Appendix A

MSC DIGITAL DESIGN

DESIGNING AND EVALUATING A C2C GAMING E-COMMERCE WEB APPLICATION IN TERMS OF USABILITY AND USER EXPERIENCE

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SOLENT UNIVERSITY

FACULTY OF BUSINESS LAW AND DIGITAL TECHNOLOGIES

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Appendix B

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DESIGNING AND EVALUATING A C2C GAMING E-COMMERCE WEB APPLICATION IN TERMS OF USABILITY AND USER EXPERIENCE

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ABSTRACT

E-commerce, known as electronic commerce, is the activity of purchasing, exchanging or selling goods or services over the internet. However, the activity of exchanging is very rare in e-commerce fields especially in consumer-to-consumer (C2C) type of e-commerce. Therefore, this study aims to design a C2C e-commerce web application prototype, specifically for gaming products, with an "exchange" feature which allows users to exchange their gaming items. Additionally, this research aims to critically evaluate the usability and user experience of the prototype. As literature is reviewed, It can be found that there is a lack of studies in terms the usability and user experience evaluations of C2C platforms.

This study also explores user experience principles, laws, psychological and ethnographical factors in HCI, as well as government regulations and professional standards in design, data protection, and accessibility guidelines and implements these factors in the design process.

This thesis adopts a case study approach and 5-step (emphatise, define, ideate, prototype, and test) design thinking methodology which includes human-centred design processes. After conducting a survey with 20 respondents for user research, users' demographics, e-commerce habits, interface experiences, and mental models were identified and user personas were created. By analysing qualitative data using qualitative coding method and affinity diagramming, key themes and pain points were identified before the design process. After creating sketches as an ideation method for the web application, mid-fidelity and high-fidelity prototypes were designed using atomic design methodology and implementing the design principles. Moderated usability testing, Single Ease Question (SEQ), pre-test interview, post-test survey, and System Usability Scale (SUS) methods were used for the user experience and usability evaluation of the prototype. The evaluation process was iterative and consisted of 2 usability sessions with 5 participants for each session.

According to the data analysis, the prototype had an 84.25 SUS score for perceived usability and user experience. In addition, post-test questionnaires on usability showed that metrics and usability components (such as learnability, effectiveness, efficiency, memorability, error tolerance, satisfaction, accessibility, and task success, etc.) scored higher than 4 on a 5-point Likert scale. However, the results of the usability tests also show that the features of the web application need to be improved for better usability and user experience.

List of Acronyms

B2B: Business to business
B2B: Business to business
B2C: Business to consumer
C2C: Consumer to consumer
HCI: Human-Computer Interaction
ICT: Information and Communication Technology
SUS: System Usability Scale
SEQ: Single Ease Question
UI: User Interface
UX: User Experience

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1 INTRODUCTION AND BACKGROUND

1.1 Introduction

The development of ICT (Information and Communication Technologies) has a great impact on the lives of individuals. Members of society have changed their daily habits with technological developments correspondingly. One of the most important factors of these changes is internet usage. People use the internet for various purposes and one of the significant purposes is online shopping. Many people prefer online shopping since it is an easier, more flexible and more comfortable way of shopping, unlike traditional shopping. Therefore, companies increasingly invest in online businesses to sell their services or products via websites and mobile applications upon strong demand for online shopping. This concept is called e-commerce (electronic commerce) which is the process of exchanging, buying or selling services or products through the internet (Mourya and Gupta 2014, p.23). E-commerce is categorised into various types (Nemat 2011, p.100) and the most common types are as follows:

- **B2C**: It refers to business to consumer activity which is the service provided by a business for consumers.

- **B2B**: It describes business to business activities which are the services provided by businesses for other businesses.

- **C2C**: It refers to consumer to consumer e-commerce activity which facilitates transactions between consumers through a third party service.

The number of e-commerce (electronic commerce) businesses has been growing substantially since the 2000s. Moreover, e-commerce sales increased dramatically from 375.1 billion pounds to 668.9 billion pounds in the UK from 2009 to 2019 (Office for National Statistics 2021). On the other hand, various industries have been involved in e-commerce. One of the prominent e-commerce industries is the gaming industry. The video game market in the UK was 3.6 billion pounds in 2016, however, it reached almost 5.9 billion pounds in 2021 (statista.com 2021). It is also concluded from the statistics that gaming e-commerce businesses have importance in the market shares.

Therefore, e-commerce companies and businesses should be aware that their e-commerce platforms meet user needs and requirements to be successful and competitive in the gaming industry. Poorly designed UI (user interface) can cause financial troubles for businesses as It can cause stress and dissatisfaction for users (Stone *et al.* 2005, p.6). UI is a concept which is used in HCI (human-computer interaction) and it enables users to interact with computer systems. As well as UI design, UX (user experience) and usability of an e-commerce website or mobile application have a key role in achieving business goals as well as satisfying the needs of the users. UX is a broad term that covers all user interactions with businesses, products, and services (Norman and Nielsen 1998). As for usability, ISO (International Organisation for Standardisation) defines it as the process of using a product, system, or service by specific users to accomplish specific tasks with satisfaction, efficiency and effectiveness (ISO, 2018). Additionally, according to Nielsen (1994, p.26), five attributes are associated with usability:

- **Learnability:** It refers to a process of learning a system that does not require a lot of effort and time for users to learn and operate the system.
- **Efficiency:** After learning the system, users should be able to perform tasks quickly.
- **Memorability:** When users did not use the system for a while, they should be able to remember the system easily after they returned to use it.
- **Errors:** The errors that occur in the system should be minimal and easy to recover. The system must not have serious errors.
- **Satisfaction:** Users should be satisfied and pleased with the system.

These attributes are crucial for accomplishing a high-quality user experience.

1.1.1 Research Aim

This study aims to design and critically evaluate a C2C gaming e-commerce web application prototype in terms of usability and UX. As well as selling or buying gaming products, the website also includes an exchange feature and functionality that enables users to exchange gaming products with other users so that a high-quality user experience could be achieved.

1.1.2 Research Questions

This study includes four research questions as follows:

- How can a C2C gaming e-commerce web application with an exchange feature be critically evaluated in terms of user experience and usability?
- How do UX design principles influence C2C e-commerce websites?
- What are the usability metrics of a C2C gaming e-commerce website?

1.1.3 Research Objectives

The objectives of this study were created following "A Revision of Bloom's Taxonomy" (Krathwohl 2002).

- To identify UX frameworks, principles, theories, or laws and implement them into the UI design of the application prototype.
- To design and evaluate a C2C gaming e-commerce website prototype with an exchange feature that enables users to exchange their gaming products.
- To test the usability of the prototype and critically evaluate the usability and UX metrics of the web application prototype.

The methodology and methods of this study contain a mixed method which is qualitative and quantitative research conducting surveys to collect data for user needs. Besides, five planes of user experience methodology are used for UX/UI design process of the C2C gaming e-commerce website prototype. This methodology helps to create user-centred products in an effective and efficient way. Additionally, the section includes creating mental models such as customer journeys, user personas, and empathy maps. The methodology of this study also covers usability testing and the evaluation of usability metrics of the website prototype.

1.2 Background

As user demands, information technology, and design trends are changing continuously, up-to-date data and evaluating information are critical factors for UX and usability research. There are some studies and research regarding the usability and UX design of e-commerce websites, however, C2C e-commerce studies for evaluating usability and UX design are too narrow. Besides, specific research on C2C e-commerce websites for gaming purposes could not be found.

A study was conducted in Nigeria to evaluate the usability and user experience of some e-commerce platforms and a digital questionnaire was conducted with 300 participants, then it was concluded that

the majority which was 37.74% of respondents use the internet for social networking purposes, secondly, 32.26% of respondents use the internet for online shopping, thirdly, 11.61% of respondents use the internet for gaming, and the rest of respondents use the internet for various purposes. (Babatunde, Abikoye and Falaju 2019, p.9) It can be concluded from this data that e-commerce and gaming have a significant role in terms of internet usage after social media, so user experience and usability studies of e-commerce and gaming platforms should be extensive. However, these findings are restricted to a single region.

As for market research, it was found that gaming e-commerce websites are mainly B2C e-commerce platforms. The most popular B2C gaming e-commerce websites in the UK are game.co.uk, uk.webuy.com, gex.uk, and gamexchange.co.uk. The main aims of these websites are to buy, sell, and exchange gaming products for fixed prices. These websites also trade with consumers and offer cash or voucher for the product that is going to be purchased or exchanged by customers. However, B2C e-commerce platforms do not allow consumers to trade and interact with each other, unlike C2C e-commerce websites. In C2C type e-commerce platforms consumers can buy or sell products or services. On the other hand, existing C2C e-commerce websites do not have a specific design function or feature that allows exchanging products between users. Therefore, designing and evaluating a C2C gaming e-commerce website with an exchange feature in terms of UX design and usability could contribute to the literature and the digital industry.

Usability and UX studies on C2C e-commerce are important for both the literature and the industry as some research indicate as well. A study proposes that apart from B2C e-commerce websites, research for other types of e-commerce websites should be conducted and e-commerce websites should be evaluated in terms of usability for exact results of user interactions with the websites (Abuzeid 2017, p.67). Therefore, It can be concluded that findings from different e-commerce types could be different and validation is necessary. Apart from e-commerce types, user behaviours might also differ from culture to culture, region to region, and language to language. For example, design conventions and usability of an e-commerce website are likely to change among left-to-right written languages and right-to-left written languages. Besides, another study “The Link Between Consumers’ Online Shopping Behaviours and E-servicescape in C2C E-commerce: Evidences from Turkey” suggests that the findings may vary regionally and ethnographically, so, other usability studies should be conducted for validation (Bulut and Onaran 2017). Syahrina and Kusumasari (2020, p.55) also recommend for further research that usability testing should be conducted to test the performance of the design with users. The majority of usability and UX studies on e-commerce show that usability evaluations mainly

consist of questionnaires and usability heuristics. However, usability evaluation could be more effective and efficient using the usability-testing methodology but it could be more time consuming and expensive as well. Usability-testing is one of the prominent methodologies in UX research. A researcher asks questions to a participant, gives specific tasks to the participant to perform on the interface, observes the participant's behaviour, and gets feedback from the participant in a usability-testing session (Moran 2019). Additionally, the “think-aloud” method used in usability testing is a powerful method to get instant feedback from users and to identify issues with the interface while observing the users’ behaviour. This also helps to create empathy maps. Therefore, in this study, a usability testing methodology is adopted to evaluate the usability of the C2C gaming e-commerce website prototype and metrics of specific tasks such as the interaction with the exchange feature of the website and the user experience.

1.2.1 Usability Heuristics for Designing User Interfaces

Jakob Nielsen first introduced “10 usability heuristics for user interface design” in 1994 and then updated them in 2020, and they are considered principles of interaction design (Nielsen 2020). Heuristics are a set of methods that are used to solve problems in a short period of time efficiently but they do not guarantee to provide optimal solutions (Chen 2021).

- **Visibility of System Status:** The design should inform users in terms of the current status of the system so that users can predict what actions to be taken in the next step. For example, if users would like to purchase a product on a website, they go to the checkout page, choose a payment method and fill in the required information, then press the button for the payment, while users are waiting for the processing of the payment, the system should inform users about what is happening (e.g., please wait for the process, almost complete!).
- **Matching the system and real-world:** The phrases, words, and jargon that users are not familiar with should be avoided. Additionally, icons, images, logos, and terms that designers are familiar with might confuse users. So, designers can use real-world conventions in their designs. For example, designing a credit card illustration is likely to be associated with a real-world credit card by users on a checkout page of an e-commerce website. This concept is also known as skeuomorphism in interface design which is imitating real-world objects with interface elements like recycle bin icons on the user interfaces (Interaction Design Foundation No date).
- **User Control and Freedom:** Users can perform some actions accidentally and want to recover them. User interfaces should allow users to undo or redo the actions easily. For example, if a user

clicks on a button by mistake, there must be an exit or cancel function on the user interface so that the user will not be frustrated.

- **Consistency and Standards:** Users spend their time on different websites and applications. They tend to see similar design conventions compared to other websites or applications they use so that they can perform actions with ease. Therefore, designers should follow design conventions for not to confuse or frustrate users. Using design conventions is a way of compatibility with standards and consistency. This method can also improve the learnability attribute of usability because users will not make an effort to learn a new system.
- **Error Prevention:** Designers should be very careful about errors that might occur. So, error prevention dialogues or warnings are critical. For example, if a user wants to transfer money to someone, a confirmation dialogue is important to remind the user to check the information again. If the designer does not include the confirmation warning, the user might transfer the money to someone else by mistake.
- **Recognition rather than recall:** Every individual has a limited cognitive capacity and memory. Therefore, designers need to make sure that users are not expected to remember everything when they use the same interface again. The design should let them recognize the information. For example, if a user returns to use an e-commerce website after a while, the website can show recently visited products that the user visited.
- **Flexibility and efficiency of use:** The design should include flexibility so that users with different proficiencies and experience levels can customise the product or service according to their preferences. For example, a simple search function and advanced search function of a website can maximise user expectations and efficiency.
- **Aesthetic and minimalistic design:** The focus of the design should be on essential elements and information. Distracting elements must be avoided from the user interface design so that users can find and focus on the essential elements. For example, if a website contains too many texts and unnecessary information, users will probably have difficulties finding the information they are looking for.
- **Help users to recognise, diagnose and recover from errors:** Using recognisable elements such as icons, illustrations, highlighted text, or red font colour help users to recognise warnings as well as using plain language.
- **Help and documentation:** If a system needs further explanations, documentation should be provided for users to perform their specific tasks easily. The documentation should be easy to find and the language should be concise and plain.

1.2.2 Five Planes of User Experience

Syahrina and Kusumasari (2020, p.55) state that five planes of user experience framework or a design method are crucial to adopt for the UX design process of a website to meet user needs. UX frameworks and design principles help to design digital products in a systematic way and they are beneficial for designers to solve issues consistently. They also contain a user-centred approach so that users can experience high-quality designed products or services.

The five planes framework, also known as the elements of user experience, explains how user experience can be designed by dividing it into different components to solve user experience problems. (Garret 2011, p.21). The framework contains "*strategy, scope, structure, skeleton and surface* planes" from abstract to concrete (Garret 2011, p23).

The first element is the strategy which is the process of identifying users` needs and requirements and balancing business goals and objectives with them. The second phase includes the scope plane which is guided by the strategy plane. In this section, the functions and features are implemented to help users to perform specific tasks and meet user needs. Thirdly, the structure plane defines how users will navigate after they complete some tasks. It is a section that identifies a set of necessary navigation items and a sitemap. The next step is the skeleton plane which indicates how web pages are connected to one another by designing the interface items such as navigation and the contents of the product. The final stage is the surface plane which is the visual design and prototyping section. In this phase, components are created such as texts, graphical elements, and buttons for the final outlook.

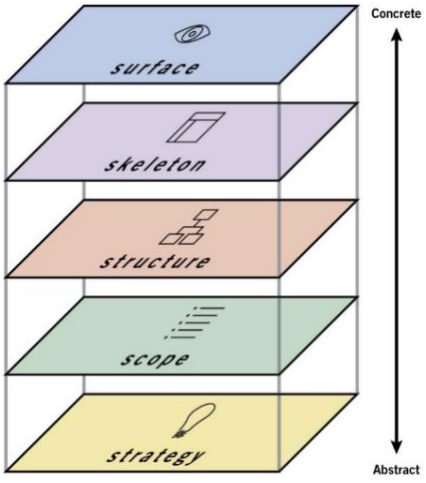


Figure 1 Five Planes of User Experience Framework (Garret 2011)

Garret's Elements of User Experience shows how a user experience design process is divided into various steps and how five planes help designers to solve problems and create a user-centred design in a less complicated way.

1.2.3 Seven Facets of User Experience

Morville (2004) propose that seven facets of user experience (useful, usable, desirable, findable, accessible, credible, valuable) go beyond usability and help businesses to achieve business goals and also satisfy users' needs. The significance of this model is to align business goals with user needs while creating websites.

- **Useful:** Designers should investigate whether the product or service they designed is useful or not. Additionally, they need to apply their knowledge and skills to design better and new solutions for more useful products and services.
- **Usable.** In contrast to the user-centred approach, interface-centred methods and approaches do not meet all requirements and aspects of web design. Usability is essential, however, it is insufficient.
- **Findable:** The website should be well-structured so that users can easily navigate the website and find whatever they need.
- **Accessible:** The websites should have accessibility functions for people with disabilities or different abilities. It is not only ethical to make websites accessible but also there are certain regulations for accessibility standards that organisations need to meet.
- **Credible:** Understanding the design components that affect users' trust is vital for web credibility.
- **Valuable:** A website that is designed for a business should add value to the business and provide a high-quality user experience for customer satisfaction.
- **Desirable:** Designers should aim to design products and services that will create a desire by users. Image, brand, identity and aesthetic appeal are some factors of desirability.

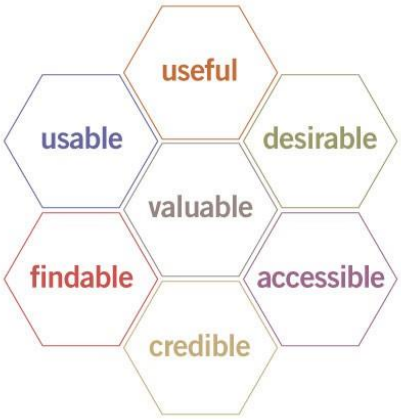


Figure 2 User Experience Honeycomb (Morville 2004)

Seven facets of user experience model can contribute to the business objectives and goals as well as user satisfaction, so, it is one of the recommended models to follow for designing web applications.

1.2.4 Professional Standards and Government Guidelines

One of the most important topics for professional standards in web development is accessibility. Accessibility supports people with disabilities or people with different abilities to use the web easily without restrictions and limitations. According to The World Wide Web Consortium (W3C), accessibility is crucial for organisations that want to create high standard websites and web tools as well as enabling social inclusion of people with disabilities and diverse abilities (W3C 2018). Besides, websites which aim to include accessibility should conform with Web Content Accessibility Guidelines (WCAG). Accessibility of a website is not only significant for business growth but also critical for ethical and legal purposes. According to Public Sector Bodies (Websites and Mobile Applications) (No. 2) Accessibility Regulations 2018, which are the accessibility regulations in the UK, public sector bodies have to meet the requirements and must have accessibility statement on their website (Gov.uk 2018). For this reason, businesses must conform with accessibility standards.

