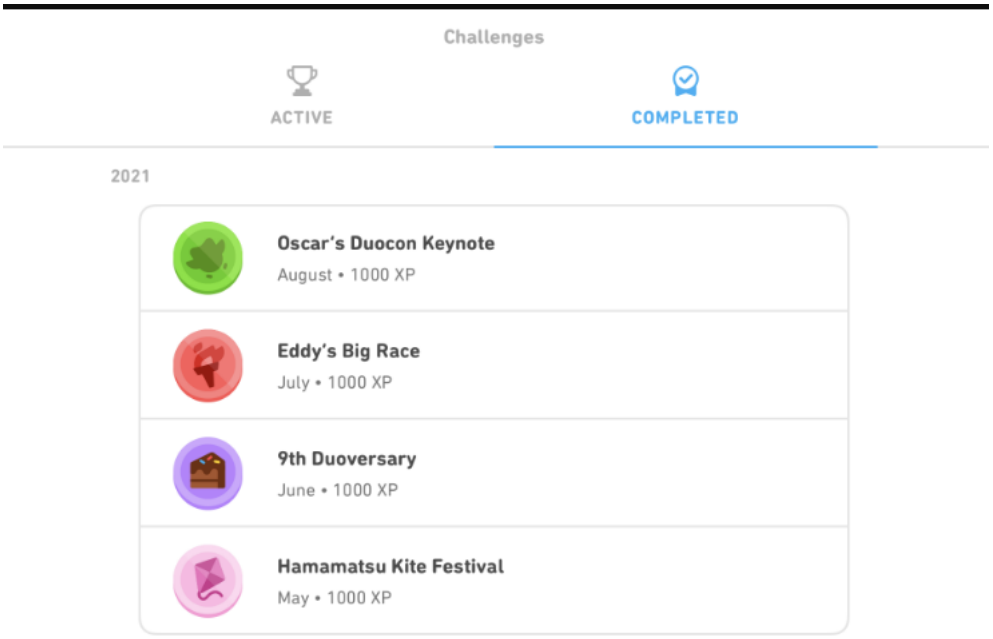

Figure 1.3: An example of a badge feature used in Duolingo

d) **Leaderboards**

A leaderboard is a feature that is frequently used to indicate rank among people who play various titles. (Hope, 2017) For example, for a first-person shooter in games like Call of Duty, there are leaderboards to rank players based on how many kills they have achieved during each match. (Hope, 2017) A leaderboard's goal is to keep learners engaged and develop a sense of urgency to progress their names for the accomplishments they have made. Leaderboards are used to promote a feeling of competition among players. A leaderboard displays the current levels of high scorers as well as the total points. Leaderboards often display only the top 5 or 10 scorers to minimize the demotivation for those who are lower ranked. Displaying the top 5 or 10 scores can minimize demotivation of those who are lower ranked. This is because, imagine if the player sees him or herself to be at the position of 2,000 in a leaderboard. They will feel they are out of the game before even starting. They will feel like they just cannot win the game. Therefore, displaying the top 5 or 10 scores can minimize the demotivation of those who are lower ranked. (Velasquez, 2018) One example of a game that uses the game design element of leaderboards is Skyscraper Stack Builder. Figure 1.4 below shows the screenshot of the leaderboard used in the game Skyscraper Stack Builder.

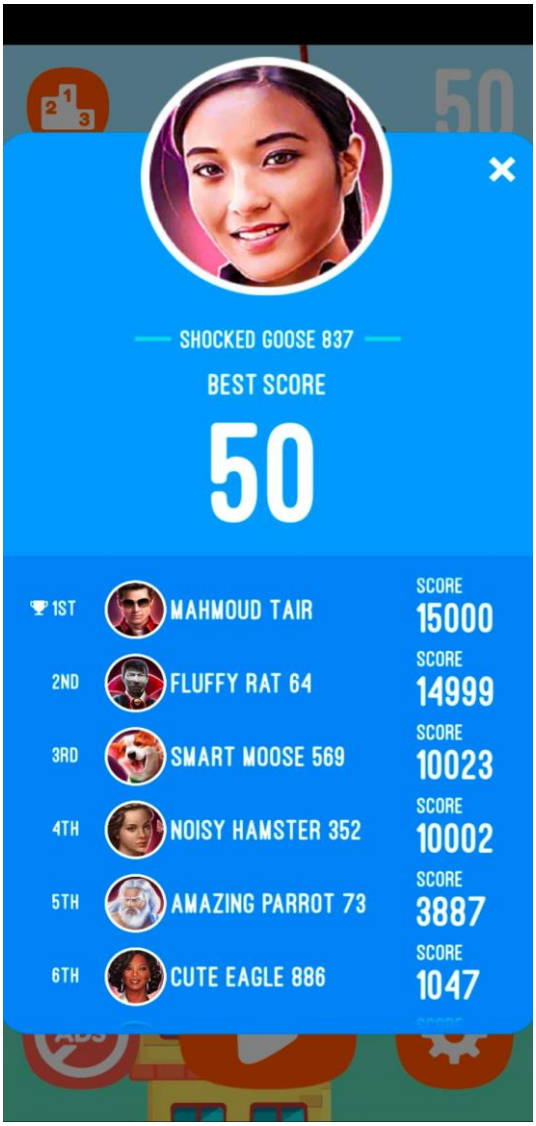

Figure 1.4: The screenshot of the leaderboard used in the game Skyscraper Stack Builder

e) Prizes and Rewards

Prizes and rewards are defined as a game design element in which the designer arranges for players to receive some type of reward for playing the game. (Techopedia, 2022) Prizes and rewards are beneficial in encouraging students. The timing and number of incentives can also have an impact on learner motivation. In general, it is preferred to provide numerous small awards than one large one. Furthermore, the timetable for awarding prizes should be divided uniformly throughout the learning process. One example of a game that uses the gamification feature of prizes and rewards is Candy Crush. (Oszi, 2022) In Candy Crush, the player needs to win a level in the game every day to collect a sticker for each day they win to get a reward. Figure 1.5 shows the screenshots of the gamification features of prizes and rewards in Candy Crush. The reward that the player gets after fulfilling all the requirements to get the reward is the boosters used in the games. (Fandom, 2021) Booster in Candy Crush is also known as Power-up. It is an item that is used to simplify the gameplay. (Fandom, 2022) One of the boosters that can be get from the daily win is Lollipop Hammer. (Fandom, 2021). The Lollipop Hammer simplifies the gameplay by breaking one piece of candy or breaking a blocker. (Fandom, 2022) Figure 1.6 shows the blocker, the moment Lollipop Hammer is

used to simplify the gameplay and the interface of the game after being simplified using a Lollipop Hammer.

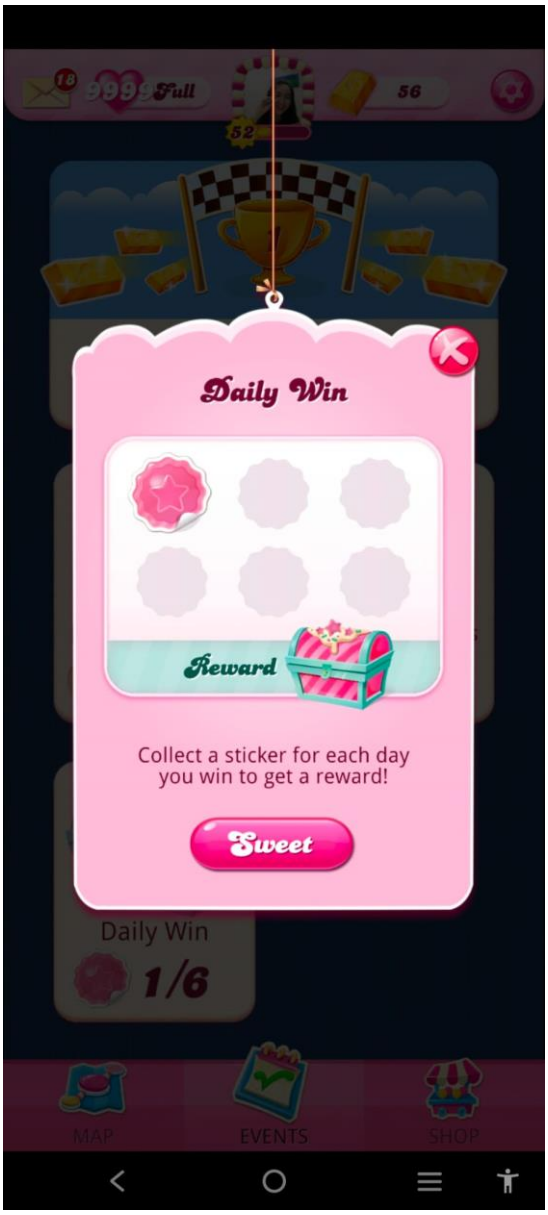

Figure 1.5: The screenshots of gamification features of prizes and rewards in Candy Crush

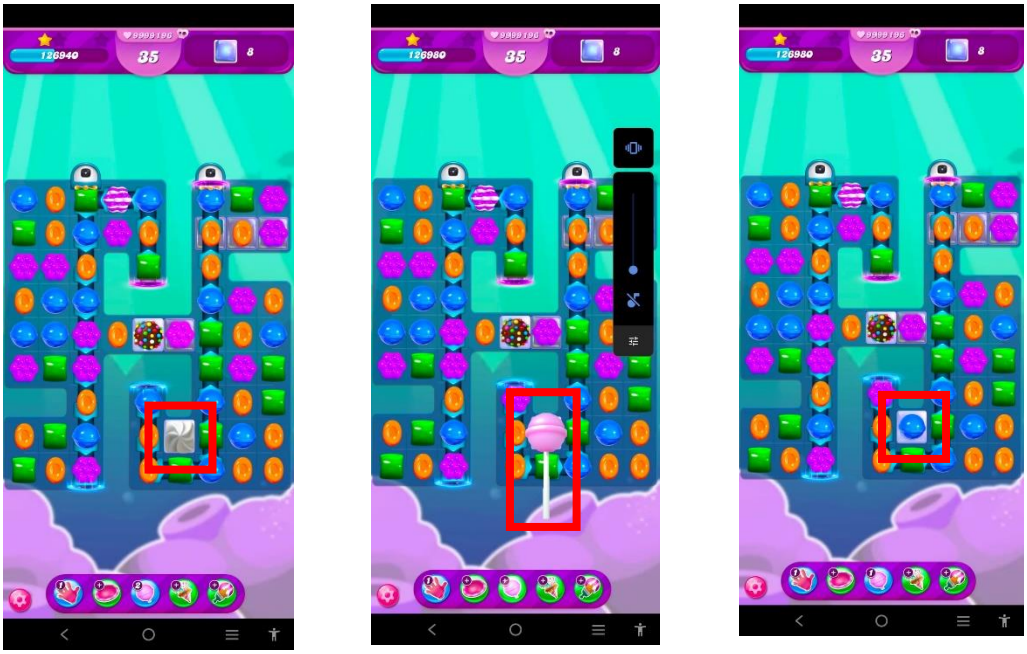

Figure 1.6: The blocker, the moment Lollipop Hammer is used to simplify the gameplay and the interface of the game after being simplified using a Lollipop Hammer

f) **Progress bar**

A progress bar is a game element that provides graphical feedback to the player on the progress toward the completion of a single challenge or set of tasks. (Lee, 2014)
The objective progression is tracked and shown using progress bars. Progress bars are used as a display mechanism in educational games to motivate people who are near accomplishing their educational objectives. If they are falling behind in their development, progress bars might help motivate them. One of the games that implement the use of a progress bar is Plant Vs Zombie. Figure 1.7 shows the progress bar in Plant Vs Zombie.

Figure 1.7: The progress bar in Plant Vs Zombie

g) **Storyline**

Storyline is defined as the narrative or plot of the game. It is a series of linked events that happen one after the other. (Juegoadmin, 2021) A good plot can assist learners in achieving an ideal interest curve, with interest peaks at the beginning and the end of the learning process, and in remaining motivated throughout the learning process. A storyline also gives context for learning and problem-solving, as well as helps to demonstrate the significance of concepts in real-life situations. One of the examples of games that uses the game design element of storyline is Scriptic: Crime Stories. There are a few different stories to be chosen from the games. One of the stories in the game is called Redman. There are a few episodes in the stories and the player will have a role as the lead detective, investigating murder victims' smartphones, finding clues in the victims' apps, tracking down and questioning suspects, and making arrests. The ending of the stories will differ based on what decisions made by the player. (Electricnoirstudios.com, 2022) Figure 1.8 below shows the screenshots of the summary of Redman and the episode available for Redman in the game Scriptic: Crime Stories.

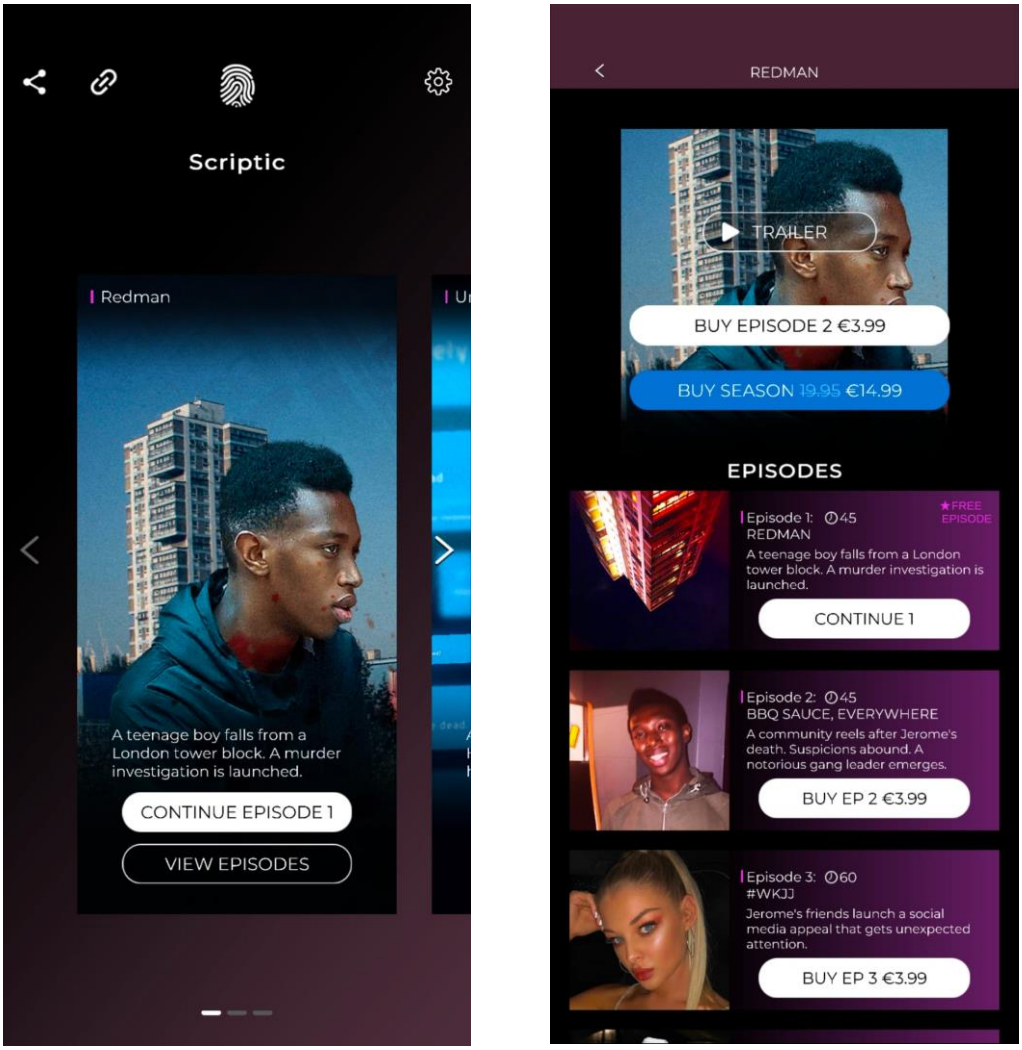

Figure 1.8: The screenshots of summary of Redman and the episode available for Redman in the game Scriptic: Crime Stories

h) **Feedback**

Feedback in games can be defined as a reaction or a response. Or in other words, feedback is the response from the game itself when the player takes an action. (Cieślak, 2021) The feedback that is frequent, intense, and immediate is beneficial to learner engagement. The more the frequency and speed with which feedback is provided, the better the learning effectiveness and learner engagement. As a result, feedback is an important criterion for performance and engagement. One of the examples of games that use the game design element of feedback is Wordscapes. Figure 1.9 below shows the screenshots of feedback provided in Wordscapes when the player completed a level.

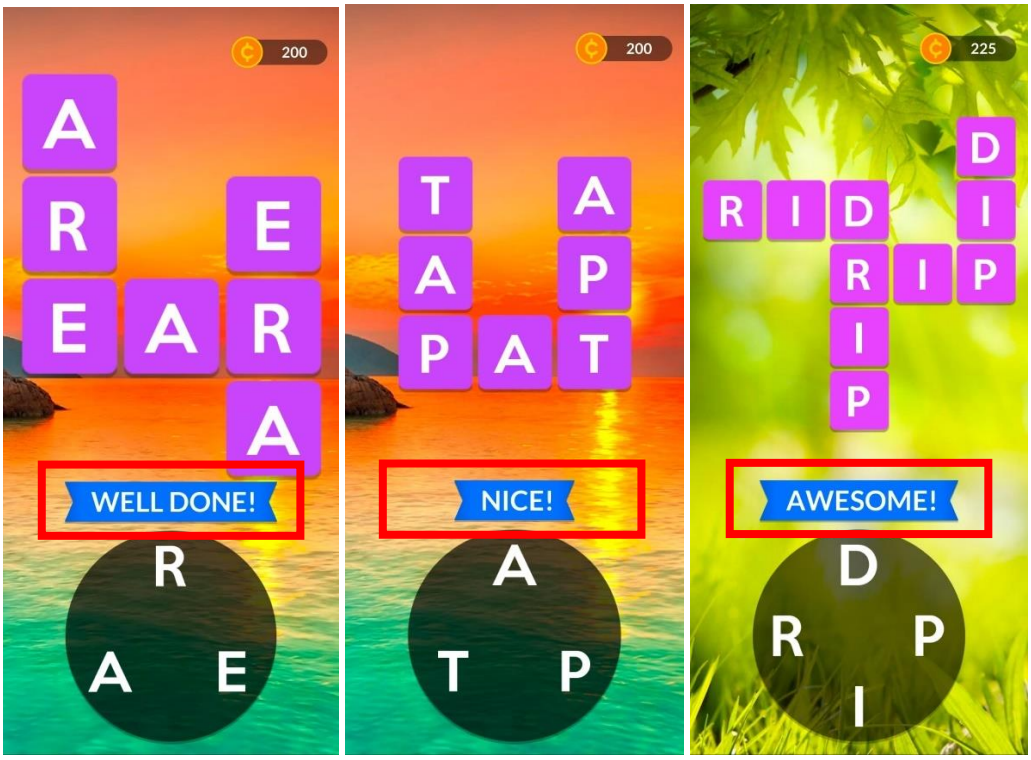

Figure 1.9: The screenshots of feedback provided in Wordscapes when the player completed a level

3.4 Examples of Gamified Educational Applications

One example of gamified educational applications is Stack Overflow (www.stackoverflow.com). In Stack Overflow, computer programmers interact with one another in a community-like environment. Figure 1.10 below shows a question being asked by a user and a few other users answering the question.

Figure 1.10 : A question being asked by a user and a few other users answering the question in Stack Overflow

Those that respond to questions asked by other users will receive benefits such as reputation points and badges. For example, figure 1.11 below shows a user with a username called ezio4df in Stack Overflow has answered 106 questions. The user with username ezio4df who has a reputation point of 2938 and has gold, silver and bronze badges.

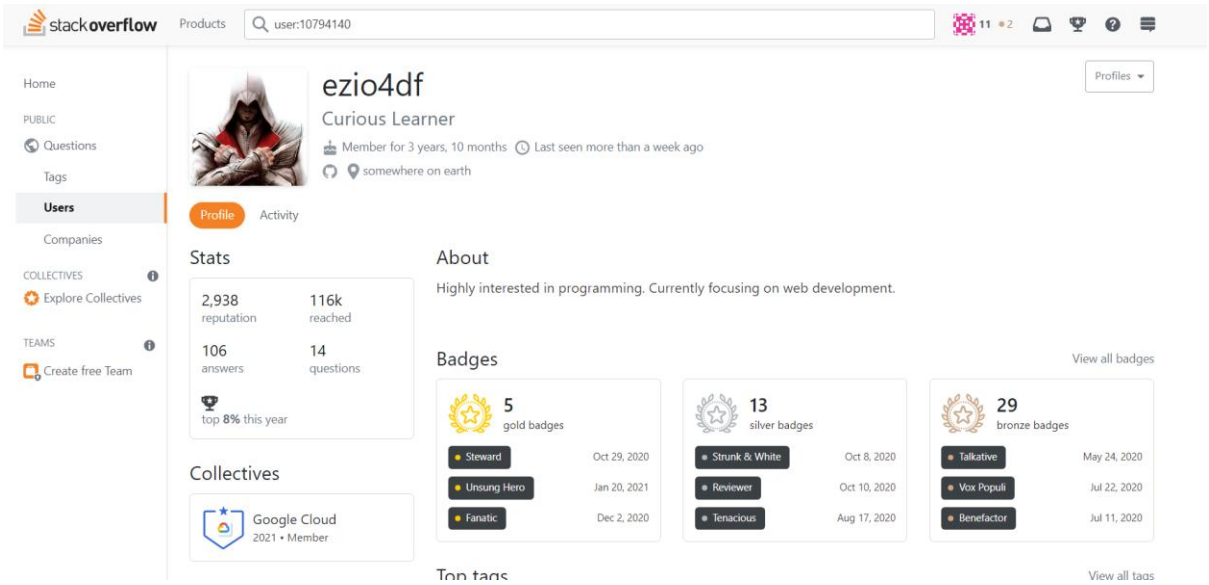

Figure 1.11 : A user with a username called ezio4df in Stack Overflow has answered 106 questions. Therefore, has a reputation point of 2938 and has gold, silver and bronze badges

Figure 1.12 below shows the first few questions answered by the user with username ezio4df

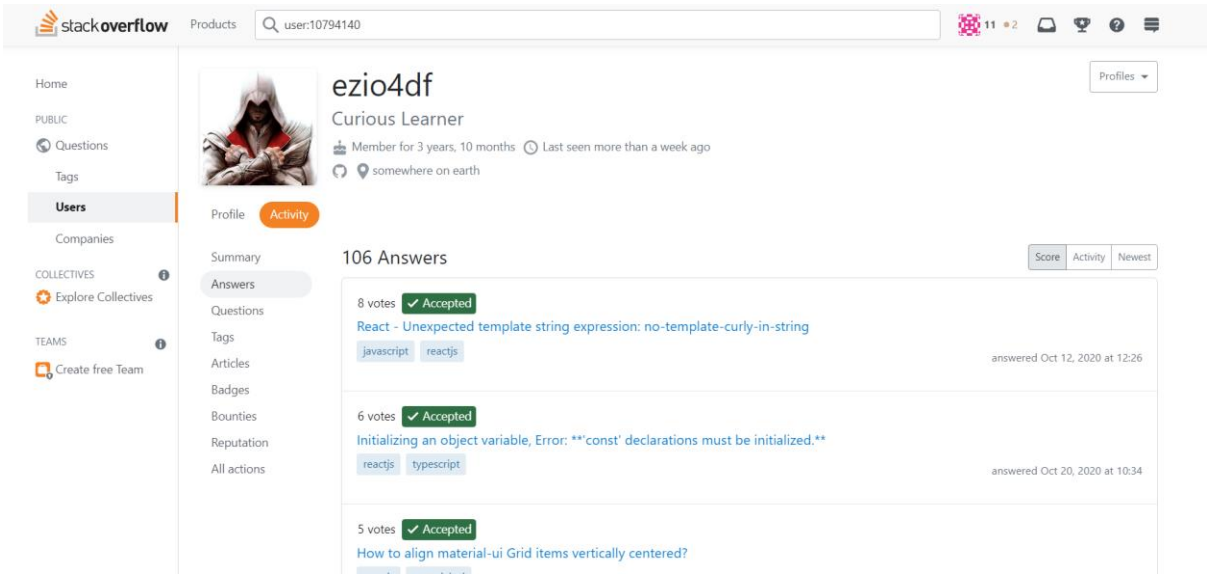

Figure 1.12 : The first few questions answered by the user with username ezio4df

After the user reaches 500 reputation points, they will be granted additional rights such as moderator, which will allow the users to help with the selection of content on Stack Overflow. (Bradley, 2022)

The role of a moderator in Stack Overflow are listed below (Overflow, 2022) :

- Posts can be locked by moderators. Posts that have been locked cannot be voted on or changed in any way.
- Moderators can safeguard questions. Protected questions can only be answered by users with more than ten reputation points.

- Moderators have access to additional data in the system, such as vote statistics (but not "who voted for this post") and user profile information.
- Moderators can suspend users for a set period and delete them if necessary.
- Moderators can perform large-scale maintenance tasks such as question and tag merging, tag synonym approvals, and so on.

3.4 Summary of Gamification

In short, the concept of gamification is formed from the combination of elements such as game-based, mechanics, aesthetics, game thinking, engaging, people, motivating action, promoting learning and solving problems. Gamification works according to the framework of gamification and the framework is evolved around five principles. The five principles in the framework of gamification are goal orientation, achievement, reinforcement, competition and fun orientation. There are a few game design elements which are commonly used in educational or learning contexts in general, as well as in the field of cybersecurity. However, only four game design elements are suitable to be used when building a gamified tool for teaching GDPR and they are points, levels/ stages, leaderboards and badges.

After this section about the concepts and elements of gamification, the research manual will move on to explain the existing apps in the market or industry that teach Cybersecurity or have an interesting integration of elements of gamification.

4. Existing Apps

4.1 Learn Cyber Security

Learn Cyber Security is first released on 28 March 2020. It is an app that teaches cyber security lessons, tutorials and training. This app is useful for people who are preparing to become cybersecurity experts. The topics such as Fundamental of Information Security, Concepts of Physical Security, Cyber Attacks & Cyber Laws, Basics of Cyber Security, Layers of Security and Digital Forensics can be learned with this Learn Cyber Security created by Cyber Security Experts.

Some interesting features of Learn Cyber Security App are the tutorial about the video. Figure 2.0 below shows an example of the tutorial about the topic "Fundamentals of Information Security":

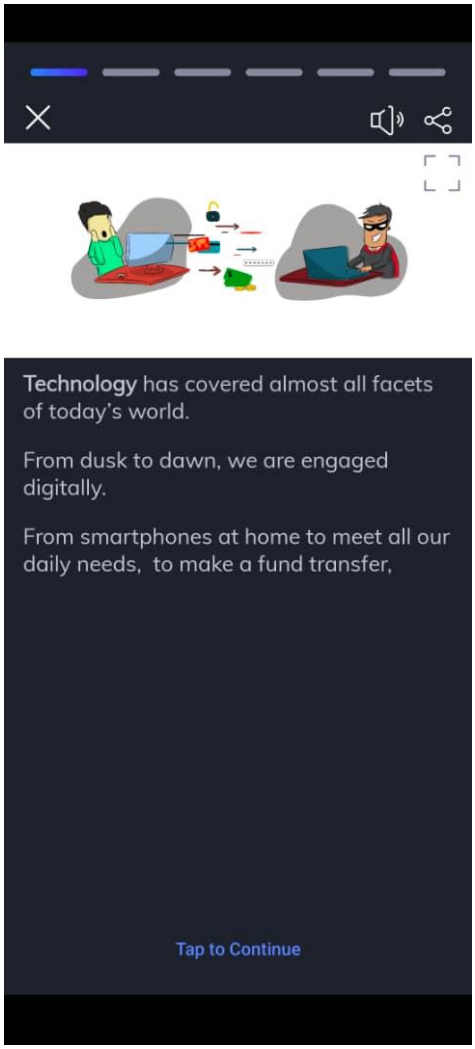

Figure 2.0: Screenshot of tutorial about the topic "Fundamentals of Information Security" in the app Learn Cyber Security

Other than tutorials about the topic, there are also quizzes for the particular topic. For example, figure 2.1 below shows the screenshot of quizzes about the topic “Fundamentals of Information Security”

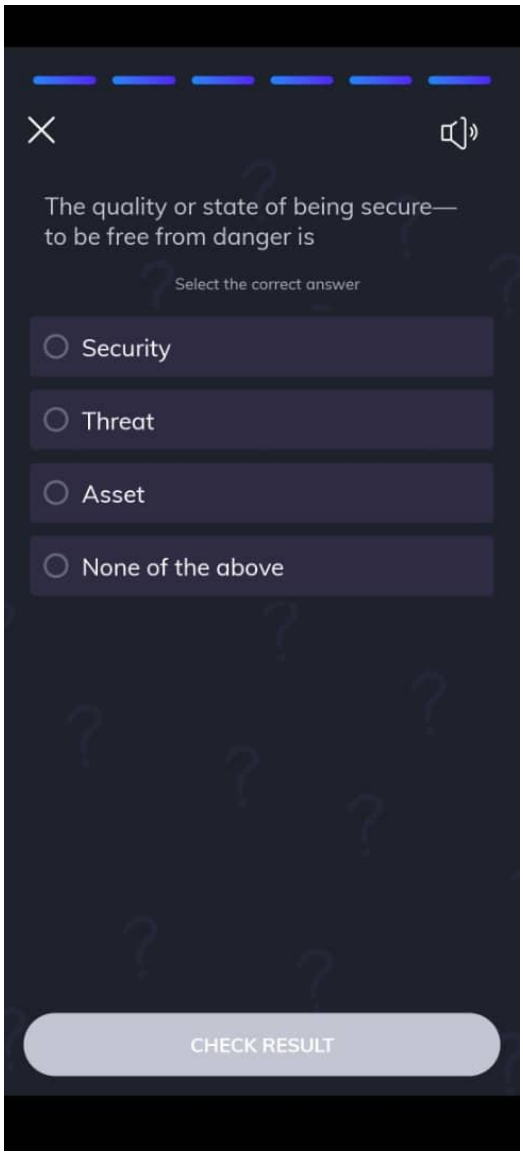

Figure 2.1: Screenshot of quizzes about the topic “Fundamentals of Information Security”

The only game design element that is used in Learn Cyber Security is levels/ stages. Learn Cyber Security is divided into a few levels and each of the levels has tutorial videos and quizzes as shown in Figure 2.0 and Figure 2.1 above. Figure 2.2 below shows the levels or stages that are available in Learn Cyber Security.