Another issue affecting businesses negatively is the absence of privacy policies and cookie statements. The privacy policy is a document that shows how a website or company complies with data protection regulations, collect personal data, and processes the data. Web platforms should have Terms and Conditions section which is the protection of the business and website rights. On the other hand, the privacy policy is related to user rights and customer protection. Additionally, the websites should provide information about the cookie policy. Cookies are small files that can be stored in users' computers by allowing them when entering a website so that the website can count site visits,

remember user preferences etc (Ico.org.uk, 2022). According to The Privacy and Electronic Communications Regulations (PECR), cookies must be explained clearly and users' consent must be taken when cookies are used on the website (Ico.org.uk, 2022). These issues of websites are crucial for businesses as they were examined.

2 LITERATURE REVIEW

2.1 Introduction

The recent increase in e-commerce websites has facilitated online shopping by users. E-commerce website designers should develop excellent and functioning sites, ensuring users' positive and desirable shopping experiences in extremely competitive markets. Online shopping permits users to purchase their preferred items from across the globe via the Internet, indicating that the Internet is an efficient medium for commercial drives. E-commerce has evolved the existing business system, profoundly changing how individuals trade and consume. With the rapid technological, economic, and societal development, e-commerce established itself as an internal retail set-up, with online shopping becoming one of the most preferred ways of shopping. According to (Huang and Wang, 2022, p. 1), the most significant difference between e-commerce and physical purchases include that the products can only reach the customer via methods that can be accessed online, such as image and sound and instinctive opinion and product trials are significantly limited.

E-commerce makes simpler trade procedures, progresses logistics systems, decreases transaction expenses, facilitates business restructuring, augments trade openings, and supports enterprises' economic reorganization, increasing output and changing the nature of trade activities. E-commerce development impacts global trade competitiveness. In online shopping dealings, all physical goods demand logistics and circulation services to be achieved (Huang and Wang 2022, p. 1). An e-commerce website focuses on attracting and customer retention; thus, guaranteeing users an excellent experience through the buying procedure is vital. Recent empirical findings indicate that 80% of highly contented users often return to buy more products within two months, while 90% recommend them to other potential users. On the other hand, 87% of unsatisfied users will never return to the same website (Zainudin et al., 2010, p. 151)

Zainudin et al. (2010 p.151) explored C2C e-commerce websites to fill the existing research and literature gap on C2C e-commerce. Most accessible studies focus on B2B and B2C. Thus, Zainudin et al. (2010, p.151) investigated problems faced by potential buyers when purchasing products online and evaluated the website usability by employing a framework for assessing e-commerce website usability. They defined e-commerce as buying and retailing products and services via online platforms. Different technologies can be employed to implement e-commerce, including smartphones.

Usability is a valuable construct for assessing websites and promoting the development of improved websites. Halibas et al. (2016 p. 143) underline that usability makes things work well so that average-minded persons can comprehend systems without frustrations. It can be done by collecting information from them via interviews, questionnaires, task analysis, and other research techniques. To users, usability encompasses their view regarding dependability, efficiency, organization, user-friendliness, and straightforwardness in completing tasks within a system. Comprehending user requirements is necessary to building a successful website (Halibas et al., 2016, p. 143). Usability testing refines UX, helping validate web design assumptions and assisting companies in realizing their targets. UX remains the most prevalently employed measurement for diagnosing usability difficulties and designing interfaces. Empirical findings substantiate that consumers are more likely to purchase from an online store with a user-friendly system (Vasić et al. 2019, p. 71) According to Halibas et al. (2016, p. 144), the most critical factor influencing online shoppers is the web design that should align with user expectations regarding navigation, content, and organization. Excellent web designs involve users in the design process, underlining the need for a usability test (Halibas et al. 2016, p. 144). Overall, UX researchers and usability engineers must conduct usability testing, enabling designers and developers to understand users' preferences and expectations.

2.2 Usability and User Experience

Human-Computer Interaction (HCI) research has been trying to bring our attention to the user experience and usability of our systems. Research has proven that good interfaces and designs are an important factor in better, great, and increased usability and user experience. With time, the aesthetics of systems and websites have become major components of HCI research. An experiment was held by (Tuch et al. 2012) using a three-factor, mixed design. In this design, there were three variables. One of them was, interface-usability which means one good (high interface-usability) and one bad (low interface-usability). The second was interface-aesthetic with low vs high levels which means an ugly (low interface aesthetics) and a beautiful (high interface aesthetics). The third was time with pre-use vs post-use levels which means pre-use and post-use evaluation of the online shop. Their experiment showed that interface aesthetics did not affect perceived usability, whereas low interface usability lowered classical aesthetics. Users were annoyed by low usability. So, it is important to focus on usability rather than emphasizing aesthetics.

Usability is not just a word to measure the degree of usefulness. It has its separate domain

“usability engineering’, a vast domain to identify and discover how can we improve the usability of any system. An individual cannot decide the factors to deliver high usability of any system. As some usability engineering specialists (Grudin et al. 1987) believe that "human factors involved with a particular product may ultimately have its greatest impact on future product releases." Usability engineering has 11 steps for delivering the high usability of any system. The first and most important step is identifying the users. You will only be able to set your usability goals after identifying your intended users (Nielsen 1993, p72).

The majority of people identify objects with the help of pattern identification. To make our design more effective and eye-catching we should give importance to patterns while designing (Weinschenk 2011, p7).

Eight golden rules are listed for a better user interface (Shneiderman et al. 2016). The design should possess consistent colours, themes, menus, layouts, fonts, buttons, and so on. This will help you to keep the user on your website. A good design always gives the user feedback according to his actions. Informative feedback will help the user to understand your system effectively (Shneiderman et al. 2016). The design should present the information only in small chunks to grab the user’s attention. An excess amount of information at the same place will make the user leave your system or website. You should thoroughly research what type of information is needed and where it is needed according to your audience (Weinschenk 2011, p62). We should present the most important information or the most popular thing in the center of the page to grab the user’s attention. (Weinschenk 2011, p13).
The design of the interface should help the user in preventing serious errors. Errors can lead to user frustration. The design should always provide a simple, constructive, and easy-tounderstand solution to the user. Try to make the user’s actions reversible. This will result in the reduction of the user’s anxiety and stress as it will remind the user that his action can be undone. The user will keep using your system or website as he will not be worried about making errors and he will explore as much as possible (Shneiderman et al. 2016)

One major aspect of the website or system is user experience. Interestingly, User Experience (UX) has been broadly and quickly acknowledged in the Human-Computer Interaction (HCI), however, without it being well understood. A survey was conducted by (Law et al. 2009) to promote active discussion on the scope of user experience. The main aim of the survey was to get the feedback of different people from the UX community. The survey was divided into three sections namely, UX Statements, UX Definitions, and Your Background. There were 23 statements in the UX statements section with a

5-point scale ('strongly disagree', 'disagree', 'neutral', 'agree', and 'strongly agree'). These statements were mainly addressing the main issues related to UX. Respondents were asked to express their opinions on the UX Definitions against the given definitions. They were supposed to tell their thoughts on the statements and any suggestions for improvements. In the last section, Your Background, they were asked to provide their education and work history, why they are interested in UX, and how much experience they have in the UX domain. The findings indicate that respondents generally concur on the idea of UX as dynamic, context-dependent, and subjective, which derives from a wide range of potential advantages consumers may obtain from a product (Law et al. 2009).

One best way for user research is a usability test. It will help you understand your audience and how they will use your system (Goodman, Kuniavsky and Moed 2012, p29). We can understand usability on a very basic level as any service or product is truly usable. Usable means that the service or product should be useful. Usefulness is the degree to which a service or product can be used by any user without any hurdles or difficulty (Rubin and Chisnell. 2008, p26). A good product should be used for every user regardless of his education, age, intelligence, etc. Best UX can be achieved by a better usability test as it will tell us how our users want the system to act.

2.3 Related Studies

A study was conducted by (Moczarny, De Villiers, and Van Biljon 2012) to identify how can usability support the user experience offered by the site in the domain of e-commerce. They evaluated four established e-commerce websites and mapped related aspects of usability and user experience. In this study, data was collected by usability testing and questionnaires. Usability testing was conducted to identify the problems experienced by the user while questionnaires help in assessing participants' user experience. Based on the findings, it was concluded that both usability and user experience is important aspects of any website. But the results were more in the favour of user experience. The designer should balance the user experience and usability during the construction of the website. (Moczarny, De Villiers, and Van Biljon 2012)

Moreover, a study was conducted by (Perdana and Suzianti 2017) to analyse the usability factors affecting the purchase intention in online e-commerce sites. This study aimed to identify the usability factors affecting Company A users' purchase intention, identify the relationship between usability factors and Company A users' purchase intention, and give recommendations to Company A in the development of their facility according to User Experience. Technology adoption lifecycle analysis was

used. It is a model which describes that how any user accepts the new technology. This model has five adaption stages namely Innovators, Early Adopter, Early Majority, Late Majority, and Laggards. This study concluded that the users of this company are in the Early Majority stage which means they are adopting Company A as an Indonesian online e-commerce website. It was also concluded that usability factors readability, telepresence, and credibility have a direct positive impact on the purchase intention of the users, and usability factors simplicity, consistency, and interactivity have an indirect positive impact on the purchase intention. (Perdana and Suzianti. 2017)

Experimental research was conducted by (Papaioannou et al. 2014) aiming to identify how we can maximize website user experience. They used Quality of Experience (QoE), which measures the delight or annoyance of a customer's experiences with a service. They calculated the mean opinions score (MOS) of several users in terms of “information perception” and “multimedia type preference”. The different multimedia types used in this research were text, audio, image, and video. The MOS of the users was more towards multimedia. It was concluded that users are more attracted to the multimedia content of the website. Hence it increases the user experience of any website.

Moreover, Experimental research was conducted by (Bulut and Onaran 2017) aiming to identify the link between consumers’ online shopping behavioural factors like they spend average time monthly on online shopping, or how frequently they visit that website. With help of a sample of 916 consumers, they provide results of how much money they spend on online shopping on e-services (Bulut and Onaran 2017) The result of this paper shows that online shopping decreased when consumers see the originality of the product. They can also reduce payment phases which will help them to engage consumers to buy online products from C2C companies. If these companies focus on a trending product or that has large sales show that product on top and the relevant product to them.

Another research conducted by (Cai et al. 2018) aims to identify the user experience of website design of B2B2C (Business to business to consumers). To enhance the usability factor of B2B (Business to business) and B2C (Business to consumers) companies they make a B2B2C model which provides unified service to all consumers with new electronic trending rules. These rules integrate production resources and retail resources for all sellers, manufacturers, and consumers. The purpose of this research paper is to identify user experience and check whether user needs meet successfully or not and increase user volume by enhancing model features which will create a good brand effect. This research proposed the design of the B2B2C website. It includes Website Positioning which means identifying the type of your website and how you will place your items on the website, analysing the

shopping behaviour of your targeted users through surveys or questionnaires, etc, and designing a website interface which includes how your website will work and its visual representation.

2.4 Consumer-to-consumer (C2C) E-commerce

C2C website is one of the most common e-commerce types. It allows the location of multiple online stores on one site. Customers pick the group they are interested in and are directed to the storefront to purchase their goods and services. Besides, it comprises a directory of goods and services categories and stores in each class, where customers can be sellers and buyers. Some C2C websites offer auction services allowing users to bid for merchandise and services. Leonard and Jones (2014, p. 1) illustrate that C2C e-commerce is utilized by individuals who join to buy and sell products and services. The prevalent e-commerce usage has prompted exploring prospective impacts on its acceptance or an individual's purpose to utilize e-commerce.

C2C e-commerce is becoming commonplace for buyers and sellers. For instance, China approximated its C2C e-commerce transaction plus retail of $179 billion in 2012 (Leonard and Jones 2014, p.1) Presently, C2C e-commerce is altering the face of vending by promoting reaching a broad customer base without geographic location barriers. It is often performed in electronic auction settings; nonetheless, it does not always take place in this approach. It can take place in a third-party customer catalogue, chat rooms, email groups, or discussion forums. C2C e-commerce faces one major challenge that includes connecting buyers and sellers. The online domain has successfully ported models from the physical world, including auctions and classified ads.

2.5 Accessibility

Customers prefer designs that different user categories can utilize, for instance, users with disabilities, such as colour blindness or low level of tech literacy. According to Acosta-Vargas et al. (2022, p. 1), many e-commerce websites exist today; however, not all are accessible. Acosta-Vargas et al. (2022, p. 1) highlight accessibility as a vital element that makes a difference and determines a digital business' success or failure.

Over the recent years, e-commerce has significantly evolved due to current digitalization. Acosta-Vargas et al. (2022, p. 2) predicted over 2.14 billion individuals globally to shop online and worldwide e-commerce revenues to grow to $5.4 trillion by 2022.

According to Acosta-Vargas et al. (2022, p. 2), the term e-commerce grew from March 2020 during COVID-19, when the majority of the users started to consume massively digital material and were leaning toward using e-commerce applications to prevent infection. The words accessibility and WCAG also grew. Over the period, e-commerce websites considerably grew; however, the majority of them are inaccessible. Acosta-Vargas et al. (2022, p. 2) define accessibility as a set of techniques, guidelines, or techniques that make web functionality and content attuned to users' desires irrespective of their physical or technical competencies.

It is vital to apply web accessibility protocols to e-commerce sites. Well-designed websites are easy to navigate for web users. Acosta-Vargas et al. (2022, p. 2) emphasize that accessibility benefits different users with ageing-related challenges that reduce their visual ability because of presbyopia, which is the gradual loss of an individual's capacity to focus on close objects. WCAG 2.1 recommends applying accessibility codes to decrease accessibility obstacles apparent to users when interconnecting with a website.

2.6 Web Accessibility Guidelines and Principles

Web accessibility suggests that individuals with inabilities can recognize, identify, navigate, and relate to the website. WCAG 2.1 comprises four principles, thirteen protocols, and seventy-eight conformance, including compliance, techniques, and success criteria. The four principles include perceptible, operable, understandable, and robust. The four principles of accessibility comprise 13 guidelines that reinforce website design goals to make content more accessible to disabled users. Each protocol encompasses success criteria that can be incorporated for compliance testing in a contractual agreement. Three compliance levels are outlined to align with accessibility requirements. The lowest is A, the medium is AA, and the highest is AAA. Principle one (perceptible) defines the website's contents coupled with the interface design for all users (Acosta-Vargas et al., 2022, p. 5). It encompasses the audio-visual contents, video players, the interface, images, buttons, and other elements that a user in any condition, tool, and operating system must access and recognize. Principle 2 (operable) underlines that a website must be as intuitive as possible and offer options to undertake an action or search for content. Including alternatives improves accessibility, emphasizing the significance of ensuring all keyboard-based functionality and avoiding designs that likely result in epileptic seizures (Acosta-Vargas et al., 2022, p. 5). Principle 3 (understandable) suggests that the site encompasses legible and comprehensible components. It should include fonts readable by all users and be predictable as to how the site works, preventing time wastage by potential users attempting to guess how tools work for improved navigation. Principle 4 (robust) emphasizes the importance of

websites being compatible with all browsers, operating systems, devices, and assistive technology applications.

According to Termens et al. (2009, p. 1171), WCAG 2.0 integrates the concept of users adjusting the timing of viewing or reading website content and underlines the significance of outlining and illustrating elements whose meaning, position, or location is transmitted non-textually. Besides, it offers specific details on creating accessible substitutes for multimedia and deals with errors arising from incorrect data input by the users. This guideline is vital for e-commerce, Web 2.0, and electronic administration (Termens et l., 2009, p. 1171). WCAG 2.0 establishes that assistive technology users should have the capacity to activate, adjust, and read interface elements. Besides, it introduces navigability as a vital web accessibility component, which is one of the best examples in which it integrates general usability principles, recognizing the connection between usability and accessibility. Lastly, WCAG 2.0 highlights the significance of the semantic structure of content via headers and lists to aid users in comprehending web page structure and locating content that interests them more easily. According to Termens et l. (2009, p. 1171), experts often criticize WCAG regarding usability and human-computer interaction coupled with associations of individuals with disabilities. Experts often argue that WCAG is not based on statistically validated users' research and fails to address the needs of cognitively disabled persons and the elderly. Besides, they contend that they are not understandable for a typical web admin coupled with encouraging web admins to seek easy compliance instead of actual accessibility.

3 PILOT STUDY

3.1 Methodology

This chapter discusses the research design, design thinking, target population, survey questionnaire, interviews, data collection, and data analysis sections.

3.1.1 Research Design

Research design is to construct a plan or structure for a research project (Leavy 2017, p.8). This pilot study adopts a mixed-method case study research. Case study research is an investigation to describe, comprehend, predict, and/or control the individual or group, organisation, process etc. (Woodside 2017, p.1). In a case study, the researcher conducts a detailed examination of a case (Creswell and Creswell 2018, p.51). For this case study, the mixed research method, which consists of qualitative and quantitative research methods, is utilised to gather data from individuals as part of user research. To collect quantitative and qualitative data, surveys and interviews have been conducted. Additionally, design thinking is an essential part of this case study. In every phase of the design thinking process, various techniques and methods are applied. This pilot study only covers 3 stages of the design thinking process. However, the final project will consist of 5 stages of the design thinking process.

3.1.2 Design Thinking

Founders of IDEO, David Kelley and Tom Kelley (2022), explain that design thinking is a methodology that can be used to find fresh solutions for a range of personal, societal, and professional difficulties. Besides, It is a process for identifying human problems and generating new solutions while utilising the methods and perspectives of design practitioners (Kelley and Kelley 2022).

According to Brown (2022), CEO of IDEO, design thinking is a human-centred innovation strategy that uses the designer's toolset to merge human needs, technological possibilities, and commercial success criteria.

Design thinking is an iterative process and leading global companies adopted the design thinking methodology (Dam and Siang 2022). Therefore, possessing strong design thinking abilities can help in handling unforeseen circumstances and solving immensely complex problems (Razzouk and Shute 2012, p.345).

Hasso Plattner Institute of Design (2016), also known as The Stanford Design School, defines the design thinking process in 5 steps as follows:

Empathise: The keynote part of the user-centred design process is empathy. Within the framework of a design problem, empathy mode is the effort design thinkers undertake to understand users. The goal of those practitioners should be to comprehend users' actions and motivations, as well as their psychological and physical requirements, worldview, and the things that are important to them.

Design thinkers can see the physical effects of people's experiences by observing them. This will allow design thinkers to infer the intangible meaning of those experiences. These insights give them direction to create innovative solutions. Direct communication with people can reveal a lot about their beliefs and values. Therefore, good dialogues can aid in revealing these beliefs and values, which are the foundation of effective designs.

Define: Bringing emphasis and clarity to the design environment is the main goal of the "define" mode of the design process. Making a problem statement that is both relevant and actionable is the aim of this step. This should be a directive that emphasises the perceptions and requirements of a certain user or composite character.