Figure 2.2: The levels or stages that are available in Learn Cyber Security

After the player finishes all the levels or stages available in Learn Cyber Security, they will be given a certification of completion from the company that developed Learn Cyber Security, Programming Hub. The review of the certification of completion is shown in Figure 2.3 as below.

Figure 2.3: The screenshots of the review of the certification of completion after completing all the levels in Learn Cyber Security

However, the players need to pay for subscriptions in Learn Cyber Security to unlock all the levels and get the certification of completion. Figure 2.4 below shows the player needs to pay for the subscription to Learn Cyber Security to unlock all the levels and get the certification of completion.

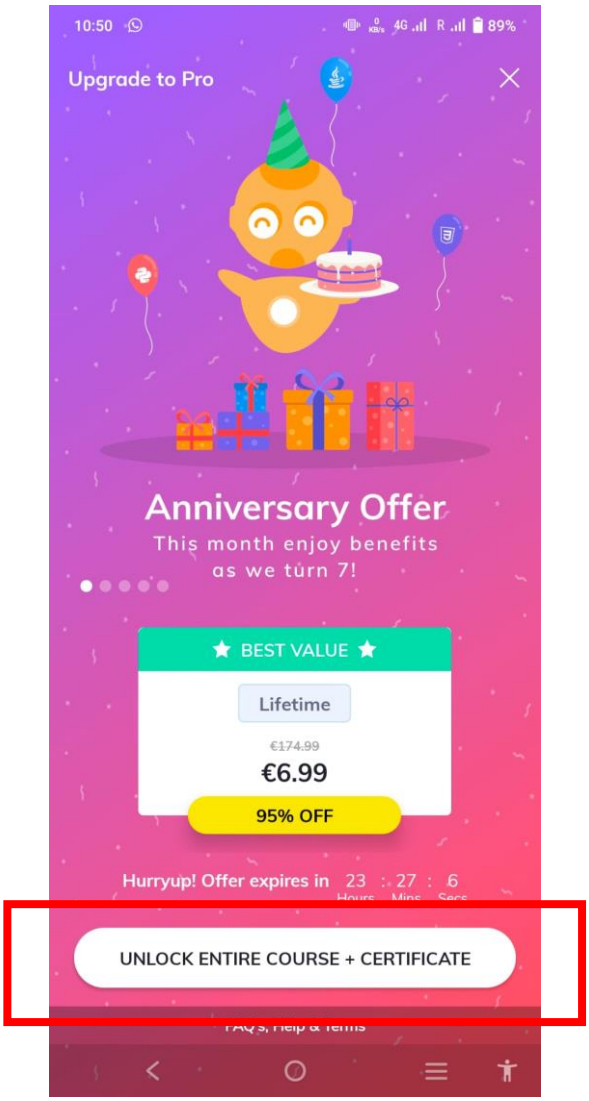

Figure 2.4: The player needs to pay for the subscription to Learn Cyber Security to unlock all the levels and get the certification of completion

4.2 Cyber Security Tycoon

Cyber Security Tycoon is a cyber security game with a storyline. The app is first released on 9 May 2021 and it teaches cybersecurity by providing the player with a scenario.

The scenario in Cyber Security Tycoon is very short and simple. When the game started, the player will be a CEO of a tech start-up. Figure 2.5 below shows the screenshots of the description of the scenario in which the player will be a CEO of a tech start-up.

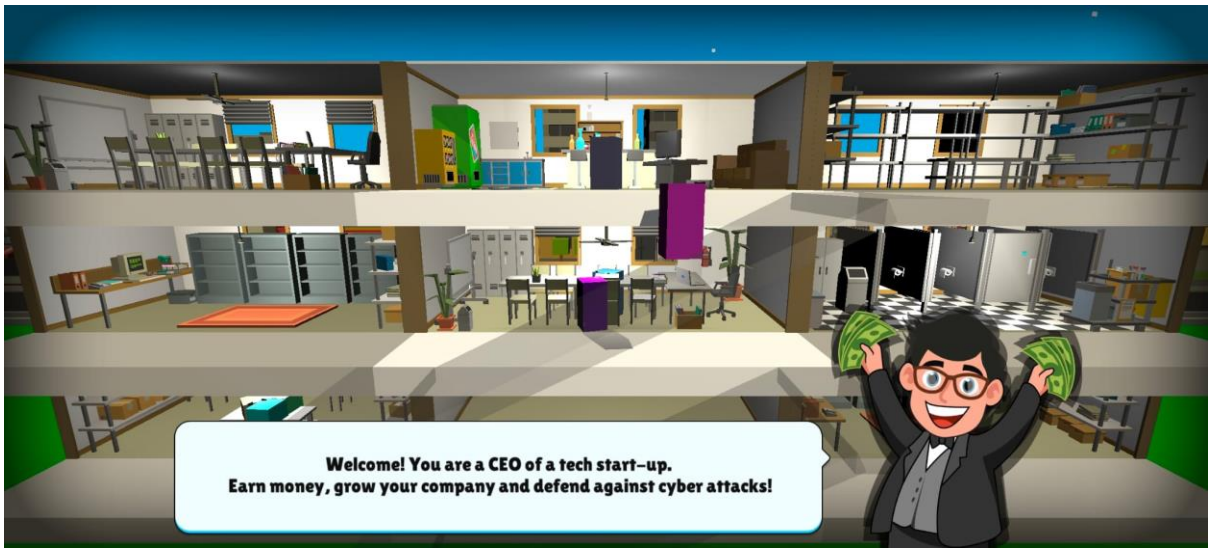

Figure 2.5: The screenshots of the description of the scenario that the player will be a CEO of a tech start-up

The player will need to buy rooms and computer devices to generate cash and security assets to protect the company from hackers. Figure 2.6 below shows the screenshots of the description of the scenario in which the player will need to buy rooms, computer devices to generate cash and security assets to protect the company from hackers.

Figure 2.6: The screenshots of the description of the scenario that the player will need to buy rooms, computer devices to generate cash and security assets to protect the company from hackers.

As time passed, the company built by the player may suffer from cyber-attacks. Figure 2.7 below shows the screenshot of the cyber-attack that happened to the company built by the player.

Figure 2.7: The screenshot of cyber-attack that happened to the company built by the player

When the player clicked on the cyber-attack, the list of all the cyber-attack suffered by the company or mitigated by the company will be shown. Figure 2.8 below shows the screenshot of the list of cyber-attack after the player clicked on the cyber-attack.

Figure 2.8: The screenshot of the list of cyber-attack after the player clicked on the cyber-attack

The app teaches cyber security by describing the cyber-attacks when the user clicks on the info for the attacks. Figure 2.9 shows the example of a screenshot of the description of the cyber-attacks when the user clicks on the info for the attacks, “Worm”.

Figure 2.9: Screenshot of the description of the cyber-attacks when the user clicks on the info for the attacks, “Worm”

One of the game design elements that is used in Cyber Security Tycoon is the leaderboard. Figure 2.10 below shows the screenshot of the leaderboard used in Cyber Security Tycoon.

Figure 2.10 : The screenshot of leaderboard used in Cyber Security Tycoon

Another game design element that is used in Cyber Security Tycoon is the progress bar. Figure 2.11 below shows the screenshot of the progress bar used in Cyber Security Tycoon.

Figure 2.11 : The screenshot of the progress bar used in Cyber Security Tycoon

4.3 Duolingo

Duolingo is an app first released on 29 May 2013. This app is used for people to learn different languages for free.

Duolingo is a very fun and interesting app that is very effective for language learning. The interface of the apps is very cheerful. The apps normally have a lot of images to keep the player's attention. People following directions with text and illustrations do better than those following directions without illustrations. (Lentz, 1982) Figure 2.12 below shows the example screenshot of the interface of Duolingo app.

Figure 2.12: The screenshot of the interface of Duolingo app

Besides its attractive interface, Duolingo also enables the player to set daily learning goals. A notification will be received by the players from the apps every day to remind them to learn every day. Figure 2.13 below shows the screenshot of the notification received by the players from the apps that remind them about the daily goals selected.

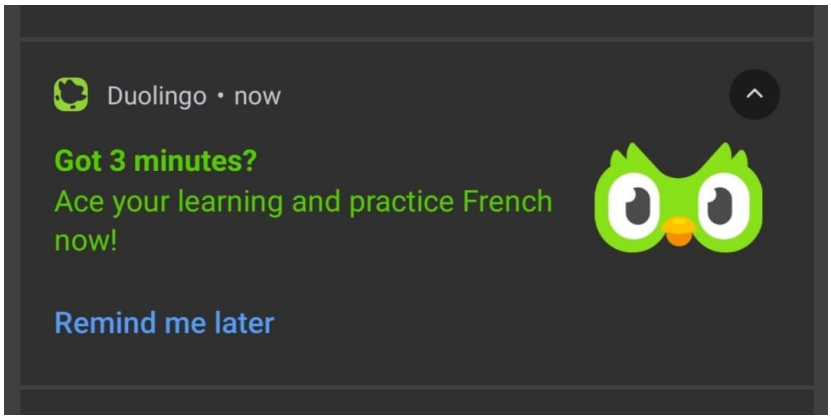

Figure 2.13: The screenshot of the notification received by the players from the apps that remind them about the daily goals selected

Other than that, Duolingo also has Leaderboard to motivate the players to learn more. Figure 2.14 below shows the screenshot of the Leaderboard from Duolingo.

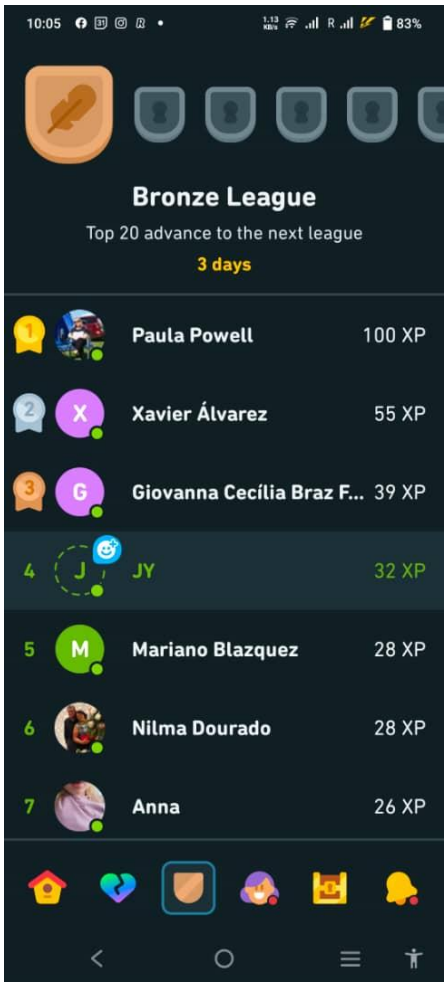

Figure 2.14: The screenshot of the Leaderboard from Duolingo

Another feature that makes Duolingo so addictive is the badge function. To earn the badge, the player needs to complete each month's challenge. In the month of October in the year 2022, the challenge is to earn 1000XP. XP in Duolingo has a function like points. To earn the XP, the player must complete different achievements. Figure 2.15 shows the screenshot of example of achievements the players must complete to earn XP.

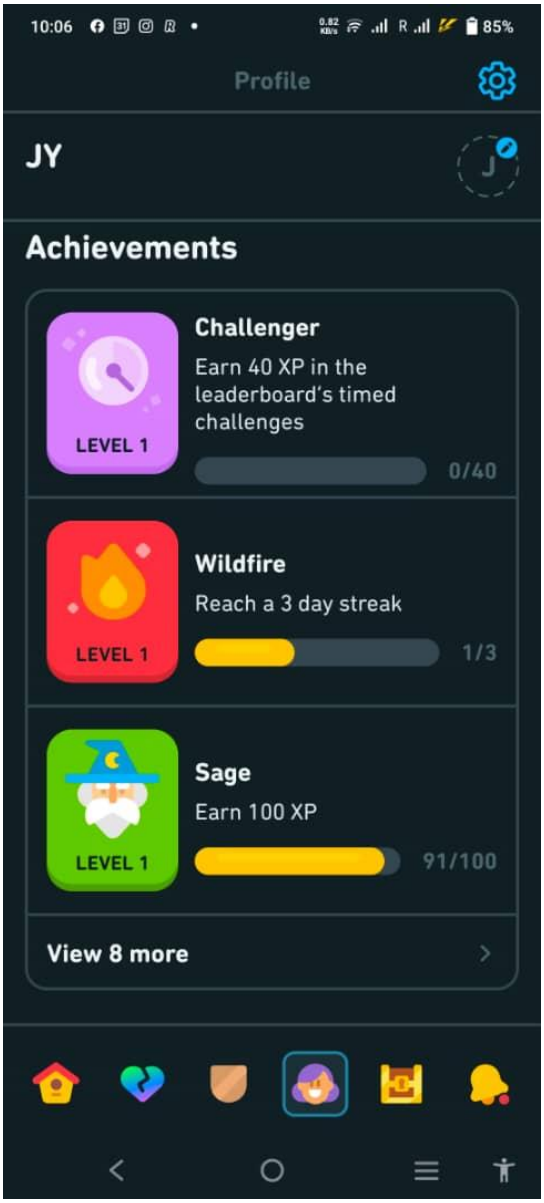

Figure 2.15: the screenshot of example of achievements the players must complete to earn XP

The next feature that makes Duolingo so interesting is the streak function. To prevent the streak from resetting, the player needs to practice Duolingo every day. Figure 2.16 shows the screenshot of the streak function in Duolingo.

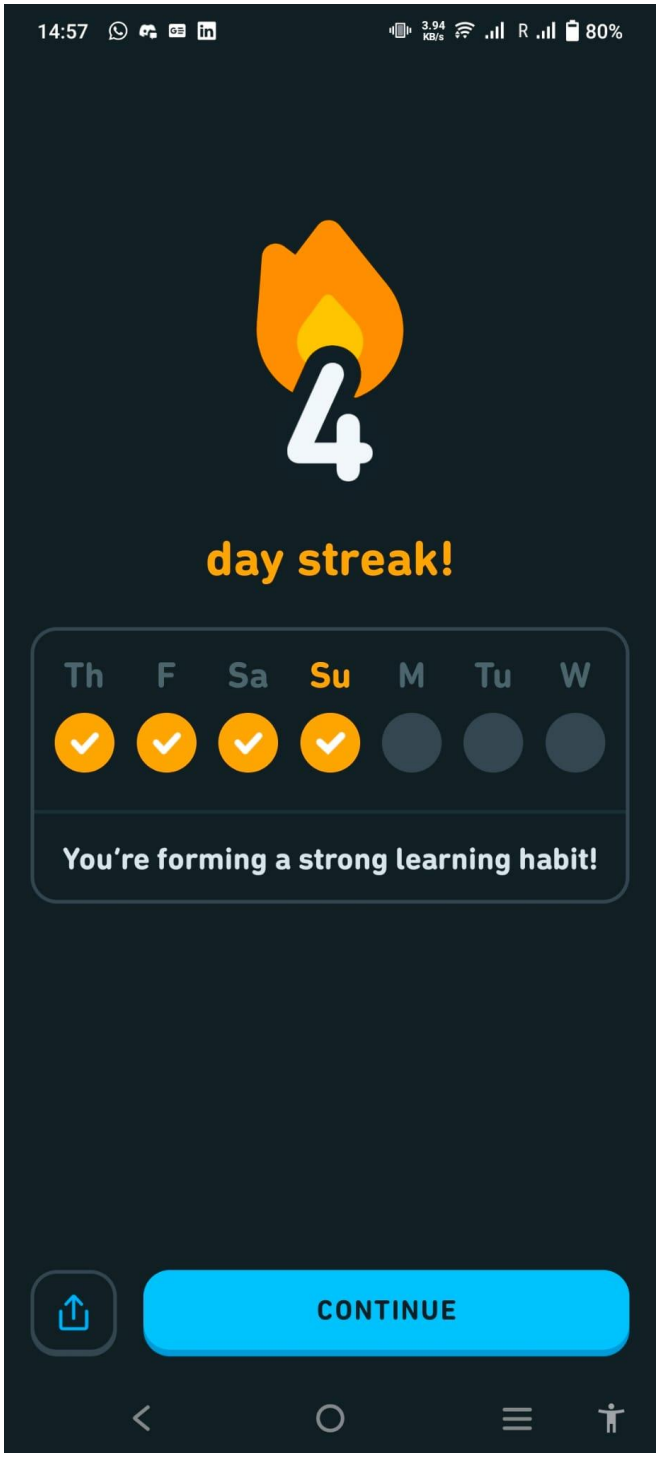

Figure 2.16: The screenshot of the streak function in Duolingo

4.4 WebME

WebME is an app that blends CyberSecurity Tutorials with the thrill of a game. WebMe is a simulation, which means that the player does not even need a connection to play the game. It makes the player feel as if they are using the Internet. Figure 2.17 shows the screenshot of one of the levels in WebME that allow the player to play the game even when the player does not have an internet connection. The player is not able to connect to a cellular or WiFi network when the player enables airplane mode. (Rennemeyer, 2019)

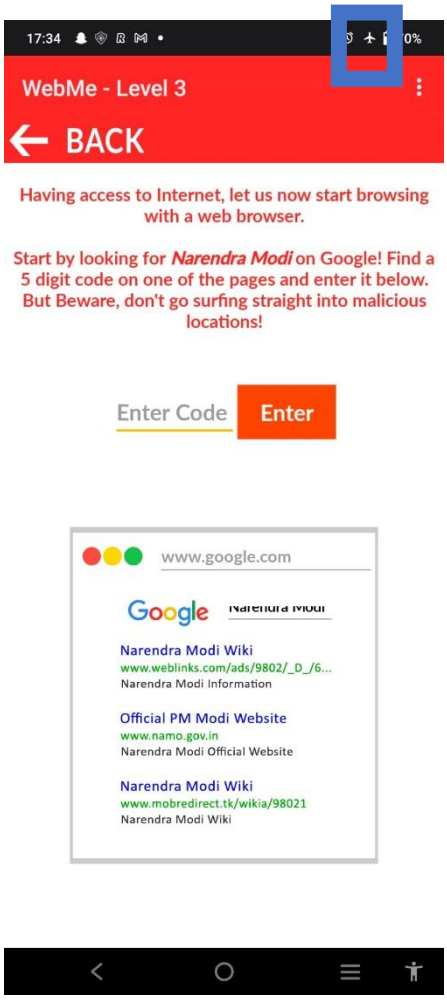

Figure 2.17: The screenshot of one of the levels in WebME that allow the player to play the game even when the player does not have an internet connection

One of the game design elements used in WebME is level/ stages. There are five levels in total in WebME. The user must pass the level before proceeding to the next one. Figure 2.18 shows the player is unable to proceed to the next level when the score is too low.

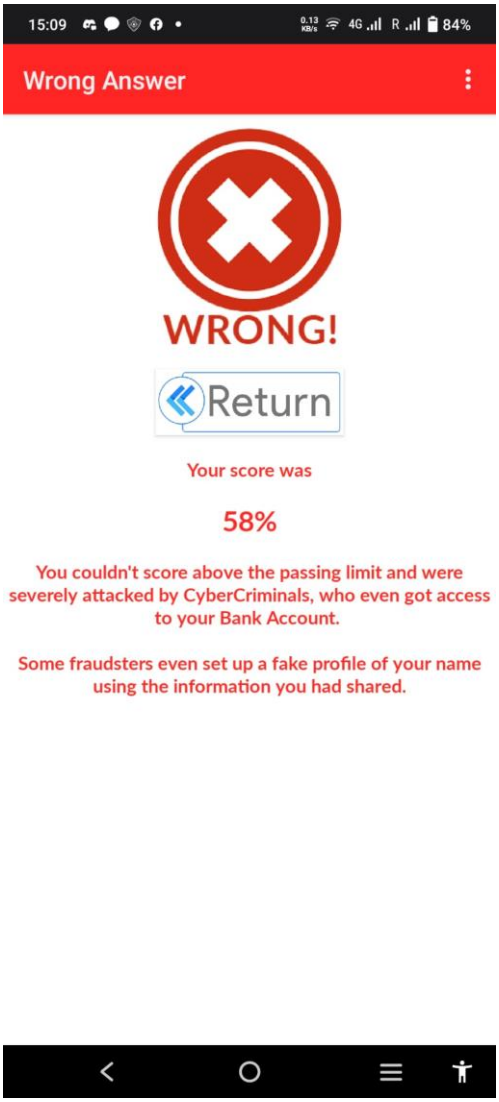

Figure 2.18 : The player is unable to proceed to the next level when the score is too low

WebME works differently from level to level.

One of the ways WebME work is by providing a simulation to the player. For example, the player can search for a word in Google without actually browsing Google. Figure 2.19 shows the Google simulation, where the player can type in the search bar without having to use Google.

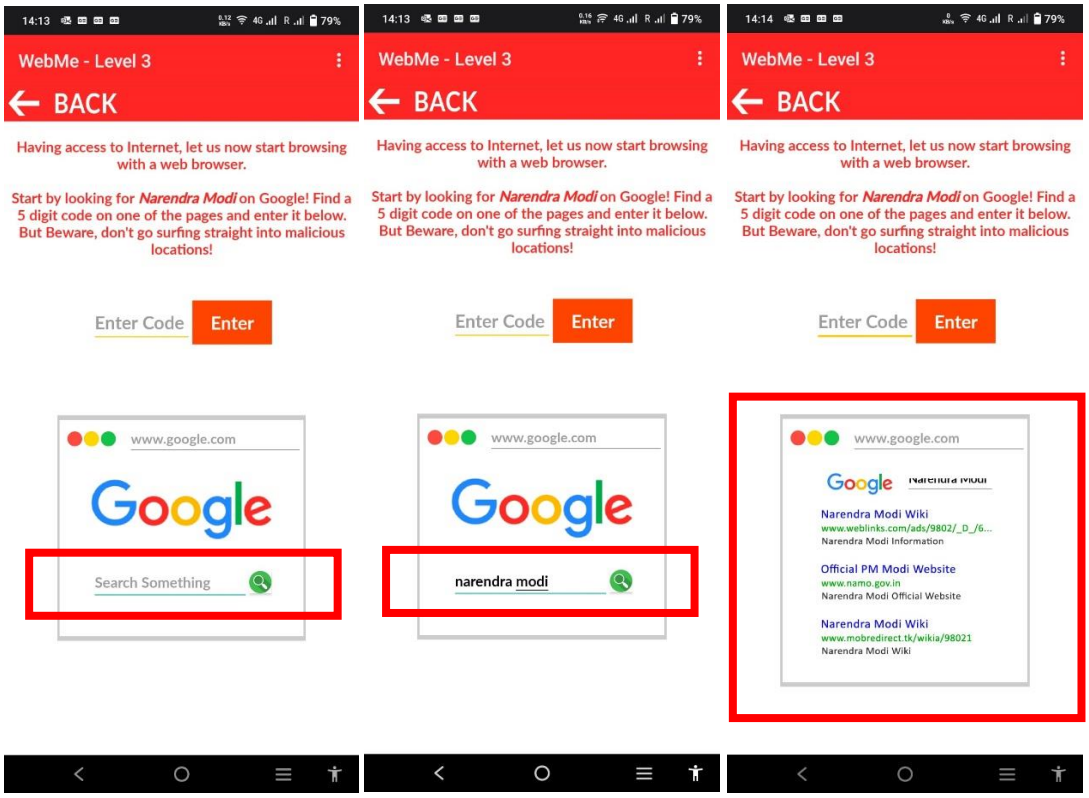

Figure 2.19 : Google simulation in WebME. Left most: Before the player types anything into the search box. Middle: The player typed something into the search box. Right most: After the player types something into the search box and hit enter.

Other than that, another way that WebME is used to teach players cyber security is by asking the player to identify whether the email is phishing or a legit one. Figure 2.20 shows the screenshots of questions that are asked in WebME to let the player identify whether the email or website is phishing or a legit one.

Figure 2.20 : The screenshots of questions that are asked in WebME to let the player identify whether the email or website is phishing or a legit one

After the player selects either phish or legit, there will be an explanation to the player about the correct answer. This is to let them know the way to identify a phishing email. Figure 2.21 shows the explanation to the player about the correct answer.

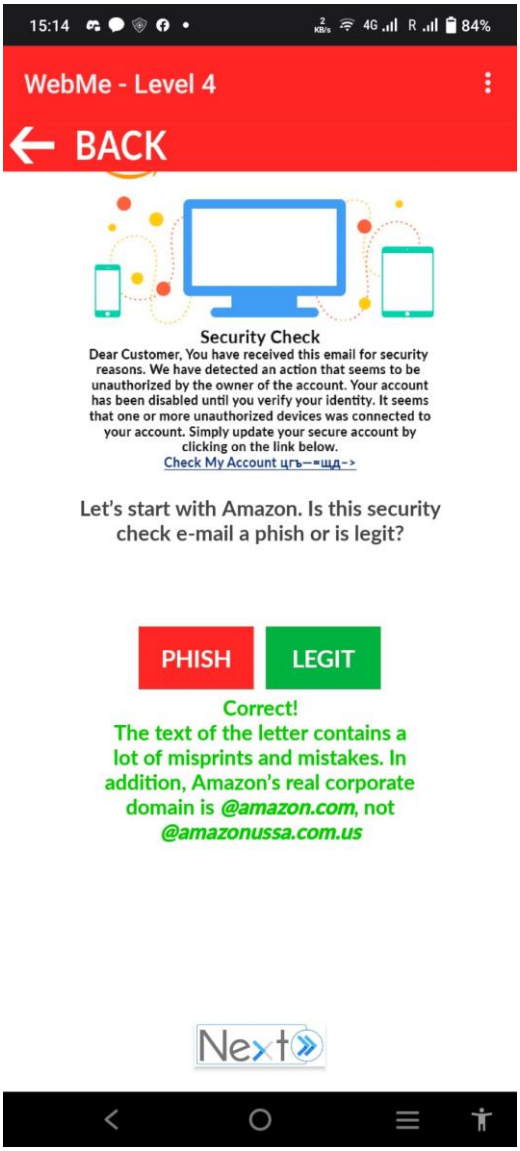

Figure 2.21 : The explanation to the player about the correct answer in WebME

Another game design element used by WebME is prizes and rewards. Once the player completed all five levels in WebME, there will be a certificate issued to the player as a reward. Figure 2.22 below shows the certificate issued to the player after he or she completed all five levels in WebME.