The Define mode is essential to the design process because it produces a point of view which is an explicit articulation of the issue that is tried to be solved. More significantly, based on design thinkers' improved knowledge of people and the problem domain, their point of view identifies the right challenge to address. The culmination of empathy research gives an edge that no one else possesses. Therefore, discoveries that can be used to address the design issue are insights.

Design practitioners should learn about the kind of person they are designing for or their users. They need to identify and prioritise a small number of needs that they believe must be met. Design thinkers may only identify and solve one salient need. Besides, they should work to explain the insights they created by combining the knowledge they have learned through study and empathy. Combining these three components, user, need, and insight to create an actionable problem statement can help design practitioners express their point of view.

Ideate: Ideate is the design process model that focuses on generating ideas. It symbolises an approach that goes wide in terms of concepts and results. Ideation serves as the catalyst and source material for creating prototypes and distributing creative solutions to users.

Design practitioners have the opportunity to blend their imagination and understanding of the specific problem and the target audience during ideation. Ideation is the process of striving for the broadest possible range of ideas, especially early in a design project. Later on, after user testing and feedback, the best solution can be identified.

Design thinkers should go beyond obvious answers to improve the innovative capacity of their solution set. Besides, finding novel areas for investigation is significant.

Some techniques that are used for generating ideas include mind mapping, bodystorming, and sketching.

Prototype: The Prototype mode is an iterative creation process for artefacts that aims to provide answers to problems that bring design practitioners closer to the eventual result.

Low-resolution prototypes in the early stages are quick to construct and inexpensive. Additionally, they may help to get valuable feedback from users. By creating low-fidelity prototypes, designers can explore a variety of possibilities without making a major decision. The prototype and the questions asked to users might both become a little more refined in later phases. A complex task can be divided up into manageable pieces by identifying a variable.

Test: In the test mode, design thinkers may ask their users for feedback about the prototypes they have made and get another chance to develop empathy for the target audience they are creating for.

Testing is an additional chance to comprehend the users' needs, but in contrast to the original empathy mode, wireframes and prototypes are developed for testing. The testing should not be limited to simply asking people if they like the solution, instead, design practitioners should keep asking “Why?" and concentrate on what they can discover about users, issues, and solutions.

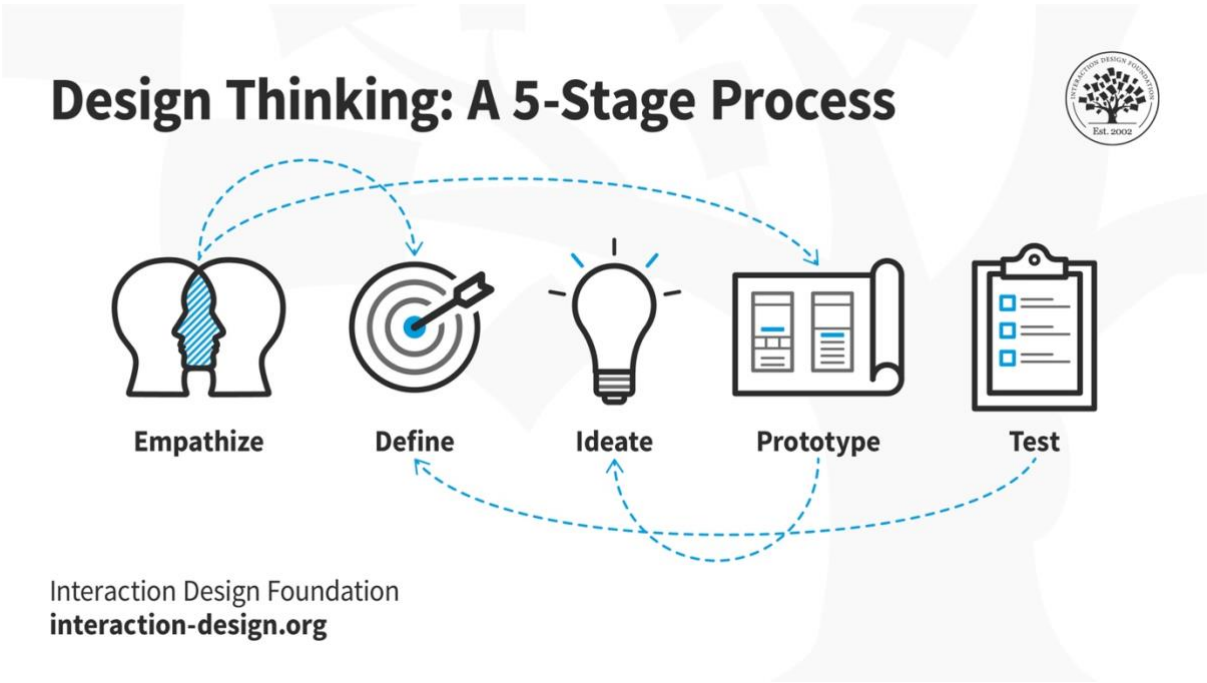


Figure 3 Design Thinking: A Five Stage Process (Interaction Design Foundation 2022)

There are various design thinking frameworks that contain different stages. For example, one of them includes the "implementation" stage which is the development phase of the product after the test stage. However, this study does not cover the development and coding process of the website, so, a 5-stage design thinking process of Hasso Plattner Institute of Design has been adopted.

2.1.3 Agile, Lean, Design Thinking, And Waterfall

Agile methodology is based on Manifesto for Agile Software Development (agilemanifesto.org 2001) and it contains four important principles:

- User and interaction are prioritised over processes and tools.
- Instead of extensive documentation, focus on the software's functionality and usability.
- Client collaboration rather than contracts
- Continual alterations rather than sticking to a plan

Agile is an iterative methodology and it emphasises constant improvements and incremental delivery methods.

Apart from Agile, one of the popular design management methodologies in the digital industry is Lean. Schneider (2017 p.6) describes that lean is a management philosophy for enhancing any

business or system that generates value. Lean management often focuses on continuous improvement, high quality, and waste minimization (Schneider 2017, p.6)

The design Thinking model is used to better understand the problems and agile how we deliver solutions (Krause 2019). There is a significant amount of overlap among Design Thinking, Agile, and Lean mindsets (Schneider 2017, p.15). Design thinking, agile, and lean methodologies have human-centred processes and there are slight differences between them. Design Thinking is about investigating issues and opportunities, Lean advances us toward developing the right things, and Agile is a methodology of building things properly (Schneider 2017, p.17).

On the other hand, the waterfall approach contains a linear project management strategy in which customer and stakeholder requirements are collected at the start of the project and then a consecutive project plan is developed to meet those needs (Projectmanager.com 2022). Since the needs of customers and users may vary over time, the long plan-based process that the waterfall model entails is not quite appropriate for design and development projects, and it is less used in the digital industry.

In this study, since user research is crucial to identify problems, empathise with users, and understand user insights, needs and requirements, design thinking methodology could help investigate and discover challenges and solutions. Therefore, design thinking is a well-suited methodology for this research.

3.2 Research Methods

Research methods are categorised into three general approaches which are quantitative, qualitative, and mixed-method research.

3.2.1 Quantitative Research

According to David Creswell and John Creswell (2018) quantitative research is a method for evaluating objective theories by analysing the relationship between variables. To provide statistical analysis of numbered data, these variables can be measured, often using instruments (Creswell and Creswell 2018, p.41). Besides, asking closed-ended questions is a way of collecting quantitative data.

3.2.2 Qualitative Research

John Creswell and David Creswell (2018) indicate that qualitative research is a method for investigating and comprehending the meaning that groups or individuals attribute to a societal or human situation. The research process includes developing questions and techniques, data collection that typically takes place in the participant's environment, data analysis that develops from specific to broad themes, and the researcher's evaluation of the significance of the finding (Creswell and Creswell 2018, p.41). Additionally, asking open-ended questions can help to gather qualitative data.

3.2.3 Mixed-method Research

Mixed-method research includes both qualitative and quantitative methods.

3.3 User Research

User research is one of the crucial elements of user experience studies. User research methods are conducted for understanding users' needs, expectations, behaviours, and standards to solve issues or create new ideas. Furthermore, user research aids in preventing our own prejudices and allows us to respond to users' needs more effectively with innovative design solutions (Chandler 2015, p.6). As empathy is the first stage of the design thinking process, user research methods come initially to empathise with users. Human-centred design processes must include individuals in the design system.

Users of a digital product might have different issues and experiences regarding that product. Hence, designers should consider users' feedback before addressing issues and making decisions. Besides, with the help of user research, designers may have the chance to eliminate problems effectively or create new solutions in a shorter period. Therefore, this study includes a mixed-method research approach to conduct user research effectively and efficiently.

3.4 Data Collection

Data is the starting point for research when it comes to drawing conclusions regarding a problem and what data must be gathered depends on the problem being investigated (Walliman 2018, p.73). The data collection tools of this study consist of a survey questionnaire and interviews.

3.4.1 Survey Questionnaire

A survey questionnaire is a list of questions that a researcher asks the intended audience to collect data. It serves as a research tool for gathering both qualitative and quantitative data. The survey

questionnaire of this study consists of a variety of open-ended and closed-ended questions. 13 questions were asked in total and 8 of them were for collecting quantitative data that could help to comprehend user profiles and create user personas, whereas 5 questions were open-ended to gather qualitative data for understanding user behaviours and insights. Google forms were used to create the survey questionnaire and It was distributed online.

3.4.2 Interviews

Two e-commerce website users and one user experience designer were interviewed (see Appendix C). The questions for e-commerce website users were the same as the questions in the survey questionnaire, however, more questions were asked after some responses for clarification. Interviews were face-to-face and responses were transcribed with permission. On the other hand, the questions for the user experience designer were different as it was an expert review on how the project should be processed and improved. The interview was done online on LinkedIn and permission was obtained from the designer.

3.5 Ethics

Ethical clearance for research and innovation projects was obtained from Solent University to conduct the research (see Appendix D). Additionally, participants were informed about the research and the confidentiality of the personal data. The data collection procedures comply with General Data Protection Regulations (GDPR).

3.6 Results

3.6.1 Target Population

The survey questionnaire was distributed to a total of 25 people and 20 responses were collected. Additionally, 2 e-commerce users and 1 user experience professional were interviewed. The sample size of this research includes 23 individuals in total. The research was conducted in the UK with people who speak English, however, the ethnicity of the population is diverse. Participants mostly were selected from people who play video games and use e-commerce websites due to the case study research. As this study contains various stages and adopts an iterative process, the size of the target population will expand gradually.

3.7 Data Analysis

The data were analysed using charts and statistics from Google Forms. In addition to that, user experience methods such as user persona, and user story were created to analyse and visualise the data.

3.7.1 Demographic Factors

- **Gender Of Respondents**

The survey findings, as it is displayed on the chart below, show that 10 of the respondents are females while the rest are male with a total of 20 respondents. On the other hand, as for interviews, one male and one female participated as users. This data indicates an equal sample size in terms of genders.

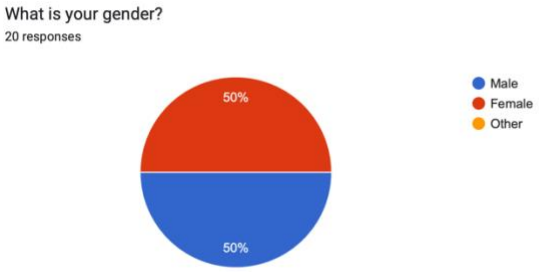


Figure 4 Gender of Respondents

- **Age Of Respondents**

The pie chart below demonstrates that the majority of respondents are in the age group of 18 and 34. The remaining 15% of people were in the age group of 35 to 44. Interview participants are in the age group of 18-34 as well. This demonstrates that the respondents are young people who engage in gaming and e-commerce.

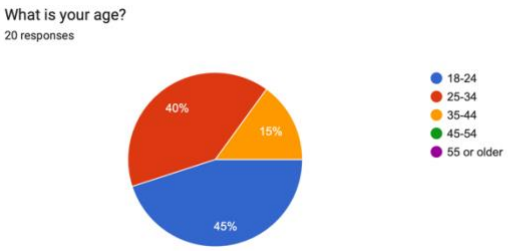


Figure 5 Age of Respondents

3.7.2 Psychographic Factors

- **How often do you play video games?**

The majority of the respondents play video games at least once a month. More than half of the respondents play video games frequently. Interview participants also play video games at least once a month. Only one respondent never plays video games.

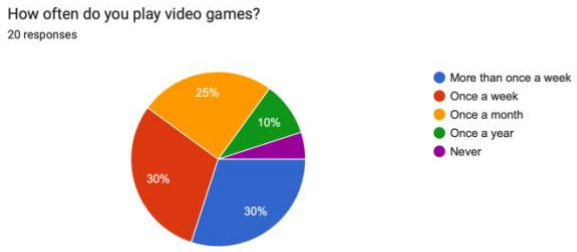


Figure 6 Frequency of playing video games

- **Where do you like to shop for gaming products?**

2 respondents purchase gaming products only in-store. While 6 respondents prefer both in-store and online shopping, the rest of the respondents prefer only online shopping. Interview participants prefer online shopping.

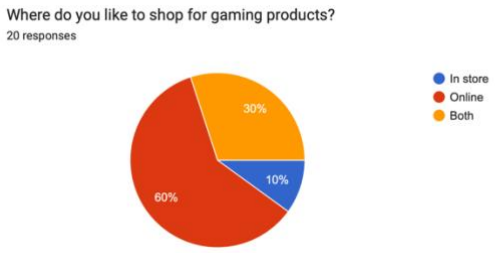


Figure 7 Gaming products shopping

- **How often do you use e-commerce websites?**

80% of the respondents use e-commerce websites at least once a month. 3 respondents use e-commerce websites once a year, whereas 1 respondent never uses e-commerce websites. Besides, participants of the interview use e-commerce websites at least once a month. The data demonstrate that almost all of the respondents are familiar with the usage of e-commerce websites.

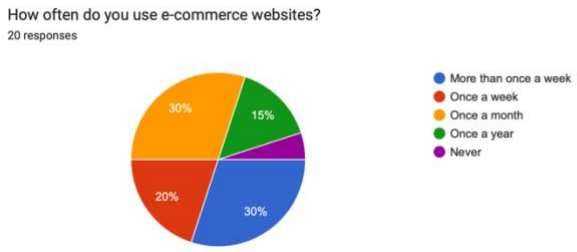


Figure 8 Frequency of E-commerce usage

- **How do you engage as?**

16 respondents engage in e-commerce as buyers, whereas 4 respondents engage as both buyers and sellers. There is no one among respondents who only engage as a seller. As for interview participants, they engage as buyers.

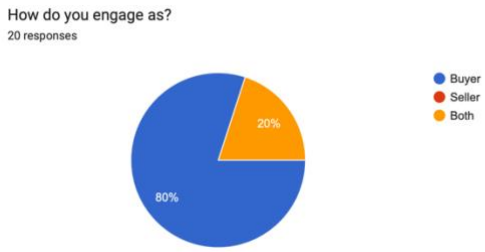


Figure 9 Engagement in e-commerce

- **Which device do you prefer to use when visiting an e-commerce website?**

Slightly more than half of the users prefer mobile devices for their e-commerce activities. Only 1 respondent use a tablet for e-commerce activities. Besides, participants of the interview use mobile devices. The data demonstrate that mobile devices are used slightly more than desktop devices among the respondents, so, the mobile-first design approach can be beneficial. Additionally, according to Statista (2021), retail website visits from smartphones are 71% and orders are 66% in the United Kingdom for the first quarter of 2022.

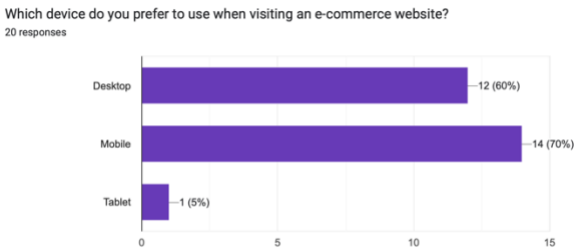


Figure 10 Devices used for e-commerce activities

- **Would you like to get in touch with other people through an e-commerce website to exchange your gaming products?**

8 respondents are interested in contacting people through an e-commerce website for exchanging gaming products, whereas 6 respondents are not willing to exchange. Besides, 6 respondents answered this question as “maybe”. One of the interview participants replied to this question as “maybe” and stated that he was not sure about that because of some concerns about the reliability of the website and users. Additionally, he mentioned that the customer support of the website must be robust in case of any negative outcomes. On the other hand, the other interviewee said that the cost of living rose dramatically, and video games and gaming products were expensive, so, it would be a great chance to play different games by exchanging with other people for free or with a low fee.

The hypothesis of this study is to create design features that will enable users to find people, communicate with them and exchange gaming items so that these activities could contribute to a better user experience on a gaming e-commerce website. The data show that the respondents who are interested in exchanging gaming items are more than the others. Therefore, design features for these exchanging activities could likely increase user experience and usability.

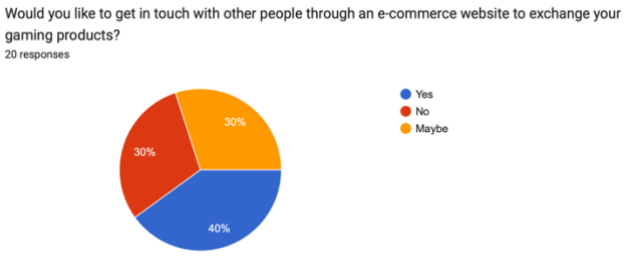


Figure 11 Interest in exchanging gaming products

3.7.3 Qualitative Coding and Grounded Theory

Levy (2015, p.92) states that when analysing data, trying to break down a lot of information into smaller, more manageable pieces is essential. We attempt to establish correlations between various inputs to draw conclusions about the causes of specific events. It is easier to address long-term goals by dividing larger challenges down into smaller ones (Levy 2015, p.92).

Finding themes and patterns in qualitative data requires a technique known as qualitative coding, which involves categorising excerpts in a systematic way (Delvetool 2022). In qualitative research, a "code" is typically a word or a brief phrase that essentially assigns a cumulative, prominent, actual fact, and/or evocative feature to a subset of language-based or visual data (Saldana 2009, p.3). Qualitative coding enables practitioners to organise semi-structured or unstructured data into themes and patterns for analysis, such as transcripts from in-depth interviews or focus groups (Delvetool 2022).

Auerbach and Silverstein (2003) explain that the grounded theory approach uses theoretical coding, a data analysis technique, to create hypotheses based on what the study participants say. The term "grounded theory" refers to the ability to base your theories on what study participants say through the use of theoretical coding (Auerbach and Silverstein 2003, p.7).