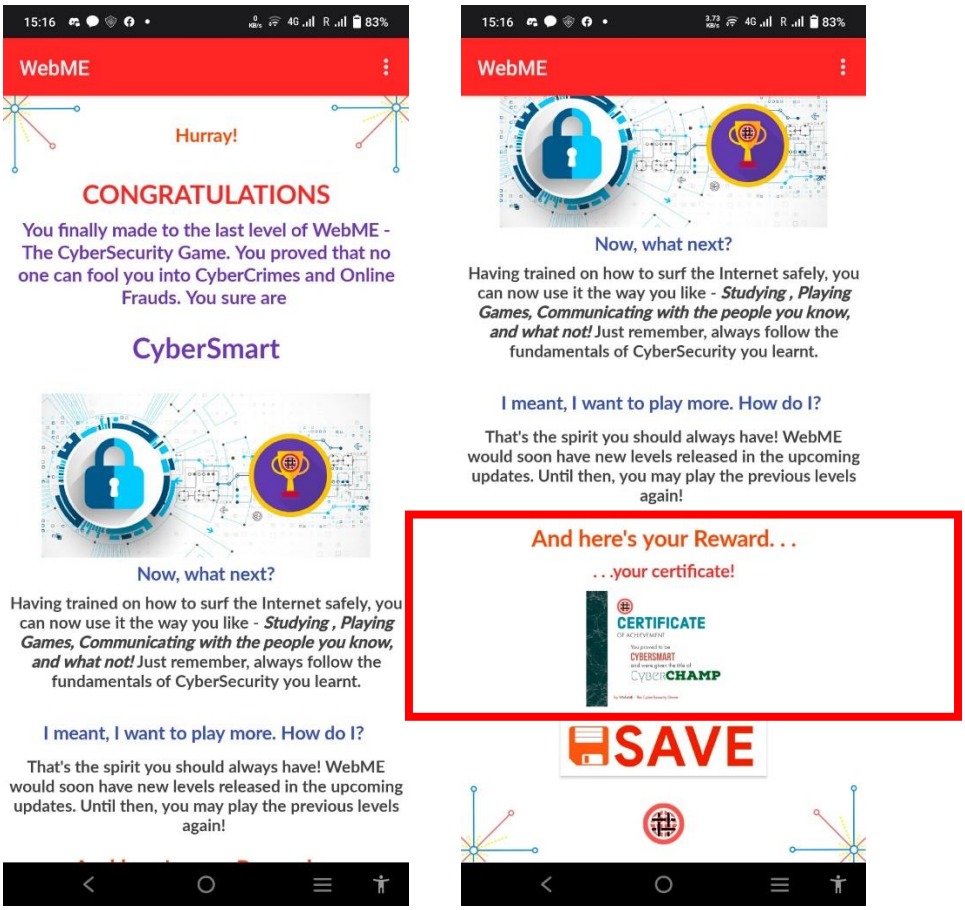

Figure 2.22 : The certificate issued to the player after he or she completed all five levels in WebME

4.5 Summary of Existing Apps

In short, most of the existing apps that teach cyber security in the industry have the game design elements such as points, levels/ stages, leaderboards and badges.

The elements that are suitable to be implemented in building a gamified tool for teaching GDPR are points, levels/ stages, leaderboards and badges.

One of the reasons why points are one of the game design elements that are suitable to be implemented in building a gamified tool for teaching GDPR is because the point system can be used to indicate the performance and achievement of the player in the game. The points can be used as prizes, as an investment for further progress toward the goals, or to represent one's position.

Next, the reason why levels or stages are one of the game design elements that are suitable to be used in building a gamified tool for teaching GDPR is that level systems can provide

players with a sense of accomplishment. This is because, less effort is needed to achieve lower levels. But more effort and abilities are needed to achieve higher levels.

Besides, one of the reasons why leaderboards are one of the game design elements that can be used to create a gamified tool to teach GDPR is because a leaderboard is able to keep learners engaged and develop a sense of urgency to improve and reach a higher position in a leaderboard. The sense of urgency is developed due to the feeling of competition among players caused by leaderboards.

Lastly, the reason a badge can be implemented in creating a gamified tool to teach GDPR is that a badge can remind and celebrate a player's progress towards achieving a larger goal. A badge is often used in a game as a reward that a player receives after completing a challenge that is made up of a few smaller tasks.

After this section about the existing apps that are available in the industry and market, the research manual will move on to explain the options of development that can be used to develop the gamified tool for teaching GDPR. The subsections that will be included in the development section are the options of tools and programming languages available. Meanwhile, the advantages and disadvantages of the tools and programming language will be discussed in the development section as well.

5. Development

5.1 Tools

5.1.1 Android Studio

One of the option of tools that can be used for development is Android Studio. Android Studio is a unified development environment that allows you to create an application for Android phones, tablet devices, Android Wear, Android TV, and Apple Car. Structured code modules allow users to divide the project into components of the system that can build, test, and debug individually. (Studio, 2022)

Advantages of using Android Studio

a. Fast and Feature-rich emulator

The Android Studio includes an emulator that allows the app to launch faster than the actual device. The emulator enables the user to test the app on various devices such as phones, tablets, Android Wear, and Android TV. Emulators used in Android Studio also can emulate a variety of hardware features such as GPS, multiple touch inputs, motion and acceleration sensors. (Ghanchi, 2022) Figure 3.0 below shows the hardware features available to choose from in Android Studio.

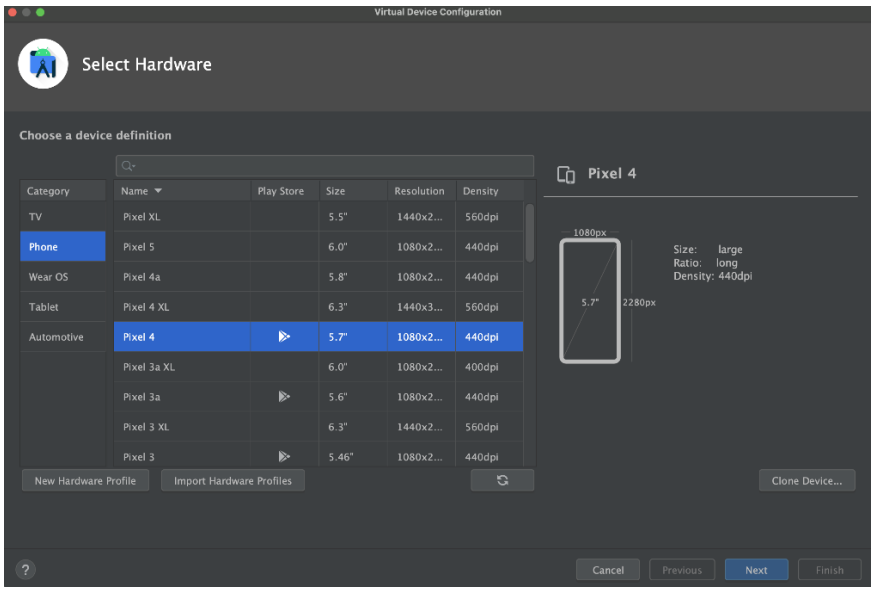

Figure 3.0: The hardware features available to choose from in Android Studio

Disadvantages of using Android Studio

a. Lack of experience

One of the disadvantages of using Android Studio is a lack of experience working with Android Studio. Before doing this research manual, I had no experience using Android Studio. However, I spent a lot of time researching the IDE. One of the ways of researching Android Studio is I took an online course on Udemy about developing using Android Studio in Java. Figure 3.1 below shows the online course that I took in Udemy to understand more about developing an Android App using Android Studio and Java.

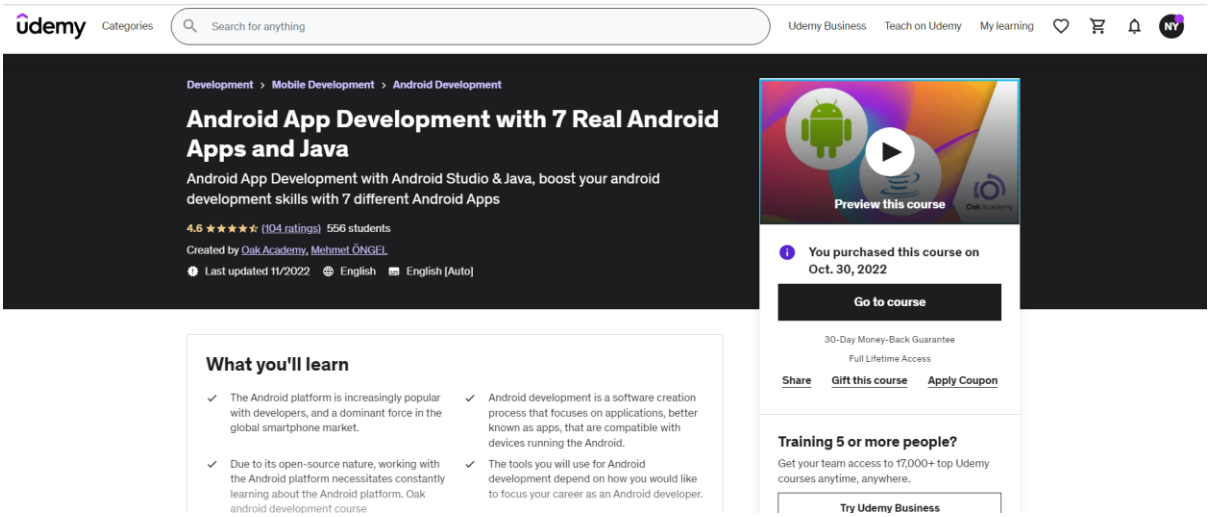

Figure 3.1: The screenshot of the online course took in Udemy to understand more about developing an Android App using Android Studio and Java

Other than watching the tutorial video on the online course, I also did some hands-on work according to the tutorial video I watched on the online course. Figure 3.2 below shows the hands-on work I did on Android Studio according to the online course.

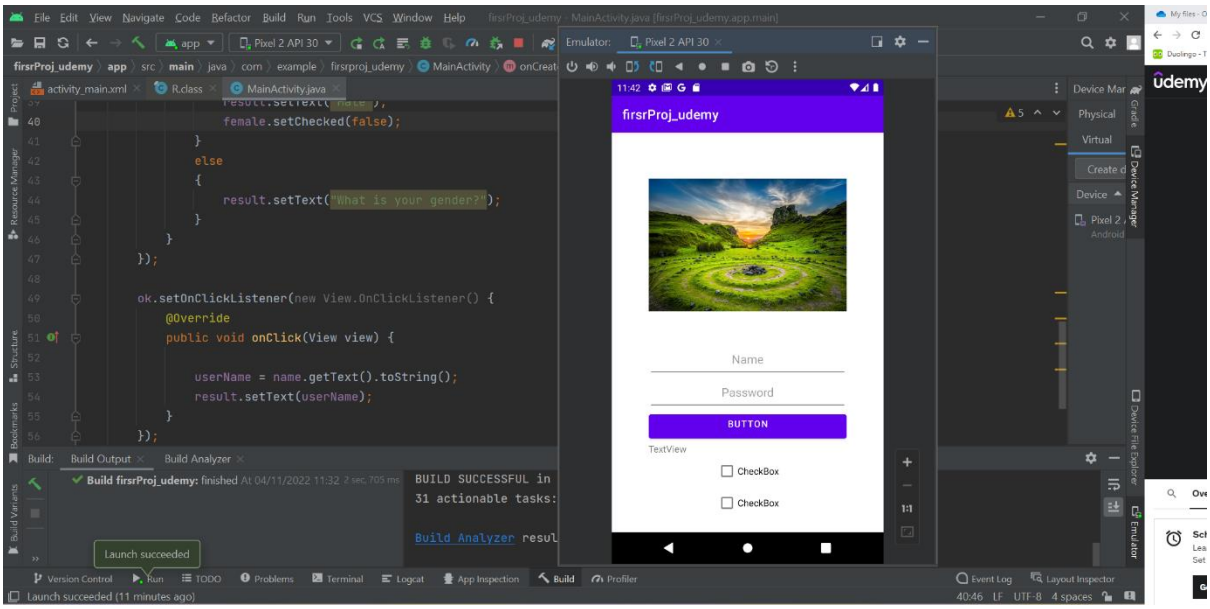

Figure 3.2: The screenshot of hands-on work I did on Android Studio according to the online course

5.1.2 Visual Studio Code

Another option tool available to be used for development is Visual Studio Code. Visual Studio Code is a simplified code editor that supports development operations such as debugging, task execution, and version control. (Code, 2022)

Advantages of using Visual Studio Code

a. Number of languages supported

Hundreds of programming are supported using Visual Studio Code. For example, the users can run JavaScript, TypeScript, CSS, and HTML using Visual Studio Code. (Code, 2022) Other than that, users can also install language extensions to use even more programming languages. For example, there are extensions for Dart and PHP in Visual Studio Code. (Code, 2022)

Disadvantages of using Visual Studio Code

a. Overwhelming when there are more extensions installed (Capterra, 2022)

According to the review from the customers who used Visual Studio Code, some of them are finding that it is overwhelming to manage plugins when there are too many plugins. Since Visual Studio code is not limited to a single language, it is difficult to manage plugins when the user uses it for multiple programming environments, such as Python or C++.

Interface of Visual Studio Code

Figure 3.3 below shows the interface of Visual Studio Code after the user first uses the software without opening any files or projects.

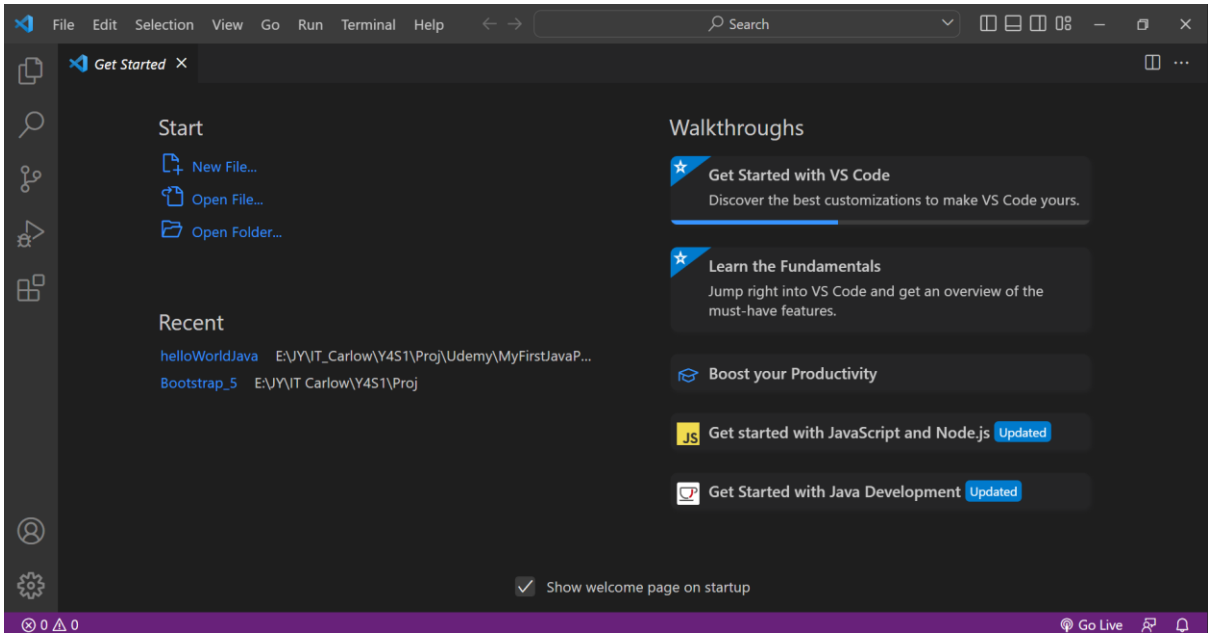

Figure 3.3: The screenshot of the interface of Visual Studio Code after the user first uses the software without opening any files or project

Figure 3.4 below shows the screenshot of the interface of Visual Studio Code after the user writes some codes using the software.