There are various methods and techniques for qualitative data analysis and coding. One of them is using CAQDAS (Computer Assisted Qualitative Data Analysis Software) such as Delvetool, MAXQDA, NVivo, Atlas.ti, and QDA Miner. In this study, none of CAQDAS was used because they are not free to use and it takes time to be proficient in using their multiple functions and instructions. They are powerful tools for analysing large amounts of qualitative data such as long transcriptions and texts but CAQDAS does not code the data itself and it is the researcher's responsibility to code the data. In this study, transcriptions of interviews and answers to open-ended questions in the survey are not long and complicated. Therefore, a method called “Affinity Diagramming” which is quite popular in the UX design process was used for qualitative data analysis and coding.

3.7.4 Affinity Diagramming

According to the description of UX Design Institute (2018), one of the fundamental UX skills is affinity diagramming and it assists UX specialists to organise ideas into logical groups. It is easy to go through extensive research data with affinity diagramming and discover the core of findings.

Large amounts of unstructured, diverse, and seemingly unrelated qualitative data about nearly anything can be organised using affinity diagramming as an efficient way of creating hierarchical categories (Hartson and Pyla 2012, p.159). The affinity diagram is one of the most important management and planning tools in business, and it has been used to arrange a variety of ideas in brainstorming sessions and qualitative data in research (Hartson and Pyla 2012, p.160).

Affinity diagrams can be created with sticky notes on a board or with the help of computer software. In this research, Figma, web-based software was used to create affinity diagrams (see Appendix E). This study combines both deductive and inductive approaches. The process starts with a deductive approach which includes a set of codes derived from research questions. These codes generate themes which are supergroups. Under those themes, the inductive approach starts. This is also called the ground-up approach, instead of starting with prior assumptions about what the codes should be, it is allowed that theory develops naturally from the raw data (Delvetool 2022). This approach is excellent for exploratory research or situations when you wish to develop fresh theories, notions, or ideas (Delvetool 2022). Therefore, this approach has been adopted.

The process continues with excerpts from interview transcriptions and qualitative survey answers and they are grouped into themes. Those themes and codes are grouped under the supergroups that were created in the first place. For example; The most important features (Supergroup) > Location (Subgroup) > Location of buyers and sellers (Excerpt).

After the affinity diagramming process, an excel document has been created to analyse the codes quantitively. The data show that the most used codes are under the group called “Aesthetics” which contains 19 codes. On the other hand, “Aesthetics” is mostly used under the supergroup “Design” rather than other supergroups such as “Expected Features”, “Most Important Features”, “Improving User Experience”, and “Least Important Features”. Additionally, under the supergroup “Least Important Features”, the most used codes are under the “Aesthetics” subgroup which has 4 related codes. This data indicates that “Aesthetics” is not a crucial element as a feature and function for users, however, it is important for the design, layout, and visual appeal of the websites. There are various studies in HCI that show the correlation between aesthetics and usability. It is also known as the aesthetics usability effect.

Kurosu and Kashimura (1995) conducted research with 252 participants on the aesthetic appeal and usability of an ATM and they concluded that there was a strong relation between aesthetic appeal and ease of use. The data showed that the user might be significantly influenced by the aesthetic component of the interface even when they attempted to evaluate it in terms of its functional aspects. The study suggests that designers should not only work on inherent usability but also they should enhance the aesthetic aspect of interfaces.

Another study conducted by Tractinsky, Katz and Ikar (2000) with 132 participants on the aesthetics and usability of ATMs shows how closely users' perceptions of the system's usability and impressions of interface aesthetics relate to one another. The study also associates its findings with social psychology findings which are associations of the physical attractiveness of a person with personal attributes of the person. It is also known as the halo effect.

An experiment was held by (Tuch et al. 2012) to evaluate the aesthetics and usability relation of an e-commerce clothing website using a three-factor, mixed design method. In this design, there were three variables. One of them was, interface-usability which means one good (high interface-usability) and one bad (low interface-usability). The second was interface-aesthetic with low vs high levels which means an ugly (low interface aesthetics) and a beautiful (high interface aesthetics). The third was time with pre-use vs post-use levels which means pre-use and post-use evaluation of the online shop. Their experiment showed that interface aesthetics did not affect perceived usability, whereas low interface usability lowered classical aesthetics. Unlike previous studies, the research proposed the term “What is usable is beautiful”. It is also suggested that it is important to focus on usability rather than emphasising aesthetics.

Aesthetics and usability have been significant topics in HCI and various studies and experiments have been conducted to evaluate the relation between them. As technology is developing day by day, the perception of usability and aesthetics might likely evolve in the future and this topic might be discussed. In the UX design process, both aesthetics and usability are important elements for better digital products. Therefore, designers must emphasise both in order to design high-quality products.

On the other hand, the second most emphasised code in this study is “Security and Reliability”. Security, privacy, and trust have always been major concerns for e-commerce users. This study also confirms that some respondents and participants have security, privacy, and trust concerns. According to the research “*Empirical investigation of the relationship of privacy, security and trust with behavioural intention to transact in e-commerce”* conducted by Gurung (2006 p.62), the findings of

the study imply that trust perceptions, privacy concerns, and security issues had an impact on risk perception. Trust had the biggest impact among these consequences, followed by privacy and security worries. Additionally, attitudes were impacted by perceptions about trust and risk perception. Gurung (2006, p.64) suggests that since online businesses do not have the same opportunity for establishing a personal connection as in an offline setting, developing trust beliefs is a must for consumers to engage in e-commerce.

Another study (Gupta and Dubey 2016) demonstrates that there is a strong correlation between consumer trust and website loyalty. Moreover, the building of trust influences not only the willingness to purchase but also the actual purchasing behaviour in terms of cost, preferences, and visit frequency. Therefore, encryption, digital certificates, domain name verifications, firewalls and data protection statements should all be displayed by websites (Gupta and Dubey 2016).

As for the “Security and Reliability” code, it can be concluded that e-commerce platforms must show their privacy policies and data protection statements, robust secure payment options, and customer reviews, testimonials or third-party references in order to build trust and loyalty among users.

The qualitative coding analysis reveals that the third mentioned code is “Easiness”. Participants and respondents emphasised “Easiness” mainly in terms of ease of use, ease of reading, ease of shopping, and simple layout and structure. Easy-to-use digital products can be achieved by applying some UX laws and principles. One of the popular and frequently implemented UX and UI laws is Fitts’ Law. Research done in 1954 by psychologist Paul Fitts on the human motor system shows that the time it takes to move toward a target depends on the distance to it, but is inversely related to its size (Interaction Design Foundation, 2022). According to this law, the trade-off between speed and precision causes higher error rates when moving quickly and hitting small targets (Interaction Design Foundation, 2022). From this UX law, a design convention has emerged and interactive components of user interfaces such as buttons are designed as large as possible and placed at a short distance that users can reach easily.

William Edmund Hick, a psychologist, asserts that if people have a lot of options, making decisions will take a long time (Soegaard 2021). They might also choose nothing in the end. The term "Hick's Law" also applies to this phenomena. Furthermore, Shwartz and Ward (2004, p. 104) note that we are less content and have less freedom the more options we have. As a result, it is known as a paradox of choices, and users may be uncertain about which buttons to press or what to do. The cognitive process of analysing the data and making decisions will take some time.

According to architect Ludwig Mies van der Rohe, less is more in design, and this philosophy is opposed to the cluttered design by minimalism and simplicity (Memon 2019). This rule can be applied to digital product design systems as well. Therefore, It can be concluded that the more minimal and simple is an interface, the more user experience is enhanced.

Krug's (2014) first rule of usability is “Don't make me think” which is also the name of his popular book in the field of UX and Usability. It refers to keeping website components clear and uncomplicated.

Another most commonly used UX law for designing easy-to-use interfaces is Miller’s Law. According to Miller's law, the quantity of information being memorised rather than the size of the information chunks affects memory span (Yablonski 2020, p.36). In cognitive psychology, the term "chunks" refers to groups of fundamentally familiar components that have been preserved in a person's memory and Miller found that young adults' memory spans were about capped at 7, regardless of the stimuli's radically varying informational densities (Yablonski 2020, p.36). For example, credit card number sections are divided into chunks as follows:

With chunks	Without Chunks
1111-2221-3331-4441	1111222133314441

Table 1 Chunking Information

Chunking helps reduce cognitive load and efficiently retain information.

Lastly, another most common UX law used in UX/UI design is "Jakob’s Law of the Internet User Experience." Jakob Nielsen, who is a usability and user experience expert, states that users spend their time on different websites and have a tendency to expect similar functionalities and design conventions from the websites based on their previous experiences in order not to be confused or frustrated (Nielsen 2000). For instance, if this law is applied to an e-commerce website or application design, it is necessary to follow design patterns and conventions from the most visited e-commerce websites and applications. Users who are familiar with a design pattern will easily use other interfaces with similar patterns. However, this does not mean that websites should be designed identically. For instance, every e-commerce website must have a search feature, which is a design convention for e-commerce websites, but how designers create that search feature depends on their design decisions.

Other themes developed from more than one code are “Searching”, “Location”, “Reviews”, “Communication”, “Product Details”, “Modern Design”, and “Customer Service”.

A search function is one of the fundamentals of e-commerce design. As it is concluded from the user research, a search function is crucial for users on e-commerce platforms. Not every website or application needs to have a search function but on an e-commerce platform, it is quite necessary to place it. User research shows that the search feature does not only include a search bar but also includes filtering and sorting features which allow users to advanced search. According to usability tests by Nielsen (1997), users have been categorised as search-dominant, link-dominant, and mixed behaviour. Additionally, Nielsen states that over half of the users are search-dominant. He explains that when entering a website, search-dominant users will usually head directly for the search button, they are not interested in browsing the site, they are task-focused and want to locate specific information as quickly as possible. In contrast, link-dominant users prefer to navigate a site by following links: even if they wish to discover specific content, they will first try to find it by following promising connections from the main page. Link-dominant users will confess defeat and utilise a search command only when they are lost.

As for the “Location” theme, some participants and respondents of this study believed that location has a significant role in C2C e-commerce websites. According to the data gathered, knowing the location of the seller or user allows users to have a clear idea about local trades, shipping procedures or other opportunities.

Customer reviews of products and sellers are another important element of e-commerce design for users. The data demonstrate that reviews are crucial for users to obtain information to decide on purchasing or exchanging products. This element of design is closely related to trust concerns. Therefore, it may be inferred that designing a section for customer reviews could improve user experience.

Moreover, users noted that being able to send messages to sellers or other users enables them to communicate effectively and it could increase the usability and user experience. So, the “Communication” theme has been derived from the coding process.

One of the design conventions of e-commerce platforms is the product details section. The product details section provides helpful information on specific products. Users emphasised that products

should have comprehensive descriptions such as the condition of the item, image, or other helpful details about the product.

“Modern Design” is a separate theme from “Aesthetics” because different respondents and participants emphasised it using the term modern design. In terms of interface design, users tend to see design trends and they want the websites not to look outdated.

The data show that users need customer service support for a better shopping experience in case they may have some issues regarding the website or products. Therefore, a contact page or help centre on an e-commerce platform could improve the usability and user experience.

3.8 User Personas

A persona is a depiction of the objectives and tendencies of a real user group, additionally, user personas have a solid basis in fact because they were developed through research involving actual consumers (Allen and Chudley 2012, p.346). Personas enable practitioners to view the overall picture and avoid being side-tracked by the raw data, which is one of their many advantages (Travis and Hodgson 2019, p.152).

Three user personas were created for this study (see Appendix F). User personas were developed using both primary research, data gathered via the survey and interviews, and secondary research, data gathered from Statista (Statista.com 2021). The primary user persona (see Figure 12) represents the consumer who is willing to exchange his gaming product through a gaming e-commerce website. The secondary persona represents a seller who tends to sell her used gaming products on a gaming e-commerce website, and the tertiary persona is a buyer who is willing to purchase used gaming items. Generally, user personas are created after user research in the second stage of the design thinking process which is “define”.

As a result, personas can be helpful to keep designers on task, eliminate self-reference, and frame design issues from the viewpoint of the user (Chen and Liu 2015, p.1l). Therefore, user personas are created to see users' mental models, allowing designers to follow design conventions according to users’ previous experiences.

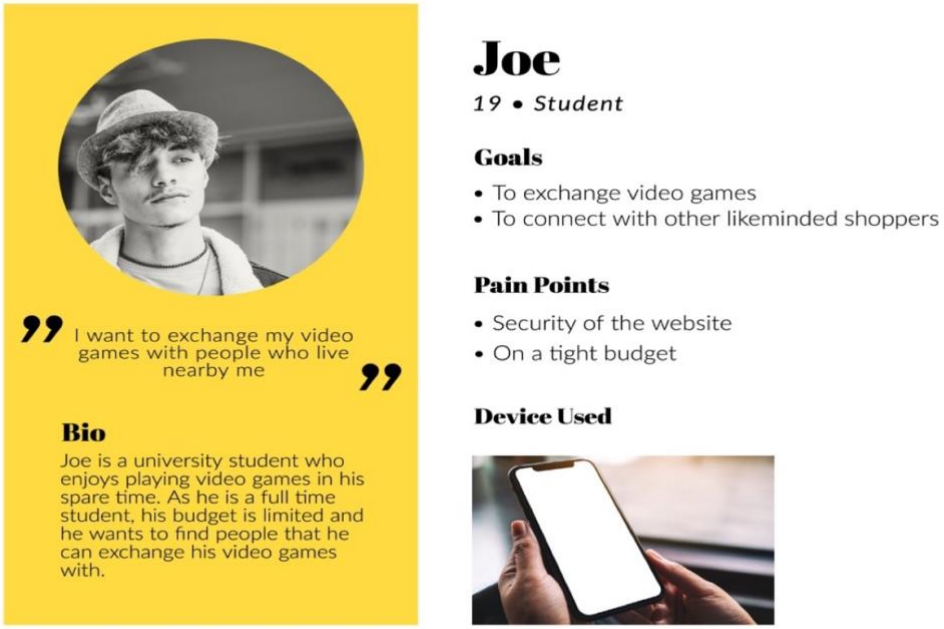


Figure 12 Primary User Persona

3.9 User Stories

According to Cohn (2004, p.4) a user story refers to the capabilities that will be beneficial for the user or customer of a system or software. Three components of a user story are (Cohn 2004, p.4):

- written descriptions utilised as a reminder and planning tool.
- discussion on the story that helps to elaborate on its details
- tests that report the details and that can be used to evaluate whether a story is finished.

User stories include simple and concise descriptions of who the user is, what the user wants, and why it is important.

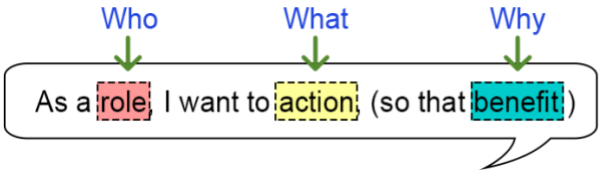


Figure 13 User Story (Visual-paradigm.com 2022)

In this study, as it is demonstrated in Table 1 below, user stories were created as the ideation phase of the design thinking process using qualitative data collected from user research. This table shows what the user wants to see on a gaming e-commerce website and why. Since user centred design

processes must include users, the user stories are quite beneficial to decide what actions will be taken during the prototype phase.

Table 2 User stories

As a {type of persona}…	I want to {objective/goal}…	So that I can{result/benefit}…
User	Search for products by location	Find the products near me
User	View the images and videos of the products	See it better and understand the condition of the products
User	Send a message to the seller	Offer exchange or ask questions about the product
User	See the items by relevant categories	Easily navigate the website and find the product that I want
User	See the ratings and reviews about the seller	Trust the seller
User	See customer comments about the products	Decide on engaging
User	Have a reliable customer support	Protect my rights and have a good experience
User	See product recommendations	Have an idea of different products
User	Use the website easily	Complete my activities in a simple way
User	See animations and game images	Be pleased with the aesthetics

In conclusion, this pilot study covered the user research section of the thesis which is designing and evaluating a gaming e-commerce website in terms of user experience and usability. Almost all of the user experience and human-centred design processes begin with user research to gather insights and data about user profiles, needs, and behaviours so that digital products can be designed with user-centric approaches to satisfy user needs. This research adopted mixed-method case study research for collecting data. A survey questionnaire and interviews were conducted with a total of 23

individuals. In terms of data analysis, qualitative coding and affinity diagramming methods were used and user personas and stories were created. The data collected demonstrated that some users were concerned about exchanging gaming items on a website because of the reliability of the users and website. On the other hand, some users clearly stated that exchanging gaming products could decrease the costs that they spend on gaming items. Apart from this, users tend to see a clear categorisation and filtering on a gaming e-commerce website. Customer support and ease of payment are other important outcomes of this research. Besides, the search capabilities of a website showing the products by location could also be important for some users. In terms of aesthetics, users also stated that they were interested In seeing the simple design, high-quality game images, and animations. As for communication, respondents said that they were willing to contact sellers easily. Lastly, the data show that ratings and reviews about sellers could highly affect the perception of users.

4 SKETCHING AND PROTOTYPING

4.1 Sketching

Sketching is one of the most common UX design ideation techniques and it can be used in the third step of the design thinking methodology which is “Ideate”. Sketching allows designers to visualise their ideas quickly. Sketches are excellent tools to produce and discuss ideas early, and they enable designers to test concepts and ideas without devoting significant effort to comprehensive wireframes or graphic designs (Allen and Chudley 2012, p.409). At the beginning of a design project, starting with graphic designs and high-fidelity frames might decelerate the project since the design and needs might change over time. Therefore, sketching is one of the best ways to begin a project and select the most suitable design ideas for wireframing and high-fidelity prototype designs. It is a cost and time-effective process and does not require a lot of experience.

Sturdee and Lindley (2019) claim that the sketching and drawing approaches are accessible to both novices and experts, and they are quick and inexpensive to generate and can have a wide range of effects on a final concept, process, or result. Additionally, they state that blending sketching and drawing may create concrete technologies in the future (Sturdee and Lindley 2019). Sketching is a powerful technique for testing ideas as well. It is also called the paper prototype method and early feedback from users or stakeholders can be received by demonstrating paper prototypes.

In this study, the sketching technique has been adopted for ideation, and web-app sketches have been created on a sketch notebook before wireframing on digital screens (See Appendix G). The sketching process has begun with creating mobile screens. Firstly, ideas for the layout and structure of the home page have been generated. Later, interaction design elements and information architecture elements have been created. Lastly, product pages with the “exchange” feature and other features have been implemented.

4.2 Prototyping

Prototyping is the fourth step of the design thinking methodology. The use of prototypes allows practitioners to test how a product will operate and feel (Buley 2013, p.192). According to Buley (2013 p.192), the simplest paper-based experiments to the most detailed, functional models can all be considered prototypes. Changing a prototype in the early stages of the development process is a much cheaper action rather than changing the digital product after the development stages. Moreover, a

prototype enables to testing of the product before its development process and the gathering of data and feedback from both users and stakeholders to improve the usability and user experience of the product. In digital design, prototypes can be created using various methods. Wireframing, which contains low and mid-fidelity models, is one of the basic methods of creating prototypes. On the other hand, high-fidelity model prototypes represent the most realistic version of the product and they include functional or semi-functional interaction design elements, as well as graphics, animations, icons, logos, interactive components, and images. In this project, Figma was used as a prototyping tool to create mid-fidelity and high-fidelity prototypes. Figma is a web-based vector graphics and interface design tool that is mostly used for collaborative teamwork design and prototyping. A design tool survey was conducted in 2021 and it was concluded that Figma is the most popular prototyping and UI design tool in the digital industry (Uxtools.co 2021). The main reason why Figma was used for this project is that Figma is a web-based tool, so, accessing the platform is very easy and useful. Additionally, it is easy to test the prototype remotely with others or collaborate.

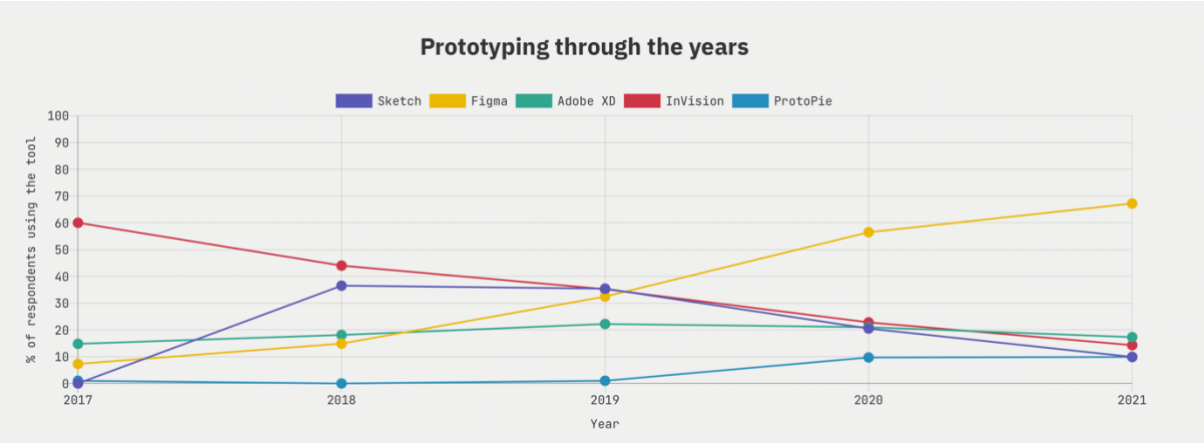


Figure 14 Prototyping through the years (Uxtools.co 2021)

4.2.1 Wireframing

Sketching is an excellent technique for ideation but when it comes to the representation of ideas on digital screens with more accurate forms, designers tend to use wireframing techniques. Wireframes are diagrams that depict the overall structure of an application or website and they enable designers to investigate information, navigation, and interactions independently of visual design components like fonts and colours (Allen and Chudley 2012, p.424). Whereas wireframes can be used to represent high-level concepts, they are more typically utilised to depict medium-fidelity interaction designs (Hartson and Pyla 2012, p.342). Generally, wireframes contain a grey-scale colour scheme and colours, fonts, and graphic design elements are not important in this method.

Creating wireframes has a significant role in building high-fidelity prototypes because wireframes are the skeleton and template of the design work. They assist in determining how much space to allot to a specific item and where that item is placed to prioritise content. Additionally, wireframes define standard methods for showing specific sorts of information on the user interface. The functionality and features of the user interface can also be determined by creating wireframes. Since wireframing processes do not give attention to a detailed graphic design, the information architecture, layout, structure, features and functions of the design are focused on and created quicker than high-fidelity prototypes. Wireframes are adaptable to changes due to their plain and simple forms.

After creating sketches for this web application project, wireframes have been created on Figma. Information architecture, interaction design elements, layout, functions and features of the web application have been wireframed according to the ideas derived from sketching.
Accessibility, functionality, structure, and navigation elements have been focused on wireframes. Sitemap and information architecture have been determined and designed to categorise the content precisely.

4.2.2 High-Fidelity Prototype

High-fidelity prototypes are the closest possible representation of the user interface of a product. High-fidelity prototyping contains images, icons, logos, animations and other interactions to simulate the real product that will be developed. Creating a high-fidelity prototype is a powerful method for testing the product before its development stage to get feedback from users or stakeholders. It may reduce costs, time, and flaws in the design process, so, high-fidelity prototyping is a widely used method in the digital design industry.

In this study, a high-fidelity prototype for a C2C gaming e-commerce web application, which is named “GAMEX”, has been created on Figma. Firstly, the Atomic Design methodology has been adopted to design the elements of the web application. Atomic design methodology consists of five separate steps (atoms, molecules, organisms, templates, and pages) to develop interface design systems in a more systematic and hierarchical way (Frost 2016).

Frost (2016) describes the five elements as follows:

- Atoms are the fundamental components of an interface and are UI elements that cannot be subdivided.

- Molecules are what make up the comparatively straightforward UI elements.
- Organisms are relatively sophisticated elements that make up distinct interface segments.
- Templates arrange elements in a layout and show how the design's fundamental content structure is organised.
- Pages use actual material to apply to templates and explain variants in order to show the finished UI and evaluate the design system's resiliency.

The atomic design approach helps to create a design system and easy-to-work process. Therefore, the process began with the home page references from mid-fidelity wireframes and interactive components were designed starting from the header.

As for the main features of the web application, users are able to buy, sell, and exchange gaming products. Some variants and options were created for users to enhance their shopping experience. For example, users might want to only sell their items or exchange their items, or they might want to both sell and exchange regarding their preferences. So, users can easily list their items for both selling and exchanging at the same time. In terms of exchanging an item, “Offer Exchange” button was created. When it is tapped, users are directed to a pop-up screen where they can choose from their listed items on the website and send an offer message to the seller. On the other hand, if users list their items for exchange on the platform, there will be a label called “Exchange” on the item card so that other users can realise the exchange products without any difficulties.

Moreover, in terms of accessibility, the search bar was designed with a voice command feature. WCAG (Web Content Accessibility Guidelines) were followed regarding the professional accessibility standards. The Colour contrast between foreground and background conforms to the standards. Font sizes are large enough in terms of ease of reading, font colours have clear colour contrast and visibility is high, and buttons are large enough to easily tap on them.

On the other hand, various design principles and UX laws were applied to this design process. These are as follows:

- **Gestalt Principles**

Gestalt Principles are a set of guidelines or laws that describe how humans organise components that are similar, spot patterns, and deconstruct complex imagery when they look at items. (Interaction Design Foundation 2022). Psychologists Wolfgang Kohler, Max Wertheimer and Kurt Koffka are

credited with creating gestalt psychology which concentrates on how individuals perceive the world. (Interaction Design Foundation 2022)

Law of Similarity

Although the pieces are separated, users often view a design as a whole when the elements are similar. Users will therefore interpret design elements that are visually similar to one another, such as those with the same size, form, or colour as having a shared meaning or function. Elements in GAMEX are visually grouped together to create similarity using size, colour, and shape.

Law of Common Region

Users combine components that share a space with specific boundaries. GAMEX created common regions for interactive designs such as the Platforms, Categories and call to action buttons.

Law of Proximity

Users combine components or elements that are placed near to one another. This principle is a categorization concept that facilitates user interaction with the design, similar to the Law of Common Region.

This law can be seen in the homepage design as the platforms, games etc were positioned close to each other and by adding borders around these elements, they separate them from surrounding elements hence the GAMEX application observed this law.

Law of Uniform Connectedness

Elements having connections are believed to be more relevant than elements without connections. The GAMEX application used the same shapes, frames, and colours to unite related elements as seen on the Login page and each category on the homepage.

- **Jakob's Law**

Users prefer web pages that are designed similarly to other web pages they frequently visit. The GAMEX web application was created using existing mental models to lessen the difficulty of learning a design. This approach improves user experience as users can easily focus on the task at hand because they are already familiar with similar websites.

Alongside creating the interactive components and the design system, market research was conducted to identify the design conventions which is related to Jakob's law. Since this project is an e-commerce web application, well-known web platforms such as amazon.co.uk, ebay.co.uk, game.co.uk, and gumtree.co.uk were analysed and some design conventions were adopted. For example, one of them is creating a search function on the header section which is a fundamental element of any e-commerce platform. Another example is the hamburger menu which is attributed to listing navigation items. This design approach is quite a popular design trend and convention for mobile screens, not only on e-commerce but also on other web platforms.

- **Doherty Threshold**

In order to avoid having to wait for responses, human-computer interaction is best when the interaction rate is less than 400 ms (Yablonski 2020, p.97). Animation or progress bars are methods of visually engaging users while loading or processing is taking place in the background to tolerate processing time. GAMEX has a transaction process animation while users wait for their transaction to be completed.

- **Fitts Law**

Designers must assure that the user can always reach the intended action with ease, both regarding the distance and the size of the target. Fitts's Law was implemented in the prototype as the interactive elements are large enough to select, clearly distinct and also clickable from anywhere. The same applies to these elements being reachable to the users.

- **Hick's Law**

Many complicated options lower the probability of the user making a decision. Therefore, GAMEX has categorised its products into four main sections and multiple subsections so that users can easily navigate the website and categories.

- **Miller’s Law**

Miller's Law states that a typical person can only hold 7 items in working memory, plus or minus 2 and it is easier for people to perceive chunked elements. GAMEX design follows these principles– design based on familiar models to reduce learning load, clutter-free designs and more importantly minimal choices. It also uses chunking to present groups of content in a manageable way and organises elements of information in categories such as the platforms

- **Occam’s Razor**

The idea behind Occam's Razor is to choose a design with the least amount of complexity. Using Occam's Razor to compare design prototypes is helpful. The idea is to choose the alternative with the simplest design possible. The big search bar was replaced with an icon instead without compromising the overall function of the prototype.

- **Pareto Principle (80/20 Rule)**

The Pareto principle is a concept claiming that 80% of the results come from 20% of the work. Generally, focusing on what is most important for a short period of time will produce better results than focusing on as many things as possible (Guy-Evans 2022). GAMEX prioritises the Buy, Sell and Exchange features and functionalities as these ones deliver the most results to their users.

- **Parkinson’s Law**

A task will evolve to consume all of the available time (Yablonski 2022). According to this law, we must keep task completion times within the range of user expectations. To observe this law, the menu provided aid to this as the different options were listed out for the user's easy accessibility. The same thing applies to the different icons in the option. This reduces the time it takes to accomplish a task.

- **Serial Position Effect**

Studies show that when people are given a list of words, they tend to recall the first and last few but forget the words in the middle (McLeod 2008). The primacy effect is the tendency to remember earlier words, while the recency effect is the tendency to remember more recent keywords (McLeod 2008).

To aid with remembering, the Serial Position Effect advises placing the most crucial UX components on the far left and right of the design. On the other hand, place the least important element in the middle. This principle was observed by the GAMEX application as the menu icon and cart icon were placed on the far left and right side of the header whilst the search icon, profile and the GAMEX can be found in the middle of the header. The same thing can also be noticed on other screens such as the menu (which had the exit icon on the left side) and other screens.

- **The Von Restorff Effect**

The Von Restorff effect, also known as the Isolation Effect, suggests that when numerous comparable items are present, the one that varies from the others would be recalled the most (Yablonski 2022). According to this effect, important objects or information must be designed visually different from others.

This law can be noticed on the GAMEX Homepage where "Exchange" is clearly shown on different game products available for exchange. It is observed also in the platform by using different colours for each category (PlayStation, Xbox etc.) Lastly, GAMEX ensured that important information and key actions were visually distinctive.

As a result, the UI and UX design of the GAMEX web application adopts various UX laws, principles, and methods to achieve a high-quality user experience and usability.

5 USABILITY AND USER EXPERIENCE EVALUATION

Evaluating the usability of a system or product and the user experience is critical for human-centred design processes. Usability and user experience evaluation help us comprehend users' needs, observe users' behaviours, and gather insights to identify issues and develop high-quality user-centred products. Many methods can be used for usability and user experience evaluation. Some methods consist of usability testing, heuristics evaluation, interviews, surveys, focus groups, eye-tracking etc. This study includes usability testing, interviews and surveys for usability and user experience evaluation. Additionally, this is the last step of the design thinking methodology that is conducted in this project.

5.1 Usability Testing

Usability testing is a broad phrase that can refer to any method used to evaluate a system or product (Rubin and Chisnell 2008, p.46). Usability testing is a method that uses people who are representative of the intended audience as testing participants to assess the degree to which a product meets specified usability requirements (Rubin and Chisnell 2008, p.46).

The aims of usability testing vary depending on the study, however, they typically include (Moran 2019):

- Identifying flaws in the product or service's design
- Identifying areas for improvement
- Understanding the target user's behaviour and preferences

Additionally, usability testing has various advantages as follows (Niranjanamurthy *et al.* 2014, p.84):

- Identifies the user's needs and tasks early in the design phase.
- Finds a balance between graphic design and operations.
- Reduces costs by predicting and eliminating probable user obstacles.
- Demonstrate significant cost reductions through increased user productivity.
- Provide a competitive advantage and satisfaction.
- Lower customer support costs
- Improved user productivity

As for conducting usability testing, a researcher (known as a "facilitator" or "moderator") invites a participant to undertake activities, usually using one or more distinct user interfaces, during a usability-testing session (Moran 2019). The researcher monitors the participant's actions and listens for feedback as the participant completes each task (Moran 2019). This study consists of 2 usability testing iterations. Each iteration includes 5 participants and 10 participants in total. Nielsen (2000) claims that the best results are obtained by testing no more than 5 users and doing as many minor tests as possible. He also adds that after the fifth user, It is waste of time repeating the same observations while learning little new. Therefore, Nielsen (2000) suggests that 5 users are enough for an iterative design approach since other usability tests could be conducted after fixing problems.

Along with the usability tests, pre-test interviews and post-test surveys have been conducted for this project as data collection methodologies (see Appendix H). Both qualitative and quantitative methods have been used for tests. Additionally, the think-aloud protocol, which requires participants to think aloud while performing specific tasks, has been used in usability sessions to gather more information about what users think, feel, and do. Moreover, the Single Ease Question (SEQ) method has been used after each task has been completed by the participant to evaluate how difficult users find the task. In addition to the usability testing sessions, post-test surveys and the System Usability Scale (SUS) has been used to calculate the overall usability score of the web application prototype.

After usability testing sessions and post-test surveys were completed, the data was analysed using affinity diagramming and qualitative coding methods. The quantitative data was analysed using statistical measurements such as mode, median, and mean. Additionally, empathy maps and user journey flows were created to comprehend the users' pain points and needs after usability sessions (see Appendix I).

The usability testing sessions were moderated and as the moderator, I guided testers through the tasks. The setting for testing was both online and face-to-face sessions. For online testing, Zoom and WhatsApp applications were used. On the other hand, in face-to-face sessions, a Huawei android mobile device was used to test the prototype. All sessions were transcribed with the permission of test participants and the data was collected according to GDPR (see Appendix J).

On the other hand, using Userbrain.com, a usability testing platform, 2 unmoderated usability tests have been conducted (see Appendix K). However, they have not been included as a part of this study. The problem with unmoderated usability tests is that users might misunderstand the instructions and

their answers could be misleading. It can be seen from 2 unmoderated session videos that users did not follow the instructions and understand tasks clearly. Therefore, they could not complete the tasks and their ratings for post-test survey questions were misleading and not reliable. Another reason why unmoderated tests are not appropriate for this study is that prototypes are not live websites, they are semi-functional and users might need assistance to complete tasks.

For the purpose of analysing the web application usability and user experience, It was decided to evaluate some of the recommended usability metrics and components as well as user experience attributes.

ISO 9241-11 (2018) suggests using the following usability metrics:

Effectiveness: The degree to which actual outcomes match expected outcomes is represented by effectiveness.

Efficiency: The resources such as time, human effort, or materials used in relation to the outcomes obtained are referred to as efficiency.

Satisfaction: Satisfaction is defined as the amount to which a user's cognitive, physical and emotional responses to a product, system or service match the user's needs and expectations.

Moreover, 5 usability components (learnability, efficiency, memorability, error tolerance, satisfaction) suggested by Nielsen (1993 p.26) have been used for usability evaluation. Apart from these components, accessibility, aesthetics, features and functions, task success, information architecture, and navigation have been evaluated.

Furthermore, important features and functions of the prototype have been pre-defined and eight tasks have been designed for usability testing.

Task 1: I would like you to log into your account.
Task 2: I would like you to offer an exchange for Gran Turismo 7 PlayStation 5 Game.
Task 3: I would like you to List a game for selling and exchanging.
Task 4: I would like you to add a product to the basket and save an item.
Task 5: I would like you to scroll the games, set some filters and use the sort feature.

Task 6: I would like you to buy Assassin's Creed Valhalla PlayStation 5 Game

Task 7: I need you to check through your messages and navigate back to your homepage.

Task 8: I would like you to go to a game product and view the seller's review

5.2 First Usability Test

Firstly, pre-test interviews were conducted before usability sessions to gather information relating to participants' demographics, video game familiarity, and e-commerce experience habits.

From the data gathered, it can be concluded that testers are comprised of young adults (all in the range of 18 to 35 years old), all possess at least one higher degree, and all participants speak English. The majority of our testers (80 %) are male, and 100% of testers are familiar with e-commerce websites and video games. Participants have been recruited within a target demographic specified by user research.

Participants were in a controlled setting as they performed a series of tasks involving the GAMEX web application prototype. Testers were guided through eight tasks, instructing them to "think-aloud" (i.e., narrate their thoughts and actions) as they perform the tasks. The predefined tasks were designed to explore certain areas of the application that may need improvement.

5.2.1 Results and Data Analysis

In the following section, major findings from usability testing have been detailed. Quotes from our participants have been included and participants have been listed by their user ID number (for example, participant 1 will be listed as 'P1'). Tables and affinity diagrams were used in conjunction with the inductive qualitative coding method to analyse the data.

Finding 1: Difficulty in offering an exchange for a game.

After being asked to offer an exchange for Gran Turismo 7 PlayStation 5 Game, users were unsure of how best to begin a search. Users commonly first checked the menu and tried clicking on the options available and then finally decided to scroll down the homepage in search of that particular game as their last destination. They commented that "*I can't seem to find the game*" (P2) and "*This is confusing*" (P3). On average, users thought the Exchange feature was "somewhat" clear and

understandable. The analysis reveals that users are uncertain of how to efficiently offer a game for exchange.