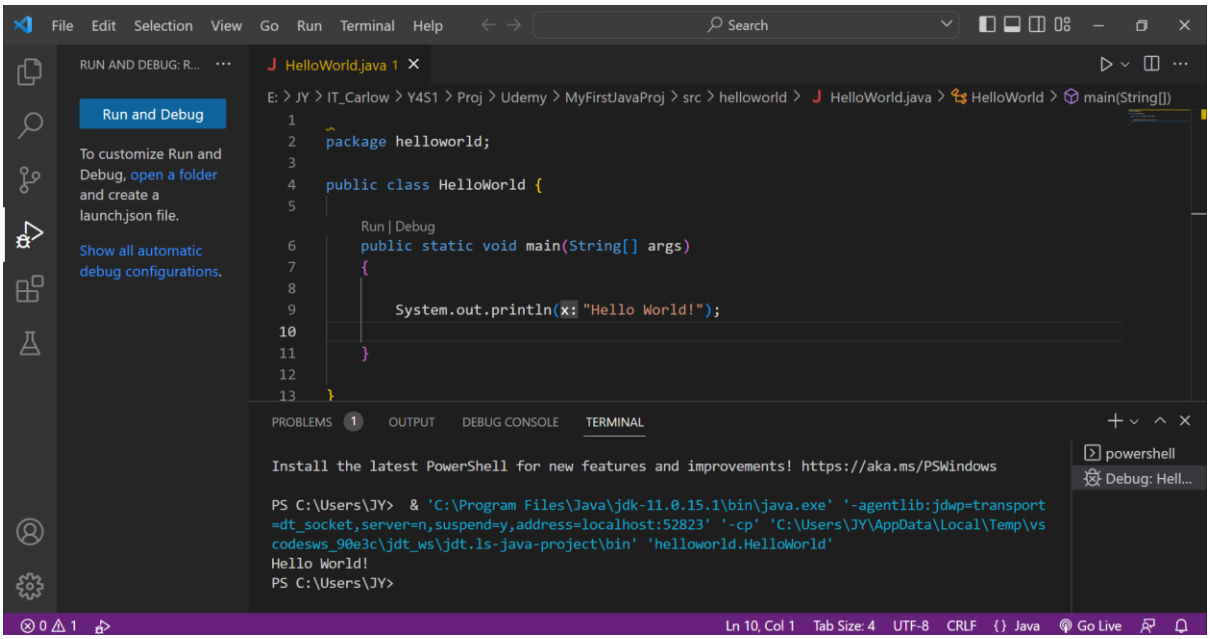

Figure 3.4: The screenshot of the interface of Visual Studio Code after the user writes some codes using the software

5.1.3 XAMPP

XAMPP is created by Apache Friends and is a free and open-source cross-platform web server solution stack package. XAMPP is the most popular PHP development environment among developers. (Friends, 2022) XAMPP is a distribution from Apache which consists of MariaDB, PHP, and Perl.

Advantages of using XAMPP

a. It is free (GeeksforGeeks, 2022)

XAMPP is free. Anyone can download XAMPP online without paying anything. Figure 3.5 below shows that users can download XAMPP from the official website of XAMPP without paying for anything.

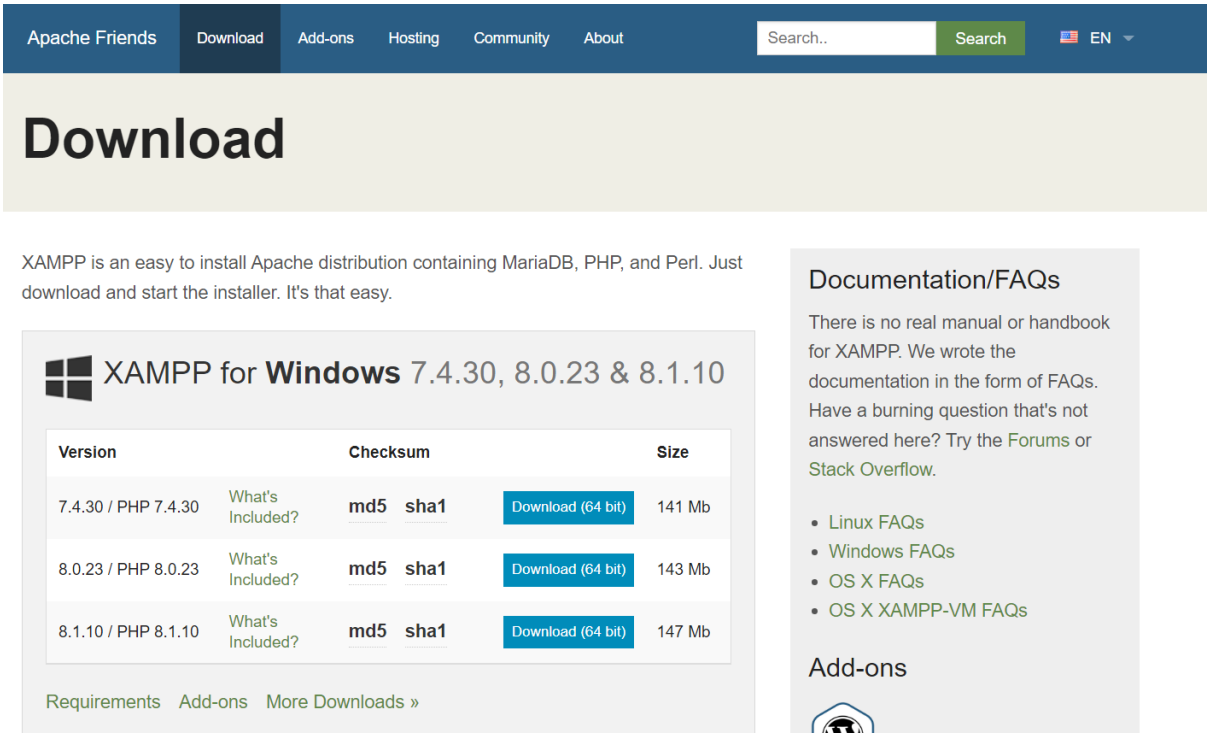

Figure 3.5: The users can download XAMPP from the official website of XAMPP without paying

Disadvantages of using XAMPP

a. The database service used by XAMPP can be accessed over a network (KUMWENDA, 2021)

MySQL or MariaDB is used by XAMPP as the database service. Unfortunately, the MySQL server is easily accessible via the network. This means that it is very useful when developing websites on a local PC, but it is not ideal for production. Even if a firewall is used to limit access, the database may still be accessed.

Interface of XAMPP

MySQL database tables can be created, modified, dropped, deleted, imported, and exported using phpMyAdmin. phpMyAdmin is an administration tool for MySQL, a database used by XAMPP. Figure 3.6 below shows the interface of phpMyAdmin.

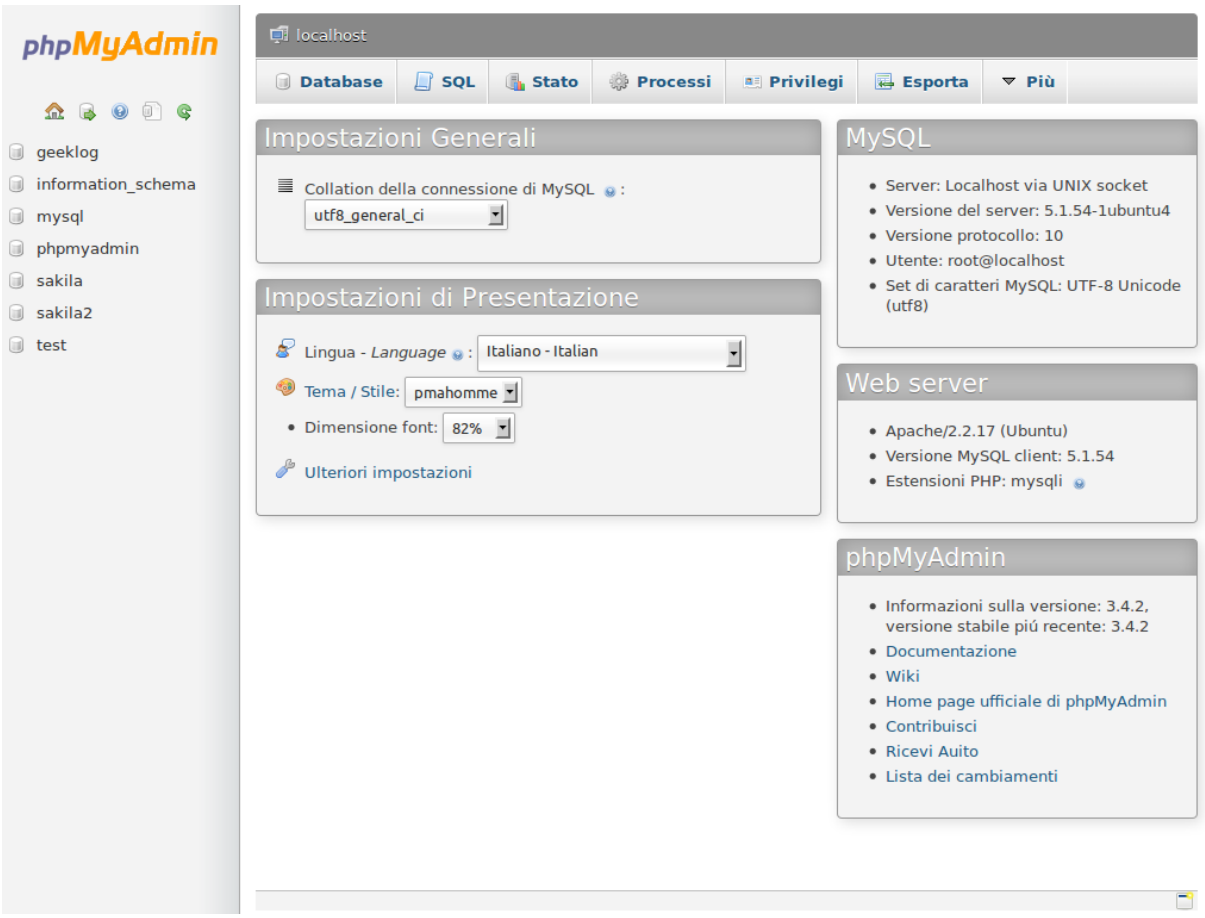

Figure 3.6: The interface of phpMyAdmin

5.2 Languages

5.2.1 Java

The first option of programming language that can be used to develop this project is Java. Java is a well-known programming language among developers. (Subham Bose, 2018) This means that a lot of developers know Java. Other than that, the official programming language for Android development is Java. Java powers 46.2 percent of all Android applications. (Fran, 2022) Android Studio, the official IDE for developing Android apps, makes use of Java.

Advantages of using Java

a. Demanding skills in the industry

The advantage of using Java is that Java is a demanded skill in the industry. This is because, Java is a popular programming language used by many companies in their tech stack. Java is used in the tech stacks of companies such as Pinterest, Google, Airbnb, Instagram, Spotify, Uber, and Netflix. Some examples of companies and their projects are listed as below (Fran, 2022):

- NASA WorldWind

Java is used by NASA to develop its WorldWind. WorldWind is a virtual globe API that is open source. WorldWind enables developers to create interactive visualizations of 3D globes, maps, and geographical data quickly and easily. WorldWind is used by organizations all over the world to monitor weather patterns, visualize cities and terrain, track vehicle movement, analyze geospatial data, and educate people about the Earth. (NASA, 2022)

- Minecraft

Minecraft is a 3-D computer game in which players can construct anything. The game, has been compared to an "online Lego" that involves building blocks and constructing structures across various environments and terrains. (Webwise.ie, 2022) Java 1.8 is included in the Minecraft Java edition and is the default platform of Minecraft. (Fran, 2022)

- Spotify

Spotify is a digital music, podcast, and video service that provides access to millions of songs and other content from creators worldwide. (Spotify, 2022) The mobile app for Spotify is called Spotify mobile and it is written in Java. (Crafts, 2020)

After knowing that many companies use Java as the programming language to develop their software or application, it is obvious that Java is a future-proof and in-demand skill needed in a variety of fields. Learning and mastering Java is important for future careers.

b. Object-oriented

The next advantage of using Java for development is Java is object-oriented. Java employs an object-oriented paradigm, making it more practical. In Java, everything is an object that handles both data and behaviour. Java makes use of object-oriented concepts such as object, class, inheritance, encapsulation, polymorphism, and abstraction. (JavaPoint, 2021)

Disadvantages of using Java

a. Slow performance

However, there are some disadvantages to using Java for development. One of the disadvantages of using Java is its slow performance. Java consumes more memory than native programming languages such as C and C++. And this is the reason why Java runs slower than C and C++. The reason why Java consumes higher memory is because of the

interpreter's additional work in converting the code into machine language. Whereas C is a compiled language, which means it converts code into machine language that the machine or system can understand.

Example of codes in Java

Figure 4.0 below shows the example of codes in Java that print the words “Hello World!”

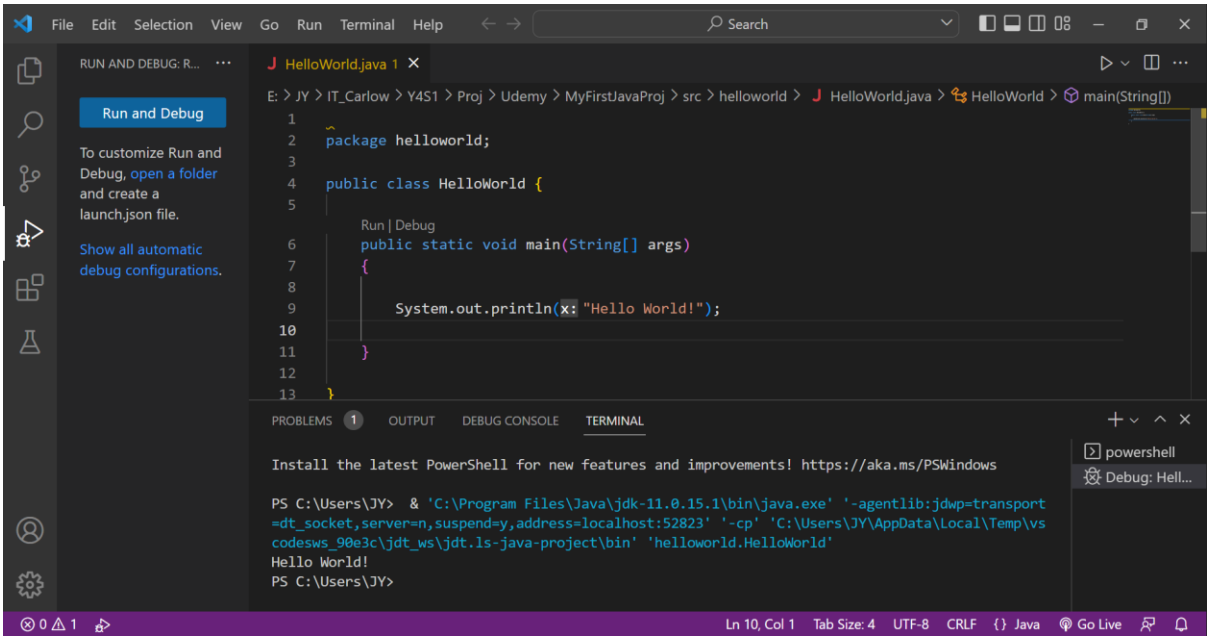

Figure 4.0: The example of codes in Java that print the words “Hello World!”