Recommendation 1: Adding the “exchange product” feature in the menu category
may clearly communicate to users of all levels how to begin the game exchange. In addition, this would clear all thoughts of confusion as every product in that category would be limited to only “Exchange”.

Finding 2: Difficulty in navigating to the messages.

Users found it difficult to access the messages in their accounts. To be able to access the messages users had to log in again to the account which can be considered a long process and could lead to the user eventually abandoning the task.

Recommendation 2a: It should be ensured that the “profile icon” do not redirect to “Login”. Therefore, a message icon can be placed on the header.

Recommendation 2b: Add “My GAMEX Account” to the menu as well. “My GAMEX Account” which would contain (orders, inbox, pending reviews, saved items etc.) could be added to the menu list. This would make accessibility and site navigation to be very easy and quite fast.

Finding 3: UI design and aesthetics.

A user stated that the fixed positioned header with a big search bar does not allow him to see all the screen and it covers a large space on the top the screen. A user mentioned about the inconsistency of using an image instead of an icon for “PC Gaming” component on the Platforms. A user stated that reviews are more important and they should be above the “Seller’s Information”. “Save an item” does not show any notification to users after clicking. A user prefers more minimal design without strokes around the product cards.

Recommendation 3a: Replacing the “search bar” with a search icon.
Recommendation 3b: Replacing the PC gaming image with an icon.
Recommendation 3c: Placing **“**Reviews” above the “Seller’s Information”.
Recommendation 3d: Adding a confirmation note to “Save an item” after clicking.
Recommendation 3e: Using lighter colours or strokes for the product cards.

Finding 4: Confusing and repetitive menu.

Users found the menu and category to be confusing and had no form of hierarchy to guide the user. The experience of getting things done with this process is a little bit lengthy due to the different options. Aside from all this, the menu seems to contain lots of repetitive categories which leaves the user confused.

Recommendation 4a: Clearly outlining the "Categories" in the menu
Recommendation 4b: Adding "My GAMEX Account" to the menu as well and clearly outline them as well.
Recommendation 4d: Adding a "Help Center" to the Menu to foster trust and user empathy.

Table 3 First Usability Test Overall User Experience Responses

Participant 2	*"So there is a problem that you are using a game picture in one of the boxes then in others you use icons, I would recommend using icons in the PC Gaming also."*
Participant 2	*"I would like to have all of the headings at one side, you know having these headings at the center is quite daunting. I think it would be great to have all the games, consoles on the left side of the pages."*
Participant 2	*"I would really love to have minimal designs instead of these heavy strokes or maybe if you can add some lighter colours to the stroke or maybe just remove the strokes, I really do not like the strokes because they are not making it look really good enough and modern website do not have these kinds of strokes."*
Participant 3	*"The design is appealing"*
Participant 3	*"The "and" symbol is mixed with the background and the rest are all fine."*
Participant 4	*"I feel the design is quite outdated and heavy. Minimal works for me and more importantly navigation. I was lost at some point whilst trying to accomplish some tasks and I could not go back to my last page. I needed to either click menu to get back to my homepage."*
Participant 5	*"I love the colours used and more importantly the exchange feature is so cool."*

Table 4 First Usability Test Task Responses

TASK 1	TASK 2	TASK 3	TASK 4
P2: *"I think about the homepage, the top header where the profile and cart should be lower than this. It's way too high as it's not that visible and I feel the profile and message are quite congested, it should be spaced out."*	P3: *"I was very confused. After clicking so many links I got to know that kind of option is available to exchange."*	P1: *"I would like the if the search bar…like its too big for me, maybe we can add a search icon in the upper part of the status behind the profile. Because here when I scroll, I would prefer if I can see the whole screen, no search bar."*	P4: *"It showed saved and added but no pop-up notification anywhere to affirm it."*
P4: *"I think the UI design can be better improved."*	P4: *"It was complicated but I believe should not be a problem."*		
	P5: *"I think this process is quite lengthy for a new user. A shorter method would go really well."*		
TASK 5	**TASK 6**	**TASK 7**	**TASK 8**
P1: *"It is very detailed and easy to perform".*	P3: *"Every time I don't want to go to PlayStation 5 and then scroll to find the game, it's a lengthy process. It should be in the game section"*	P2: *"I think it would be a lot easier if the message would be on the top right button beside the profile so it would be a lot easier for me to check my message, I don't want to use my time to go through this stress so maybe adding that feature would be better"*	P2: *"I think would prefer if I have the reviews first and the seller's information next because if I have to reach out to him, first I would read the review to see if he is a legit seller, so after that, I would contact him."*
P5: *"Adding the filter icon to the search bar so anyone can as well search from hence giving them more options."*		P5: "I could recall seeing this in my profile but for better accessibility. I would definitely opt for a message icon, button or link somewhere around the homepage and menu."	P2: *"If possible, I would prefer to have buttons instead of the send a message link as it makes it much clearer."*

5.2.2 Task Success

Task success is one the most popular performance metrics in usability and UX evaluation and It evaluates how well users are able to carry out specific series of tasks (Tullis and Albert 2013, p.65).

According to Tullis and Albert (2013 p72), one of the easiest ways of measuring task success is using levels of success measurement as follows:

- Complete Success (With assistance)
- Complete Success (Without assistance)
- Partial Success (With assistance)
- Partial Success (Without assistance)
- Failure (User thought it was complete, but it wasn't)
- Failure (User gave up)

In this study, levels of task success were measured and it was found that users mostly needed an assistance for "Exchanging a product (Task 2)", "List a product for selling and exchanging (Task 3)", and "Checking the messages (Task 7)". Therefore, task 2, task 3, and task 4 should be enhanced in terms of usability. In the previous section, recommendations were listed to improve usability and UX of the prototype. On the other hand, users did not need any assistance for task 1, 4, 5, and 8 as it is seen from the figure below.

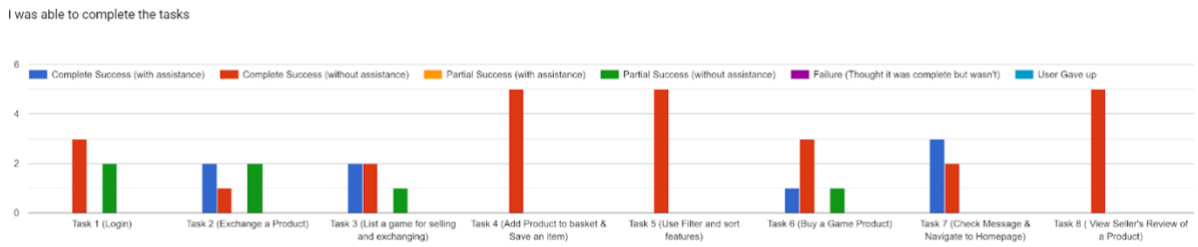


Figure 15 Levels of Task Success (First Test)

5.2.3 Post-Test Survey Analysis

This survey consists of 21 closed-ended questions to measure the user experience and usability metrics quantitatively and 4 questions are open-ended for measuring qualitative data in terms of user experience and usability. This study was conducted with 5 people and individuals were asked to

evaluate their own user experience after using the prototype. Users responded to a 5-point Likert scale for each quantitative question. The higher score indicates the better usability and user experience.

First Post-test Survey		Overall Score (Mean)
Learnability		4,2
Effectiveness		4,2
Efficiency		4,6
Memorability		4
Errors		4
Satisfaction		4,4
Accessibility		4.1
All questions		
Mean: 4.15		
Median: 4.2		
Mode: 4.4		

Table 5 First Post-test Survey Quantitative Data

When the responses to usability components were analysed, it was found that the average response was above 4 as it can be seen from the Table 2. It was revealed that the participants generally found the application effective and useful.

However, in terms of information architecture, it was found that the average scores are below 4 band. Users had difficulties to get information quickly. Respondents could not get enough information for each screen. Additionally, the information provided was not very sufficient for users. The data shows that the information architecture of the prototype should be revised.

Furthermore, after analysing positive and negative emotions responses, it was found that 60% of the users had difficulties in understanding the prototype and only 40% replied as easy to use. On the other hand 60% found the application as useful and enjoyable. The data demonstrates that even if users had difficulties in understanding and completing some tasks on the prototype, their satisfaction rate did not decrease. According to Nielsen (2012), usefulness consists of utility and usability. He states that utility means a product provides the features needed, usability is how easy and pleasant to use the features of that product, and useful is the combination of utility and usability. As we can see from the data collected, a system or product might not be easy to use in order to be useful.

In terms of features and functionality, 2 respondents rated “Excellent”, 2 respondents rated “Good”, and 1 respondent rated “Average”. The data indicates that respondents are satisfied with the functionality and features of the application.

Users mostly rated the “Ease of Use” and “Navigation” as “Average”. It can be concluded from the data that navigation structure should be improved.

Figure 16 Overall Experience

In terms of aesthetics, users were satisfied with the use of colour and visual appeal. However, compared to other applications the aesthetics remained on average.

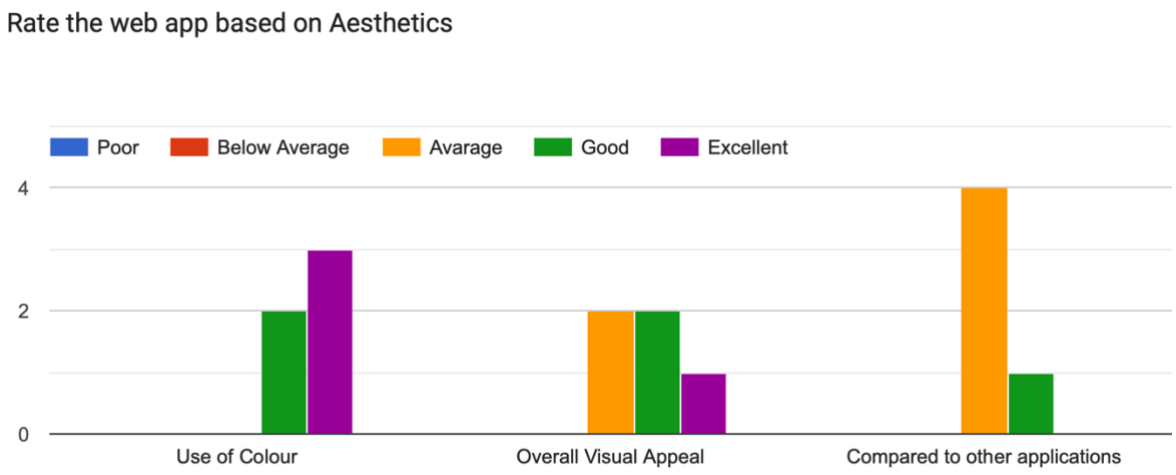


Figure 17 Aesthetics

After the quantitative data analysis, qualitative data was analysed. Respondents mostly liked the exchange feature, detailed product pages, login process, saving items, and buying features. On the other hand, users did not like the positions of the buttons, search bar, and the notification system. According to the responses, the exchange feature will make users to use the application more. Users also suggested some changes on the application to improve their user experience. The recommendations are as follows:

- Adding a notification system
- Changing the search bar
- Working on call to action buttons
- Improving Category section
- Enhancing UI design

Before conducting the second usability session, the prototype was redesigned according to the recommendations and pain points.

5.3 Second Usability Test

First, prior to the usability session, pre-test interviews were held to collect data on participant demographics, video game familiarity, and e-commerce experience patterns.

The information acquired indicates that the testers are young adults with at least a bachelor's degree and are all between the ages of 18 and 35. All of our testers are familiar with e-commerce websites and video games, all of them are male and they speak English. Participants have been recruited from a target demographic that has been identified in user research. The data was analysed using the qualitative inductive coding method with affinity diagrams and tables.

5.3.1 Results and Data Analysis

Finding 1: Difficulty in navigating the application especially back to the home

Upon completing most of these tasks, especially after accomplishing the task of listing an item for selling and exchanging, users were confused on how to get back to the homepage as there was no sort of backlink or button. This most times leads to having to guess and take a more lengthy process of login into the account or through the menu options before they can get back on track. Aside from Navigating back to the homepage, users faced general navigation issues when they clicked on the categories such as the PlayStation or Platform category, and they had difficulty in returning to either the previous page or the home screen. Most times this led them to take the longer process which could be time-consuming.

Recommendation 1: Adding a “back to shopping” feature at the end of every important task and also a back icon to aid freedom of navigation.

Adding the back-to-shopping feature at the end of these tasks will clearly communicate to users to head back to the homepage to either keep shopping or carry out other activities. Adding a back icon also would aid navigation to a certain level.

Finding 2: “Exchange a Product” feature was not so obvious

Though it was way easier to exchange a product this time than the first iteration, users still faced difficulty in finding this feature hence had to guess to accomplish the task which took longer time and also left few of them confused. According to the words of one of the participants, “The Exchange a product” should be placed at the top of the menu especially if it is considered an important feature.

Recommendation 2: Adjusting the “Exchange a Product” feature to the top of the menu

Adjusting this feature to the top of the menu and also placing a form of hierarchy with either the colour or type form would aid and ensure that this particular feature is very visible to the users and easily accessible even by first time users.

Finding 3: The “Text Label” was confusing and also inconsistent.

Users got confused about the “Selling & Exchanging” feature and the “List a Product” feature leading to the same page but the text label was inconsistent which led to some sort of confusion. Same thing happened with the “Exchange Offer” as its misguided users to clicking it in hopes to get the the Exchange a product feature.

One of the participants also noted that the label “selling and exchanging” gives the impression that you could perform the task of both selling a product and exchanging a product via that link whereas that was not the essence of the link hence leading to confusion and misdirection.

Another notable text label issue would be the List an item. One of the participants shared his frustration about how the “list an item” did not go as expected. He felt the list an item feature should literally lead to selecting an already listed item and then putting it up for sale, more like a one way sort of action.

Users also observed the “my account” and the “profile icon” to be repetitive and also inconsistent, in a bid to return to the homepage, participants clicked the profile icon which sometimes led to the login page and my account page as well. that is to say the outcome of that icon or text label is not consistent across the application and this can be really confusing to the user deciding what direction a particular action would lead to.

Recommendation 3a: Replacing the “selling and exchanging” text label to “Create a New Listing with a plus icon” and making it consistent across the application.

Recommendation 3b: Replacing “Exchange Offers” with “Notification” instead as this would serve both the exchange offer and also help users get updated about their activities.
Recommendation 3c: Add a “Logout” button or icon” to the menu page and also in the profile page.

Recommendation 3d: Adding a back icon that leads to the homepage.

Other Findings and Recommendations

- No notification icon or button to notify user of their activities

Users noted that there is literally nothing to show that they performed any activity on the application or give them a sense of update on their latest activity. Including a notification button or icon that shows a blue or red dot on either the profile or menu icon to notify the users of a new notification or message.

- Menu hierarchy

The visual hierarchy can be improved on the menu section. Additionally, different colours might be used on the menu.

Table 6 Second Usability Test Overall User Experience Responses

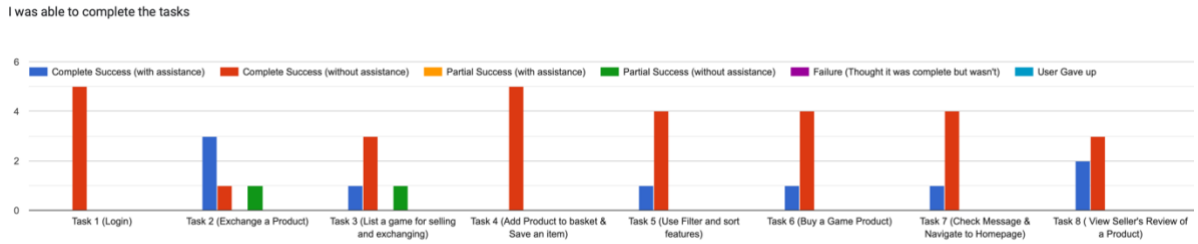
Participant 1	*"Another colour can be used in menu, probably a different colour."*
Participant 1	*"The homepage is actually very nice."*
Participant 2	*"There should be some sort of hierarchy in the Menu. The menu part should be worked on."*
Participant 2	*"Overall I love Interface Design. It's definitely cool"*
Participant 3	*"I think what could be improved would be the filter in the search feature."*
Participant 3	*"I think the overall experience is good. The task was easy to accomplish and the homepage is appealing"*
Participant 4	*"I think the interface is really beautiful and really appealing and the categories were really thoughtful. The experience was exciting for me"*
Participant 5	*"Overall, it's good."*
Participant 5	*"I think adding a home button or icon would be helpful."*

Table 7 Second Usability Test Task Responses

TASK 2	TASK 3	TASK 6	TASK 7
P2: *"I should not be seeing the buy now when it's in an exchange category"*	P2: *"I think there's a better way to present the information actually. It could have been easier if the Content was like CREATE A NEW LISTING with probably a plus icon."*	P1: *"I'd prefer to see what the screenshot of what the game is like."*	P2: *"If I get a new message, there is no notification icon to show I got a message. I think it's important to have that as well to stay updated."*
P2: *"If it's an important task, then it should be at the top to catch the user's attention immediately."*	P4: *"It was complicated but I believe should not be a problem."*		P4: *"I think it's not fast loading back to my homepage from the message."*
	P5: *"I think this process is quite lengthy for a new user. A shorter method would go really well."*		P5: *"The task of checking my message was super easy but navigating back seemed rather lengthy"*

5.3.2 Task Success

When levels of task success were compared to the task success of the first usability test, there is an increase in the success rates of Task 1, Task 3, Task 6, and Task 7. However, users needed assistance with exchanging a product (Task 2) and some users were able to complete the task with assistance. It can be concluded from the levels of task success rates that exchanging a product still needs improvements for better usability and UX. Additionally, functionality and features for listing a product should be enhanced as well.



5.3.3 Second Post-Test Survey Analysis

The user experience and usability metrics are measured quantitatively in this survey using 41 closed-ended questions, while the user experience and usability metrics are measured qualitatively using 9 open-ended questions. Five participants were recruited for this study, and after utilising the prototype, each was asked to rate their personal user experience. For each quantitative question, users responded on a 5-point Likert scale. Better usability and user experience are indicated by a higher score. This survey is more comprehensive than the previous post-test survey. It allows for measuring perceived usability metrics in a more detailed way.

Second Post-test Survey		**Overall Score (Mean)**
Learnability		4,4
Effectiveness		4
Efficiency		4,2
Memorability		4,6
Errors		4
Satisfaction		4,2
Accessibility		4.3
All questions		
Mean: 4.22		
Median: 4.4		
Mode: 4.4		

Table 8 Second Post-test Survey Quantitative Data

As it is seen from the table above, although there are more questions in this survey, overall average scores slightly increased compared to the previous survey.