5.2.2 Kotlin

Since Android Studio can be run using another programming language which is Kotlin, there is another choice of language available for development using Android Studio which is Kotlin.

Advantages of using Kotlin *(Krify, 2022)*

a. Fewer chances of bugs

One of the advantages of using Kotlin as the language for development is that Kotlin has fewer chances of bugs than Java. This is because, Kotlin leaves no room for making errors for a simpler and lightweight codebase. The output codes issued using Kotlin are also more stable. The compiler can detect any potential errors without any hassles during the compilation time frame. This has indirectly made Kotlin become a safer alternative than Java.

b. Co-ordinate with existing Java code

Kotlin can be exchanged with Java. Kotlin is Java as well as several other frameworks and software associated with the project. This enables the transition to Kotlin, and the two programming languages can be used concurrently.

Disadvantages of using Kotlin

a. Timeframe available

Another disadvantage of using Kotlin as the language for development is about the time that I have to do this project. Since I have no experience working with Kotlin before, that means I need to learn Kotlin starting from the ground up. With the fact that I need to pick a tool to be used for development, I don't think I have enough time to learn Kotlin from the ground up without any prior basics.

b. Robust knowledge is needed

Despite Kotlin's importance, only a few programmers are currently available in this field. Every mobile application developer who wants to work with Kotlin needs extensive knowledge. (Krify, 2022) In other words, if a person wants to work with Kotlin in the industry, they need to have a robust knowledge of Kotlin.

Examples of code in Kotlin

Figure 4.1 below shows the example of codes in Kotlin that print the word “Hello World!”

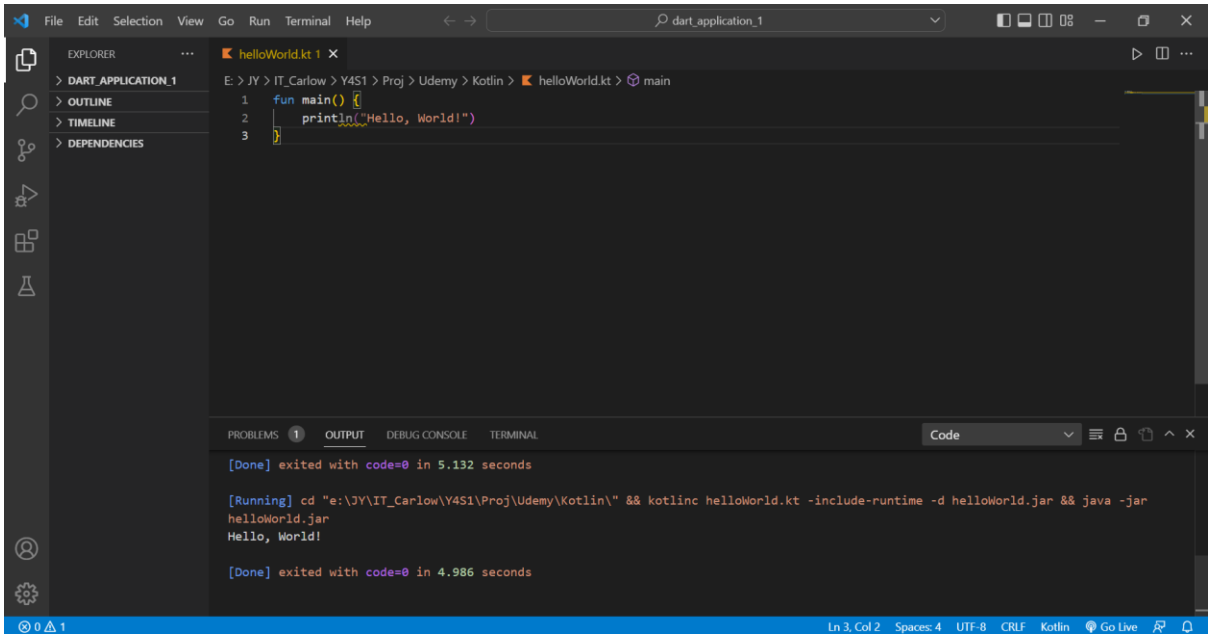

Figure 4.1: The example of codes in Kotlin that print the word “Hello World!”

5.2.3 Dart

Another option that is available for development is using Visual Studio Code with the extension of Flutter. The programming language that is used by Flutter is Dart.

Flutter is a Google open-source framework for creating beautiful, natively compiled, multi-platform apps from a single codebase. (Flutter, 2022)

Advantages of using Dart

a. Increased time-to-market speed

One of the advantages of using Visual Studio Code with the extension of Flutter and using the programming language of Dart for development is increased time-to-market speed. Flutter development framework is faster than its competitors. In most cases, a Flutter app will require half as many person-hours as the same app developed separately for Android and iOS. The primary reason for this is that the developer does not need to write any platform-specific code to achieve the desired visuals in the application. Flutter can implement any 2D-based UI without requiring interaction with a native application counterpart. (Dziuba, 2022)

b. Ability to customize anything on the screen

Other than that, Flutter also has the advantage of its ability to customize anything on the screen, regardless of how complex it is. Even though all other technologies in the market allow the developer to do that, Flutter adds flexibility and versatility to the process without increasing the workload. Shared element transitions, shape/colour/shadow manipulations, clipping, and transformations are all possible with Flutter. For example, the code to make a rotation of 45 degrees is just a few lines as shown in Figure 3.3 below.

Figure 3.3: The code to make a rotation of 45 degrees using Flutter

Disadvantages of using Dart

a. limited community support

Using Visual Studio Code with the extension of Flutter has disadvantages also. One of them is the limited community support. Since Flutter uses Dart, the framework's language is a significant part of the problem. Flutter, by relying on Dart, positions itself in a distinct and relatively isolated position in comparison to tools that rely on JavaScript. This is because, there are very less libraries and tools that are available for Dart. (Deed, 2022)

c. Timeframe available

Another disadvantage of using Dart as a development language is the amount of time that I have to complete this project. Because I have no prior experience working with Dart, I must learn it from the ground up. Given that I need to choose a tool for development, I don't think I have enough time to learn Dart from zero without any prior knowledge about it.

Examples of code in Dart

Figure 4.2 below shows the example of codes in Dart that print the word “Hello World”

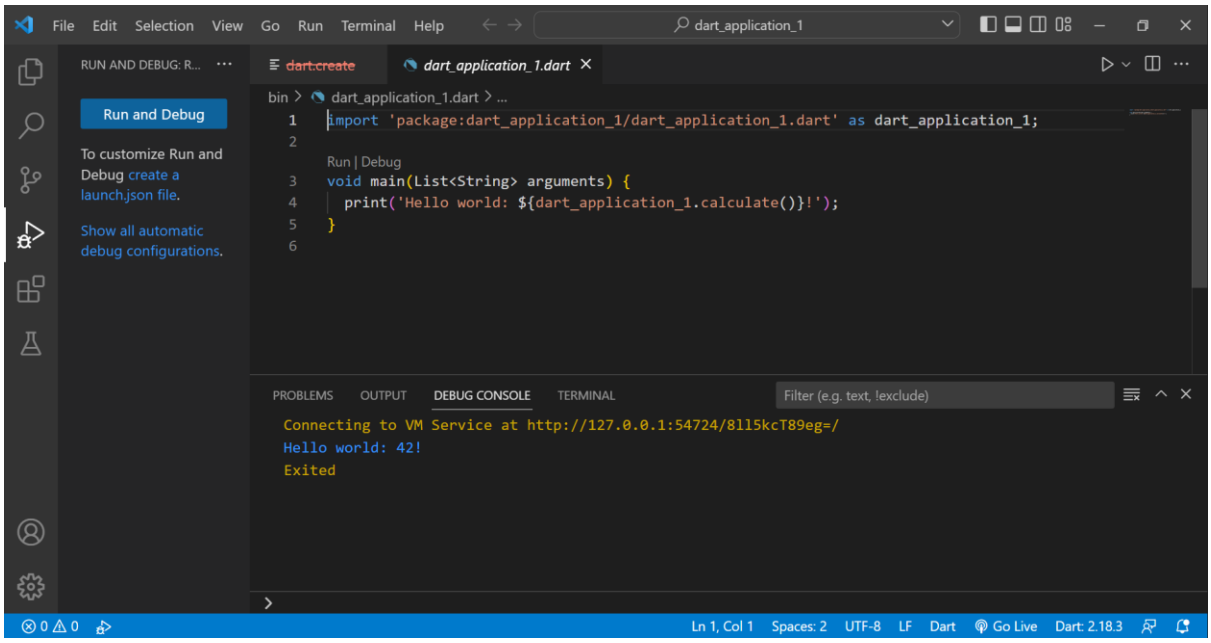

Figure 4.2: The example of codes in Dart that print the word “Hello World”

5.2.4 HTML, CSS, Bootstrap, PHP

Other options to use for development is using HTML, CSS, Bootstrap and PHP as the programming languages. HTML, CSS and Bootstrap will be used to design the front-end interface of the web page. Meanwhile, PHP will be used for the back-end functionality of the website. The tools that will be used for this option are Visual Studio Code and XAMPP.

Advantages of using HTML, CSS, Bootstrap, PHP

a. Experience in college

One of the advantages of using HTML, CSS, Bootstrap and PHP as programming language for development is my experience in working using HTML, CSS and PHP from my previous year in college.

Disadvantages of using HTML, CSS, Bootstrap, PHP

a. PHP is not suitable for enterprise features (Babu, 2020)

I have little to no experience in working using Bootstrap. And Bootstrap is just a CSS framework that is used for developing a responsive and mobile-first website. (w3schools, 2022) Therefore, the way the website is built fully depends on the language used for the back-end functionality of the website.

There are disadvantages to using PHP for the development of the back-end functionality of the website. One of the disadvantages of using PHP for development is PHP is not suitable for enterprise features like multi-threading. Multithreading is like multitasking in that it allows you to process multiple jobs at once rather than on multiple processes. (Patil, 2021) In other words, PHP is a programming language that is generally suitable to be used in building personal and small business websites or applications. This is because, PHP is executed line by line.

b. Timeframe

Even though I have experience in working using HTML, CSS and PHP from my previous year in college, I have forgotten most of the language. This means that I need to recall all four languages by going through my assignment, notes and practical that I used in the previous year; To make sure that I can recall back everything I learnt in the previous year, I might have to do some hands-on practice on those four languages.

Examples of code in HTML, PHP

Figure 4.3 below shows the example of codes in HTML and PHP that print the word “hello World”

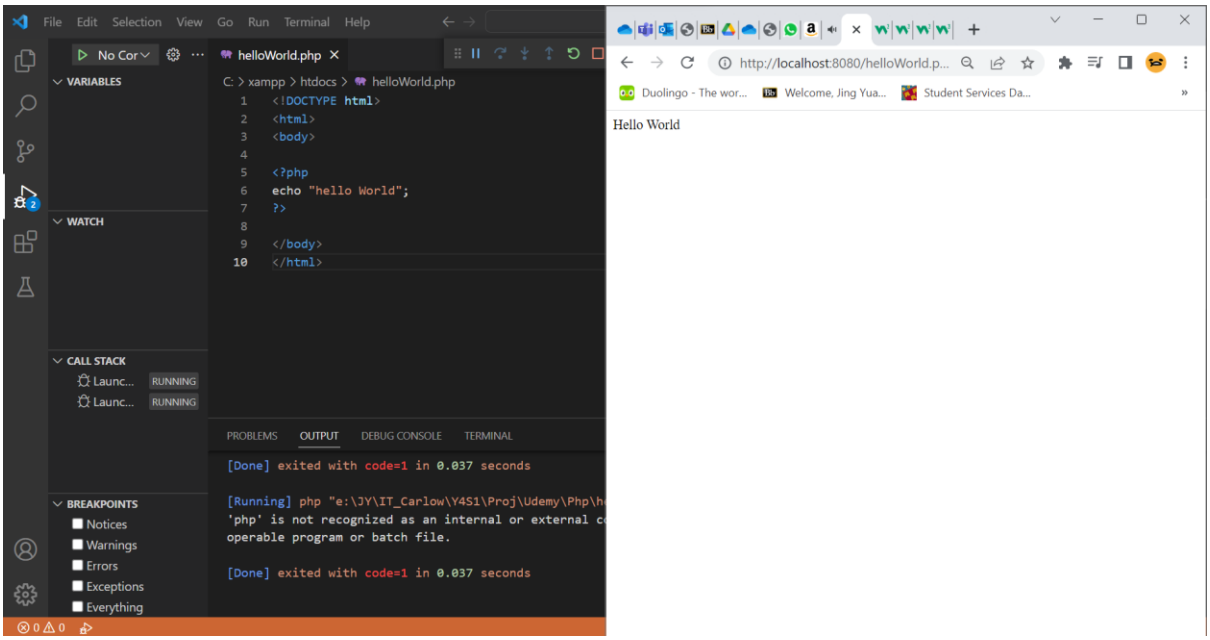

Figure 4.3: The example of codes in HTML and PHP that print the word “hello World”

5.3 Summary for Development

In short, there are a lot of tools and languages that can be used for the development of this gamified tool for teaching GDPR. The tools that are available to develop this gamified tool for teaching GDPR are Android Studio, Visual Studio Code and XAMPP. Meanwhile, the programming languages available to build this gamified tool for teaching GDPR are Java, Kotlin, Dart, HTML, CSS, Bootstrap and PHP.

Even though building this project using Dart seems exciting and interesting, due to the limited timeframe that is available to do research and build this project, I will not pick Dart as the programming language.

Visual Studio Code and XAMPP will be the tool that is used to build the gamified tool for teaching GDPR and HTML, CSS, Bootstrap and PHP will be the programming language that is used to build the project. This is because I used HTML, CSS and PHP during my previous year in college before. Even though developing a mobile app using Android Studio seems interesting, I have no basics in developing mobile apps before. Based on the limited timeframe available to build this project, I think it is better to choose the options of using HTML, CSS, Bootstrap and PHP as the programming language to build this project.