Positive and negative emotional responses demonstrate that only one respondent found the application difficult to understand and only two respondents found the application easy to use. Compared to the first survey, “easy to use” remained the same and “difficult to understand” decreased to one respondent. On the other hand, 60% found the application as useful as it was in the previous survey.

As it is seen from Figure 6, the overall experience increased in terms of navigation structure and ease of use after adjustments to the navigation and the menu. However, interactivity has an average score which should be improved in terms of information architecture and interaction design. On the other hand, users liked the features and functionality of the application in this survey as well.

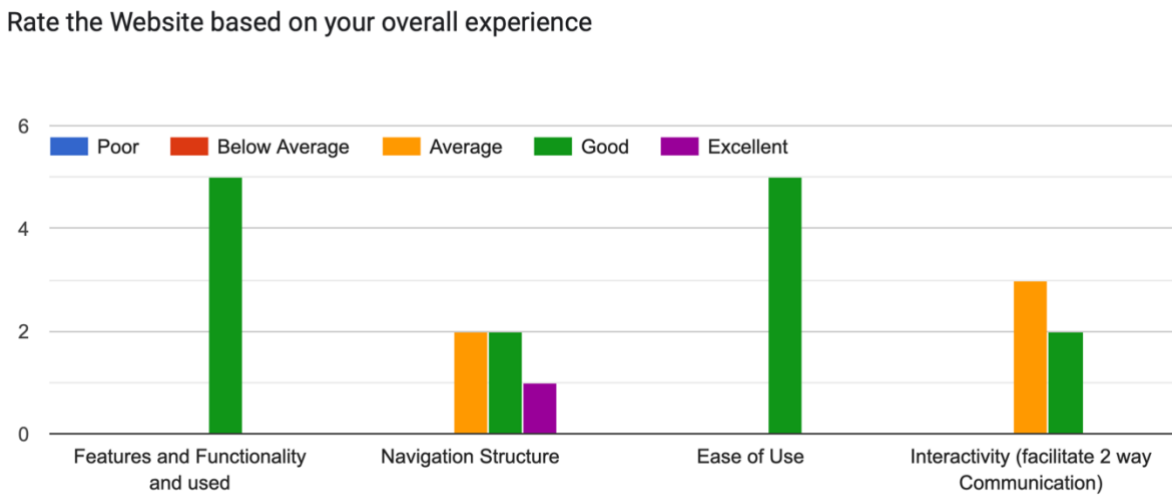


Figure 18 Second Survey Overall Experience

Respondents rated the aesthetics of the application higher than in the previous survey. This shows an improvement in the aesthetics of the website after changes in heading positionings, product card colours, and other minor visual adjustments through the prototype.

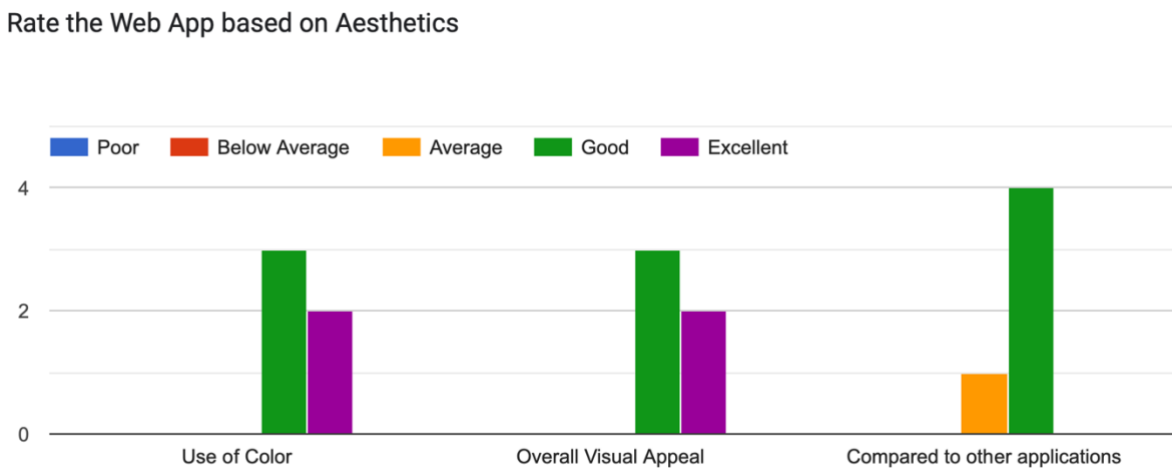


Figure 19 Aesthetics Second Survey

As for qualitative data analysis, 3 users stated that they liked the exchange feature the most whereas 1 user liked the buying feature and 1 user liked the navigation bar the most. What users did not like about the application was the repetition of login and home button navigating to the home page. Users also suggested some changes to the application as follows:

- The exchange and selling label is confusing. Exchanging labels should be placed in an obvious place.
- Screenshots of the gameplay of the games.
- Ease of navigation.
- Home icon or button

As a result, users were satisfied with the exchange feature which is the main feature of this web application and project. However, this feature still needs improvements for better user experience and usability. Enhancing information architecture and navigation may contribute to the improvement of the exchange feature. On the other hand, adding icons and buttons for navigating to the home page could increase the overall usability.

5.4 Single Ease Question (SEQ)

The Single Ease Question (SEQ) is a 7-point grading system used to determine how difficult an activity is for users (Sauro 2012).

SEQ is a powerful method in two ways (Laubheimer 2018):

- Since the answers are gathered after each activity, participants let us compare which elements of the interface (or workflows) are thought to be the most difficult.

- Participants are better equipped to express their perspectives about the experience right after the activity ends because their minds will not be clouded by following tasks.

As it is seen from Table 8 below, task 2 (exchange a product) and task 7 (checking messages) had a significant increase in terms of ease of use after the first usability test adjustments on the prototype. A new page only for exchangeable items was added to the menu section and labelled "Exchange Items", so, it was easier for users to find exchangeable items by checking the menu. However, usability test findings indicate that exchanging a product process still needs improvements. On the other hand, after the first usability testing feedback was collected, the "My Account" section was added to the menu which contains the inbox to check the messages easily.

FIRST USABILITY TEST SEQ				(P=Participant)		(1 Very difficult- 7 Very Easy)		
P1	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	7	4	7	7	7	7	5	7
P2	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	7	4	6	6	6	7	4	6
P3	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	7	3	4	7	7	6	5	7
P4	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	6	5	7	7	7	6	4	7
P5	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	6	3	7	7	6	4	6	7
SECOND USABILITY TEST SEQ				(P=Participant)		(1 Very difficult- 7 Very Easy)		
P1	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	7	7	7	6	7	6	7	7
P2	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	6	6	5	5	6	7	7	7
P3	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	5	5	7	7	5	7	7	7
P4	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	6	7	7	7	7	7	6	7
P5	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8
	6	7	4	7	7	7	5	7

Table 9 Single Ease Question

5.5 System Usability Scale (SUS)

The System Usability Scale (SUS) is one of the most popular questionnaires utilised in user experience research. John Brooke is credited with creating it and the validity and dependability of SUS have been established experimentally since the 1980s interface era (Laubheimer 2018).

According to Sauro (2011), SUS can be applied to very small sample sizes (as few as two users) and still produce trustworthy findings because sample size and reliability are unrelated. Small sample numbers, however, result in inaccurate estimates of the SUS score for the unknown user group (Sauro 2011).

The absolute meaning of a SUS score could also be understood by using a letter grade scale rather than an adjective scale (Bangor, Kortum and Miller 2009, p.122).

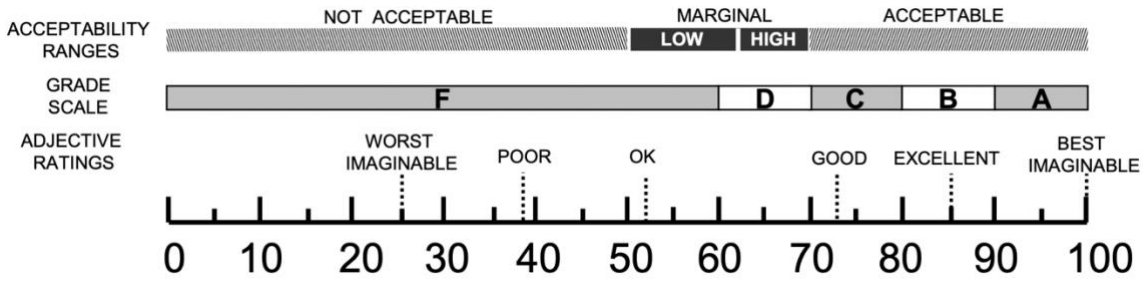


Figure 20 SUS Score (Bangor, Kortum and Miller 2009)

Sauro (2012) conducts 500 studies and he finds that the average SUS score is 68. Anything with a SUS score of 68 or higher would be regarded as above average, whereas anything with a score of 68 or lower would be considered below average (Sauro 2012).

In this study, 10 respondents rated our SUS questionnaire and it was calculated that the SUS score was 84.25 (see Appendix L). This score is equivalent to a B grade which means almost excellent usability. However, this test only measures perceived usability which means the subjective user experience. On the other hand, large sample size and fully functional live application might result in different scores.

6 CONCLUSIONS

This study aimed to design and critically evaluate a C2C gaming e-commerce web application prototype with an “exchange” feature in terms of usability and user experience. By analysing the usability and user experience metrics collected from usability tests, surveys and interviews, it can be concluded that exchanging gaming products among users can be possible and beneficial for gaming enthusiasts with the help of this web application. It was also found that respondents and participants of this research wanted to use this web application not only for exchanging gaming items but also for selling and buying features. Additionally, the data analysis demonstrated that the web application had an 84.25 SUS score in terms of perceived usability and user experience. Moreover, post usability test surveys demonstrated that usability components and metrics (learnability, effectiveness, efficiency, memorability, error tolerance, satisfaction, accessibility, task success etc.) had above 4 points on a 5-point Likert scale. However, the usability test findings also illustrate that the features of the application should be improved for better usability and UX.

On the other hand, the research aim was achieved by using the design thinking methodology. This methodology assisted in identifying and solving user challenges and issues in their e-commerce experiences. Additionally, 5 distinct and iterative steps of the design thinking methodology aided the project to achieve a systematic user-centred design process.

Furthermore, exploring the UX principles, laws, psychological and ethnographical factors in HCI, as well as government guidelines and professional standards in design, data protection, and accessibility, contributed to the designing of the prototype in professional standards.

As the literature was reviewed, the studies mainly focused on B2C e-commerce live websites and it was found that there was a lack of C2C e-commerce studies as well as usability and user experience evaluations for prototypes. Additionally, after conducting market research as competitor analysis, it was found that some B2C gaming e-commerce platforms allow exchanging gaming items, however, these platforms do not allow consumers to exchange gaming items with other consumers. Therefore, this web application was designed to allow game enthusiasts to exchange, buy, or sell their gaming products. This research and the web application could also contribute to the literature and the digital industry in terms of specific cases in C2C e-commerce, features, and usability and UX findings.

6.1 Limitations

This research is not exempt from any limitations. The main limitations of this study are the sample size of usability tests, the number of iterations in the process, and usability and UX evaluation methods. The tests might result in different findings if they are tested with larger sample sizes. On the other hand, if the number of iterations increases, the number of issues identified and solved may increase as well. More iterations might result in achieving better usability and user experience. Due to the time and financial constraints, recruiting more participants and conducting more usability and user experience evaluations using different methods such as eye tracking, heuristics evaluation by usability experts, A/B testing, time on task, and various usability questionnaires could not be possible experiments in this research.

6.2 Future Work

Due to time and financial constraints, many various modifications, testing, and experiments have been postponed for future work. Recommendations for further studies can be listed as follows:

- Experiment with different usability and UX evaluation methods such as eye-tracking, heuristics evaluation, different usability measurement questionnaires, and A/B testing.
- Testing the usability with large sample groups.
- Measuring the time on tasks with a fully functional live application.
- Designing a desktop version and evaluating it in terms of usability and user experience.
- Coding the web application and testing the fully functional live version.
- Conducting a study on cost-effectiveness compared to B2C gaming e-commerce platforms.

7 REFERENCES

ABUZEID, S.A.H., 2017. *Criteria Affecting of User Experience Design of E-Commerce in Sudan*, Sudan University of Science & Technology

ACOSTA-VARGAS, P., SALVADOR-ACOSTA, B., SALVADOR-ULLAURI, L. and JADÁN-GUERRERO, J., 2022. Accessibility challenges of e-commerce websites. *PeerJ Computer Science*, *8*, pp.1-21.

ALLEN, J. and CHUDLEY, J., 2012. *Smashing UX design : foundations for designing online user experiences.* Chichester: Wiley

ALLEN, J.J. and J.J. CHUDLEY, 2012. *Smashing UX Design: Foundations for Designing Online User Experiences.* John Wiley & Sons

AUERBACH, C. and SILVERSTEIN, L.B., 2003. *Qualitative data: An introduction to coding and analysis* (Vol. 21). NYU press.

BABATUNDE, A., O. ABIKOYE and O. FALAJU, 2019. Usability evaluaton of users' experience on some existing E-Commerce platforms. *Library Philosophy and Practice,* 2019

BANGOR, A., P. KORTUM and J. MILLER, 2009. Determining what individual SUS scores mean: Adding an adjective rating scale. *Journal of usability studies,* 4(3), 114-123

BROWN, T., 2022. *Design Thinking Defined* [viewed 27 June 2022]. Available from: https://designthinking.ideo.com

BULEY, L., 2013. *The User Experience Team of One: A Research and Design Survival Guide*. Brooklyn N.Y: Rosenfeld Media.

BULUT, Z. and B. ONARAN, 2017. *The Link Between Consumers' Online Shopping Behaviours And E-Servicescape In C2c E-Commerce: Evidences From Turkey*.

CAI, L., HE, X., DAI, Y. and ZHU, K., 2018. Research on B2B2C E-commerce website design based on user experience. In *Journal of Physics: Conference Series*(Vol. 1087, No. 6, p. 062043). IOP Publishing.

CHANDLER, C., 2015. *A field guide to user research*. Freiburg, Germany: Smashing Magazine

CHEN, J., 2021. *Heuristics* [viewed 9 June 2022]. Available from: https://www.investopedia.com/terms/h/heuristics.asp

CHEN, R. and LIU, J. 2015. *Personas: Powerful Tool for Designers.* In: SWAN, S. et al. *Design Thinking: New Product Development Essentials from the PDMA.* Hoboken: John Wiley & Sons, Incorporated, pp.1k-3c

COHN, M., 2004. *User stories applied: For agile software development*. Addison-Wesley Professional.

CRESWELL, J. W. and CRESWELL, J. D., 2018. *Research design: Qualitative, quantitative, and mixed methods approaches*. 5th ed. Thousand Oaks, CA: SAGE Publications.

DAM, R.F. and SIANG, T.Y., 2022. *What is Design Thinking and Why is it so popular?*[viewed 5 July 2022]. Available from: https://www.interaction-design.org/literature/article/what-is-design-thinking-and-why-is-it-so-popular

DELVETOOL, 2022. *The Essential Guide to Coding Qualitative Data* [viewed 31 August 2022]. Available from: https://delvetool.com/guide

FROST, B., 2016. *AtomicDesign* [viewed 30 August 2022]. Available from: https://atomicdesign.bradfrost.com/chapter-2/

GOODMAN, E., M. KUNIAVSKY and A. MOED, 2012. *Observing the User Experience, Second Edition: A Practitioner's Guide to User Research.* San Francisco, CA, United States: Morgan Kaufmann Publishers Inc.

GOV.UK, 2018. *Understanding accessibility requirements for public sector bodies* [viewed 13 August 2022]. Available from: https://www.gov.uk/guidance/accessibility-requirements-for-public-sector-websites-and-apps

GUPTA, M.P. and A. DUBEY, 2016. E-commerce-study of privacy, trust and security from consumer's perspective. *International Journal of Computer Science and Mobile Computing, Vol.5 Issue.6, June-2016, pg. 224-232*

GURUNG, A., 2006. *Empirical investigation of the relationship of privacy, security and trust with behavioral intention to transact in e-commerce.* The University of Texas at Arlington

GUY-EVANS, O., 2022. *Pareto Principle* [viewed 10 September 2022]. Available from: https://www.simplypsychology.org/pareto-principle.html

GRUDIN, J., 1987. Social evaluation of the user interface: who does the work and who gets the benefit?. In *Human–Computer Interaction–INTERACT'87* (pp. 805-811). North-Holland.

HALIBAS, A.S., MAATA, R.L. and SIBAYAN, R.O., 2016. Usability evaluation of selected Oman-based eCommerce websites. *Asian Journal of Business and Management*, *4*(4), 142-151.

HARTSON, R. and P. PYLA, 2012. *The UX Book: Process and Guidelines for Ensuring a Quality User Experience.* Elsevier Science

HASSO PLATTNER INSTITUTE OF DESIGN, 2016. *An Introduction to Design Thinking Process Guide* [viewed 27 June 2022]. Available from: https://web.stanford.edu/~mshanks/MichaelShanks/files/509554.pdf

HUANG, J. and WANG, X., 2022. User Experience Evaluation of B2C E-Commerce Websites Based on Fuzzy Information. *Wireless Communications and Mobile Computing*, *2022*, pp.1-10.

ICO.ORG.UK, 2022. *Cookies* [viewed 10 August 2022]. Available from: https://ico.org.uk/your-data-matters/online/cookies/

INTERACTION DESIGN FOUNDATION, 2012. *Gestalt Principles* [viewed 10 September 2022]. Available from: https://www.interaction-design.org/literature/topics/gestalt-principles?gclid=CjwKCAjw1ICZBhAzEiwAFfvFhG8mQNO5Ctp61VgMYPEzmpp2s78KddwK-ycU3cLf6kcY0YlFBOpNhBoCDDcQAvD_BwE

INTERACTION DESIGN FOUNDATION, 2022. Fitts' Law [viewed 10 August 2022]. Available from: https://www.interaction-design.org/literature/topics/fitts-law

INTERACTION DESIGN FOUNDATION, No date. *What is Skeuomorphism* [viewed 9 June 2022]. Available from: https://www.interaction-design.org/literature/topics/skeuomorphism

ISO, 2018. *ISO 9241-11:2018(en) Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts* Available from: https://www.iso.org/obp/ui/#iso:std:iso:9241:-11:ed-2:v1:en

ISO, 2018. *ISO 9241-11:2018(en) Ergonomics of human-system interaction — Part 11: Usability: Definitions and concepts* [viewed 9 June 2022]. Available from: https://www.iso.org/obp/ui#iso:std:iso:9241:-11:ed-2:v1:en

KELLEY, D. and KELLEY, T., 2022. *How do people define design thinking* [viewed 27 June 2022]. Available from: https://designthinking.ideo.com/faq/how-do-people-define-design-thinking

KRATHWOHL, D.R., 2002. A Revision of Bloom's Taxonomy: An Overview. *null,* 41(4), 212-218

KRUG, S., 2014. *Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability.* 3rd ed. Thousand Oaks, CA, United States: New Riders Publishing

KUROSU, M. and K. KASHIMURA, 1995. Apparent usability vs. inherent usability: experimental analysis on the determinants of the apparent usability. *Conference companion on Human factors in computing systems.* pp.292-293

LAUBHEIMER, P., 2018. *Beyond the NPS: Measuring Perceived Usability with the SUS, NASA-TLX, and the Single Ease Question After Tasks and Usability Tests* [viewed 10 September 2022]. Available from: https://www.nngroup.com/articles/measuring-perceived-usability/

LAW, E.L.C., ROTO, V., HASSENZAHL, M., VERMEEREN, A.P. and KORT, J., 2009. Understanding, scoping and defining user experience: a survey approach. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 719-728).