After this section about the development such as tools and programming languages that are available to build this project, the research manual will move on to discuss the platforms that are going to be used for the development of this gamified tool for teaching GDPR.

6. Platforms

Mobile

One of the platforms for the development of this gamified tool for GDPR is mobile. There are two types of operating systems to be used to develop mobile application development. The two operating systems are iPhone Operating System (iOS) and Android Operating System.

iOS

iOS is an operating system created by Apple for its products, including the iPhone, iPad, and iPod Touch. It also serves as the foundation for other Apple operating systems. After Android, iOS is now the second most widely used operating system. Some iOS applications can be used without an Internet connection. They are far more powerful and faster than other applications on the market. (Development, 2022)

Advantages of building mobile apps in iOS *(Development, 2022)*

1. Improved Security

   Before iOS applications can be downloaded, they must be approved by the App Store. Apple application development protects against external security threats such as data theft, encryption, and data duplication. The system protects data privacy, user identity, and cloud data.

   For the average user, hacking an iOS app is much more difficult, whereas hacking an Android app requires only downloading the .apk file from the Internet and installing it on the device.

2. Fewer updates result in fewer tests

   There are only a few versions of iOS. Although each application must meet all criteria of the current version of iOS, updates are released once a year. This has indirectly resulted in significantly less testing needed to build a mobile app in iOS. Since there is less testing that is needed to be done, the developers do not need to hire so many mobile apps tester to test the applications. This has also made the development of mobile apps in iOS cost lesser than the development of Android.

Disadvantages of building mobile apps in iOS *(Limited, 2021)*

1. App sizes are usually too big consuming too much space

   The file size of a mobile app is critical. If the mobile app is too large, users may find it difficult or costly to download. The experience of waiting a long time to download apps may turn users off before they even try your mobile app. Furthermore, a user's device may have a very limited amount of disk space. These issues are exacerbated if the target market includes the developing world.

   One of the disadvantages of building mobile apps in iOS is the platform of iOS is very heavy and takes up a lot of storage space on the device. This is due to the specific features and characteristics made specifically for iOS.

   The average app file size for iOS mobile apps is 38MB. Meanwhile, the average app file size for Android mobile apps is 15MB. (Boshell, 2017) Figure 5.0 below shows the average mobile app file size for Android and iOS in the year 2017.

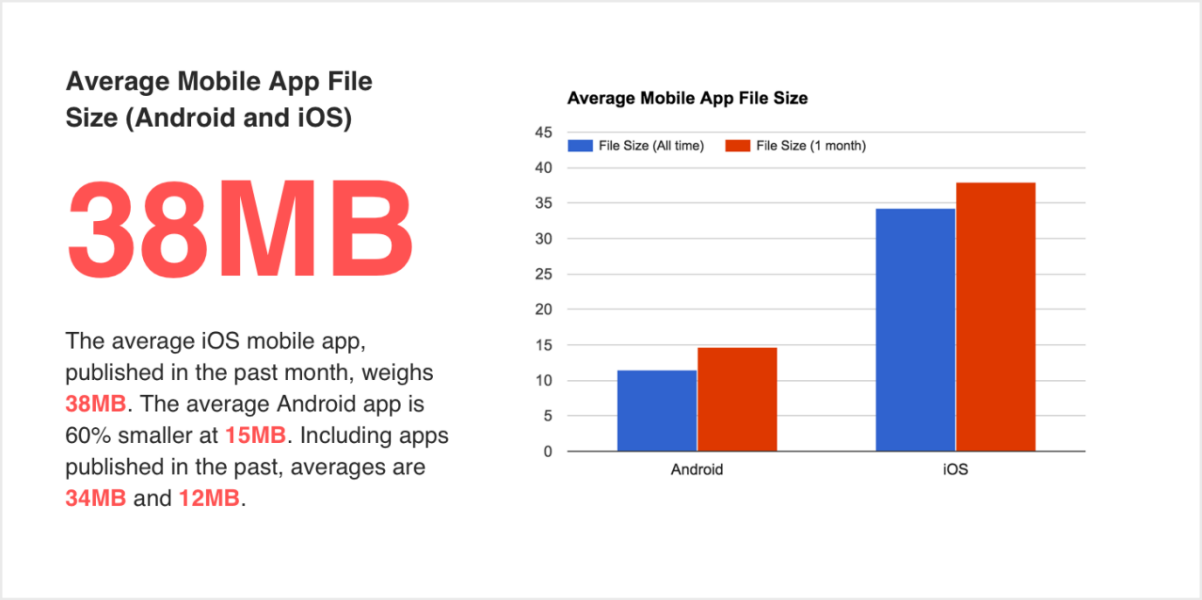

Figure 5.0: The average mobile app file size for Android and iOS in the year 2017

2. Limited device use as platform runs only on Apple devices

There is a limitation when it comes to using iOS devices because the platform only runs on company-made devices. As a user, even if the user likes the extra features that any other device outside the company provides, they won't be able to use them because iOS only runs on hardware manufactured by Apple. (Limited, 2021)

The device that runs on iOS is called an iOS device. It is a computer or mobile device that runs iOS. iOS devices from Apple include the iPad, iPod Touch, and iPhone. (Cole, 2020)

Android

The Android operating system is defined as Google's (GOOGL) mobile operating system, designed primarily for touchscreen devices, cell phones, and tablets. The Android operating system's design enables users to manipulate mobile devices intuitively, with finger movements that mimic common motions. Some of the common motions from the users are pinching, swiping, and tapping. Google also uses Android software in televisions, cars, and wristwatches, each with its own user interface. (Chen, 2022)

Advantages of building mobile apps in Android *(Development, 2021)*

1. Broad market presence

Google is constantly working with Samsung, Xiaomi and others to improve Android. This has made it easier for professional Android apps to be distributed geographically and demographically on the Android operating system. The Android operating system is easily adaptable to wearable devices, media streaming devices, Android-based smart TVs, and is compatible with VR, AR, and IoT technologies. The market share of Android remains at the level of 70 – 80% because the Android operating system is very common. The strength of Android is that it is available on devices from a variety of manufacturers, which are also more affordable and thus more widely distributed than iOS devices. By developing an Android application, the developers make it available on a wide range of electronic devices from various manufacturers all over the world compared to the iPhone.

2. Google Play Store options

The time spent for an Android app and/or game to be approved in the Google Play Store is usually a few hours. Meanwhile, it usually takes several days to be approved in the App Store. Developers can make changes in a matter of hours, making Google Play especially useful for new applications. Typically, after uploading, the application must be adjusted several times in response to user requests. Applications can even be tested on personal electronic devices before being released on Google Play.

Google Play developers can release the Android apps as a minimum viable product (MVP) in Google Play Store and provide access to their testing to certain groups of users. This approach will help to correct possible errors found in the application. This has caused the users to get a ready-to-use application. If the app is available on Google Play, it is also added to the Google app indexing library. The number of visits to the site increases as the number of application views increases. Therefore, developing mobile apps in Android can solve the other marketing tasks which are increasing the website ranking in Google, website traffic growth and client number growth.

Disadvantages of building mobile apps in Android *(Anastasiya, 2021)*

1. Many advertisements in Apps

There are a lot of Android applications that are available for free download. However, there are also plenty of advertisements that appear on the screens of applications or while you use a function in the application. Having a lot of advertisements can be quite annoying to the user. This is because, the user needs to purchase a software license to delete or disable the advertisement. Figure 5.1 below shows the screenshot of an advertisement on Android.

Figure 5.1: Screenshot of an advertisement on Android

2. Google Account Needed

A Google profile is needed to install any applications via the Google Play Store. Other than that, a Gmail profile is also needed to use a few Google apps too. Google Apps is a collaborative Web-based Software as a Service (SaaS) solution that personalizes the proprietary Google platform and brand for businesses of all sizes, including big corporations. Some examples of Google Apps that need a Gmail profile are Gmail, Google Calendar, Google Slides and Google Docs. (Technopedia, 2022) This means that the developer must have a Google profile to develop an application in Android. They will need to register a Google profile if they do not have one. This is because, they will need to use the Google profile when publishing the mobile apps on Google Play Store.

Web Sites

Advantages of building Web Sites

1. Creating a professional-quality website is the easiest it has ever been (Feeny, 2020)

Many years ago, if a user didn't know how to code, he or she had to have someone else to code a website for him or her. Fast forward to today, there are some do-it-yourself website builders such as Wix and Squarespace that have editors which allow users to drag and drop content without needing to know a single line of HTML or JavaScript. Wix and Squarespace are "all-in-one" platforms, which means they offer design tools, hosting, support, and even the ability to build a web store within your account. Figure 5.2 below shows the interface of the home page for Wix.

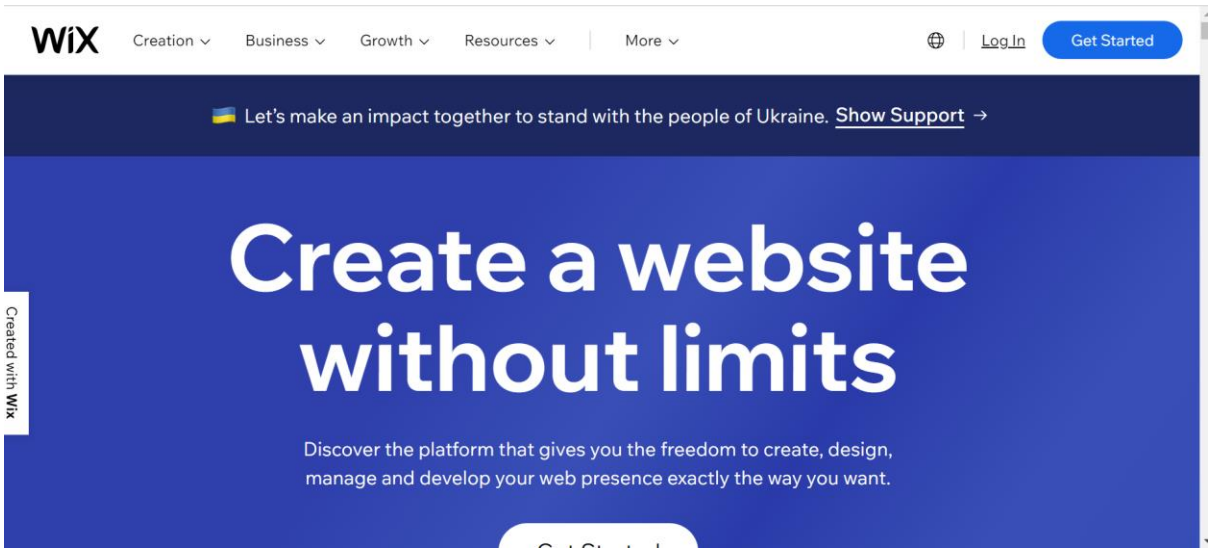

Figure 5.2: The interface of home page for Wix

Meanwhile, figure 5.3 below shows the interface of home page for Squarespace

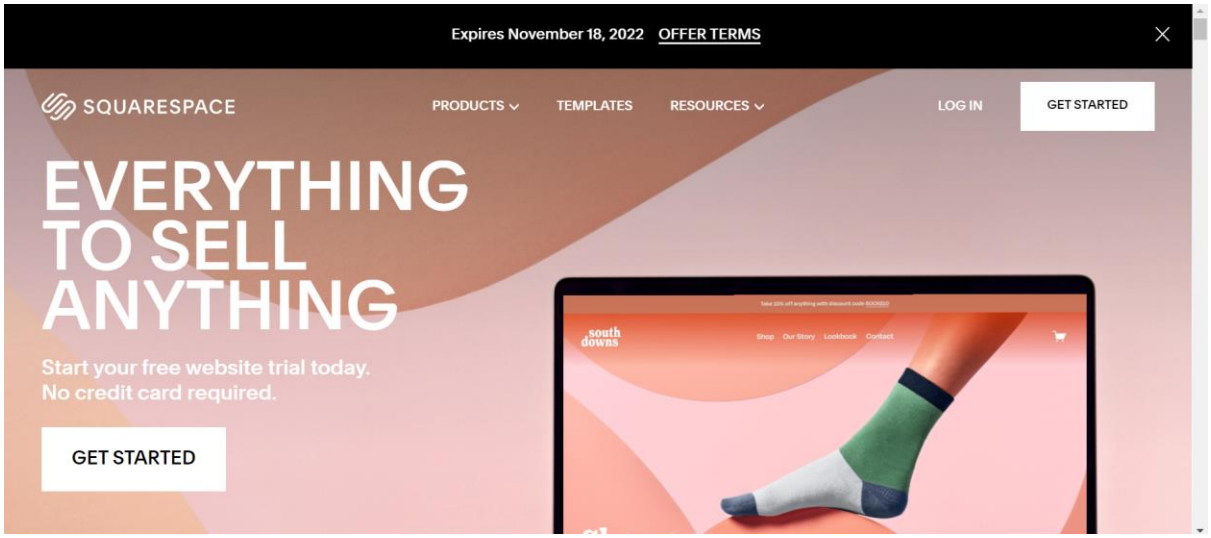

figure 5.3: The interface of home page for Squarespace

All of these platforms provide templates or themes that look great right away. If there is a design using responsive design, the content on a website or web page can be rearranged according to the size of the screen it is on. This is because, the responsive design has the function that can do that.

Disadvantages of building Web Sites

1. It is hard to customize templates

Even though there are website builders such as Wix and Squarespace, it is hard to customize templates. If there is some specific website that the user would like to change, a web designer is needed to be hired to do that. When a web designer is hired, it is more expensive than the fees that the users need to pay for Squarespace.

Summary of Platforms

The options for building websites and mobile apps are both interesting. However, I think web sites are much more suitable to be used for the development of a gamified tool for teaching GDPR. This is because, the users can open the websites using mobile. Since bootstrap is one of the languages that I think is suitable to build this gamified tool for teaching GDPR and can make the display different according to the screen size, building a website that can be opened on any electronic device will be a choice to that is much more suitable.

After this section about the options available for platforms, the research manual will continue to talk about the conclusion.

7. Conclusion

In conclusion, I will be using Visual Studio Code and XAMPP as tools for development. This is because, I have experience using both tools in my previous year in college. Other than that, I am very familiar with HTML, CSS, Bootstrap and PHP when doing my research for this application. Gamification features that I will implement into this gamified tool for teaching GDPR are points, levels/ stages, leaderboards and badges. I also intended to use some of the fields in GDPR as the topics in this gamified tool for teaching GDPR. The fields in GDPR are What is GDPR?, Where does the regulation apply, The seven principles and The eight rights. One of the reasons why these fields will be included in this gamified tool for teaching GDPR is because, I think those fields are the foundation of the knowledge about GDPR.

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