LEONARD, L.N. and JONES, K., 2014. Consumer-to-consumer e-commerce: Acceptance and intended behavior. *Communications of the IIMA*, *14*(1), pp.1-19.

LEAVY, P., 2017. *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches.* Guilford Publications

LEVY, J., 2015. *UX strategy: How to devise innovative digital products that people want.* O'Reilly Media, Inc.

MCLEOD, S., 2008. *Serial Position Effect* [viewed 12 September 2022]. Available from: https://www.simplypsychology.org/primacy-recency.html

MOCZARNY, I.M., DE VILLIERS, M.R. and VAN BILJON, J.A., 2012. How can usability contribute to user experience? A study in the domain of e-commerce. In *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference* (pp. 216-225).

MORAN, K., 2019. *Usability Testing 101* [viewed 10 September 2022]. Available from: https://www.nngroup.com/articles/usability-testing-101/

MORAN, K., 2019. *Usability Testing 101* [viewed 8 June 2022]. Available from: https://www.nngroup.com/articles/usability-testing-101/

MORVILLE, P., 2004. *Seven Facets of User Experience* [viewed 9 June 2022]. Available from: https://semanticstudios.com/user_experience_design/

MOURYA, S.K. and S. GUPTA, 2014. *E-Commerce.* New Delhi: Alpha Science International

NEMAT, R., 2011. Taking a look at different types of e-commerce. *World Applied Programming,* 1(2), 100-104

NIELSEN, J., 1993. *Usability Engineering.* San Francisco: Morgan Kaufmann

NIELSEN, J., 2000. *End of Web Design* [viewed 31 August 2022]. Available from: https://www.nngroup.com/articles/end-of-web-design/

NIELSEN, J., 2000. *Why you only need to test with 5 users* [viewed 12 September 2022]. Available from: https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/

NIELSEN, J., 2012. *Usability 101 Introduction to Usability* [viewed 10 September 2022]. Available from: https://www.nngroup.com/articles/usability-101-introduction-to-usability/

NIELSEN, J., 2020. *10 Usability Heuristics for User Interface Design* [viewed 9 June 2022]. Available from: https://www.nngroup.com/articles/ten-usability-heuristics/

NIRANJANAMURTHY, M. *et al.,* 2014. Research study on importance of usability testing/User Experience (UX) testing. *International Journal of Computer Science and Mobile Computing, IJCSMC,* 3(10), 78-85

NORMAN, D. and NIELSEN, J., 1998. *The Definition of User Experience (UX)* [viewed 3 June 2022]. Available from: https://www.nngroup.com/articles/definition-user-experience/

OFFICE FOR NATIONAL STATISTICS, 2021. *E-commerce and ICT activity, UK: 2019* [viewed 3 June 2022]. Available from: https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/ecommerceandictactivity/2019

PAPAIOANNOU, E., GEORGIADIS, C.K., ASSIMAKOPOULOS, C. and MANITSARIS, A., 2014. Maximization of users experience in websites: estimating the optimum size of the multimedia content. *Electronic Commerce Research*, *14*(1), pp.87-109.

PERDANA, RA and SUZIANTI, A., 2017. Analysis of usability factors affecting purchase intention in online e-commerce sites. *IOP Conference Series: Materials Science and Engineering*, vol. 185, no. 1, 012015.

PROJECTMANAGER.COM, 2022. *Waterfall Model* [viewed 4 September 2022]. Available from: https://www.projectmanager.com/guides/waterfall-methodology

RAZZOUK, R. and V. SHUTE, 2012. What is design thinking and why is it important? *Review of educational research,* 82(3), 330-348

RUBIN, J. and D. CHISNELL, 2008. *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests.* 2nd ed. Indianapolis, IN: Wiley Publishing Inc.

SALDANA, J., 2009. *The coding manual for qualitative researchers.* Sage Publications Ltd.

SAURO, J., 2011. *Measuring Usability with the System Usability Scale (SUS)* [viewed 12 September 2022]. Available from: https://measuringu.com/sus/

SAURO, J., 2012. *10 Things To Know About The Single Ease Question (SEQ)* [viewed 10 September 2022]. Available from: https://measuringu.com/seq10/

SCHNEIDER, J., 2017. *Understanding Design Thinking, Lean, and Agile.* First ed. CA, USA: O'Reilly Media, Inc.

SHNEIDERMAN, B., PLAISANT, C., COHEN, M.S., JACOBS, S., ELMQVIST, N. and DIAKOPOULOS, N., 2016. *Designing the user interface: strategies for effective human-computer interaction*. Pearson.

SCHWARTZ, B. and WARD, A., 2004. Doing better but feeling worse: The paradox of choice. *Positive psychology in practice*, *86*, p.104.

SOEGAARD, M. 2021. *Hick's Law: Making the choice easier for users* [viewed 10 May 2022]. Available from: https://www.interaction-design.org/literature/article/hick-s-law-making-the-choice-easier-for-users

STATISTA.COM, 2021. E-commerce in the United Kingdom (UK) [viewed 1 July 2022]. Available from: https://www.statista.com/study/22340/e-commerce-in-the-united-kingdom-uk-statista-dossier/

STATISTA.COM, 2021. *Video game market value in the United Kingdom (UK) from 2016 to 2025* [viewed 5 June 2022]. Available from: https://www.statista.com/statistics/282068/value-of-the-video-game-market-in-the-united-kingdom-uk/

STATISTA.COM, 2021. Video gaming in the United Kingdom (UK) [viewed 5 June 2022]. Available from: https://www.statista.com/study/18484/gaming-market-in-the-united-kingdom-statista-dossier/

STONE, D. *et al.,* 2005. *User interface design and evaluation.* Elsevier

STURDEE, M. and J. LINDLEY, 2019. Sketching & drawing as future inquiry in HCI. *Proceedings of the Halfway to the Future Symposium 2019.* pp.1-10

SYAHRINA, A. and T.F. KUSUMASARI, 2020. Designing User Experience and User Interface of a B2B Textile e-Commerce using Five Planes Framework. *INTERNATIONAL JOURNAL OF INNOVATION IN ENTERPRISE SYSTEM,* 04(01), 44-55

TERMENS, M., RIBERA, M., PORRAS, M., BOLDÚ, M., SULÉ, A. and PARIS, P., 2009, April. Web content accessibility guidelines: from 1.0 to 2.0. In *Proceedings of the 18th International Conference on World Wide Web* (pp. 1171-1172).

TRACTINSKY, N., A.S. KATZ and D. IKAR, 2000. What is beautiful is usable. *Interacting with Computers,* 13(2), 127-145

TRAVIS, D., and HODGSON, P., 2019. *Think Like a UX Researcher: How to Observe Users, Influence Design, and Shape Business Strategy*. London: CRC Press

TUCH, A.N. *et al.,* 2012. Is beautiful really usable? Toward understanding the relation between usability, aesthetics, and affect in HCI. *Computers in Human Behavior,* 28(5), 1596-1607

TULLIS, T. and W. ALBERT, 2013. *Measuring the User Experience, Second Edition: Collecting, Analyzing, and Presenting Usability Metrics.* 2nd ed. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.

UX DESIGN INSTITUTE, 2020. *Affinity diagrams: Everything you need to know* [viewed 31 August 2022]. Available from: https://www.uxdesigninstitute.com/blog/affinity-diagrams-everything-you-need-to-know/

UXTOOLS.CO, 2021. *Design Tools Survey 2021* [viewed 30 August 2022]. Available from: https://uxtools.co/survey-2021/

VASIĆ, N., KILIBARDA, M. and KAURIN, T., 2019. The influence of online shopping determinants on customer satisfaction in the Serbian market. *Journal of Theoretical and Applied Electronic Commerce Research*, *14*(2), pp.70-89.

VISUAL-PARADIGM.COM, 2022. *What is User Story?* [viewed 6 May 2022]. Available from: https://www.visual-paradigm.com/guide/agile-software-development/what-is-user- story/

WALLIMAN, N., 2018. *Research methods : the basics*. London: Routledge

W3C, 2018. *Accessibility* [viewed 16 August 2022]. Available from: https://www.w3.org/standards/webdesign/accessibility

WEINSCHENK, S., 2011. *100 Things Every Designer Needs to Know About People* . Berkeley, CA: Pearson Education

WOODSIDE, A.G., 2017. *Case study research : core skills in using 15 genres*. 2nd ed. Bingley: Emerald Group Publishing Limited

YABLONSKI, J., 2020. *Laws of UX: Using Psychology to Design Better Products & Services.* O'Reilly Media, Incorporated

YABLONSKI, J., 2022. *Parkinson's Law* [viewed 12 September 2022]. Available from: https://lawsofux.com/en/parkinsons-law/

YABLONSKI, J., 2022. *Von Restorff Effect* [viewed 12 September 2022]. Available from: https://lawsofux.com/en/von-restorff-effect/

ZAINUDIN, N.M., AHMAD, W.F.W. and NEE, G.K., 2010. Evaluating C2C e-commerce website usability in Malaysia from users' perspective: A case study. In *2010 International Symposium on Information Technology* (Vol. 1, pp. 151-156). IEEE.

9. APPENDICES

9.1 Appendix C

User Interviews Pilot Study

User Interview 1

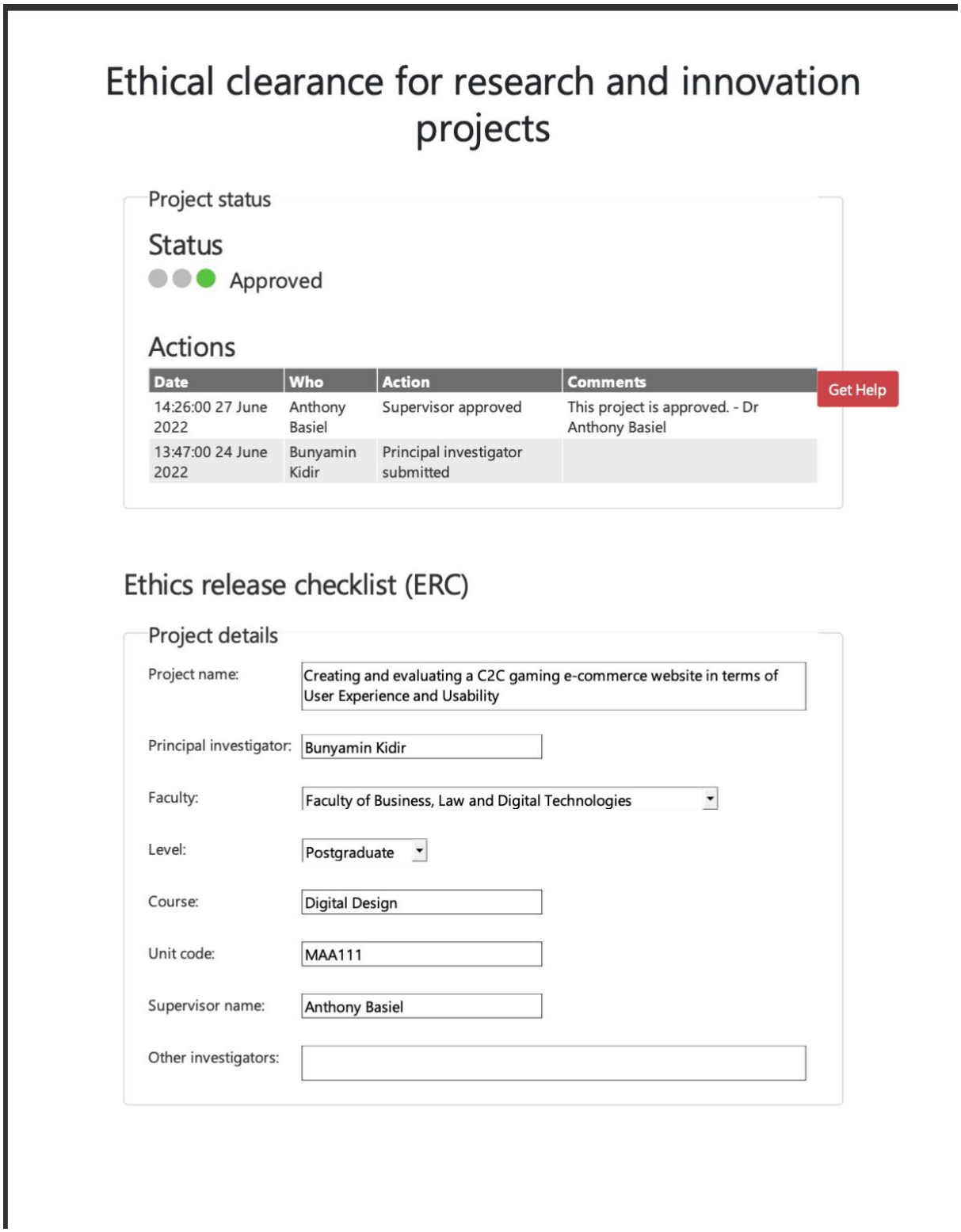
Q:	How often do you play video games?
A:	More than once a week.
Q:	Where do you like to shop for gaming products?
A:	Online
Q:	How often do you use e-commerce websites?
A:	More than once a week
Q:	How do you engage as?
A:	As a buyer
Q:	Which device do you prefer to use when visiting an e-commerce website?
A:	Mobile
Q:	Would you like to get in touch with other people through an e-commerce website to exchange your gaming products?
A:	Maybe, but I am not sure because I need to trust to the website and the people on the website. Even if I meet people in person, the products I will get might be broken or not functioning properly. Reliability of the website is also important.
Q:	What kind of features do you want to see on a gaming e-commerce website in terms of exchanging gaming products between users?
A:	Advanced searching and product filtering is very important for me. I always want to search for specific stuff.
Q:	Which features of an e-commerce website are most important to you?
A:	Payment methods should be reliable and secure. I would love to see a wide range of products. Stock availability is also another important thing for me.
Q:	Which features of an e-commerce website are most least important to you?
A:	I don't remember any unimportant things.
Q:	What can be done to improve your user experience on e-commerce websites?
A:	The number of product pictures should be sufficient, the description should be relevant to the product, and the product features should be well described, how often the item was used and the condition of the product should be on the page.
Q:	What kind of design do you expect to see on a gaming e-commerce website?
A:	I would love to see multiple categorisations for game genres such as rpg, fps etc., and filtering. And I also expect to see upcoming game trailers, and gaming pictures on the website

User Interview 2

Q:	How often do you play video games?
A:	Once a week.
Q:	Where do you like to shop for gaming products?
A:	Online
Q:	How often do you use e-commerce websites?
A:	Once a week
Q:	How do you engage as?
A:	As a buyer
Q:	Which device do you prefer to use when visiting an e-commerce website?
A:	Mobile
Q:	Would you like to get in touch with other people through an e-commerce website to exchange your gaming products?
A:	I definitely would. As you know, games are a great stress relief tool for a person, as well as an entertainment method that is extremely exciting and opens up one's horizons. Unfortunately, it is not easy for everyone to access this entertainment area in today's conditions, due to both its price and the fact that it is inaccessible (such as PS5). In addition, the covid 19 pandemic, which affected the whole world, caused inflation in every country, and people now have a living problem. I believe that exchanging the things we have (game, console,) in this way will make it easier for everyone to access this entertainment tool. Think about it, you can play thousands of games without taking a huge amount of money out of your pocket. When I look at it from my own point of view, I can say that it will be a method that I will use with pleasure as a gamer.
Q:	Which features of an e-commerce website are most important to you?
A:	First of all, the diversity, that is, the presence of many users. When there is no variety in terms of the products and games I am looking for on such a platform, it would just be a waste of time for me to use that site. In addition, it is functional and easy to use. I don't want to get lost on the website
Q:	Which features of an e-commerce website are most least important to you?
A:	I don't know, from my point of view, everything seems very important
Q:	What can be done to improve your user experience on e-commerce websites?
A:	As I said, the sort and filter parts are some of the most important details for me, and many websites I come across use these two functions very badly. most of the time I can't find the right product I'm looking for. I would prefer it to be more usable in this regard. In addition, there is sometimes an excessive color mix in the website design and this is very eye-catching. When I come across such a website, I immediately close it.
Q:	What kind of design do you expect to see on a gaming e-commerce website?
A:	A simpler website, both in terms of color and content density. Instead of seeing hundreds of products on one screen, I would like to see fewer products with more detail.

9.2 Appendix D

Ethical Clearance



Ethical clearance for research and innovation projects

Project status

Status

Approved

Actions

Date	Who	Action	Comments
14:26:00 27 June 2022	Anthony Basiel	Supervisor approved	This project is approved. - Dr Anthony Basiel
13:47:00 24 June 2022	Bunyamin Kidir	Principal investigator submitted	

Get Help

Ethics release checklist (ERC)

Project details

Project name: Creating and evaluating a C2C gaming e-commerce website in terms of User Experience and Usability

Principal investigator: Bunyamin Kidir

Faculty: Faculty of Business, Law and Digital Technologies

Level: Postgraduate

Course: Digital Design

Unit code: MAA111

Supervisor name: Anthony Basiel

Other investigators:

Checklist

Question	Yes	No
Q1. Will the project involve human participants other than the investigator(s)?	◉	○
Q1a. Will the project involve **vulnerable participants** such as children, young people, disabled people, the elderly, people with declared mental health issues, prisoners, people in health or social care settings, addicts, or those with learning difficulties or cognitive impairment either contacted directly or via a **gatekeeper** (for example a professional who runs an organisation through which participants are accessed; a service provider; a care-giver; a relative or a guardian)?	○	◉
Q1b. Will the project involve the use of **control groups** or the **use of deception**?	○	◉
Q1c. Will the project involve any **risk to the participants' health** (e.g. intrusive intervention such as the administration of drugs or other substances, or vigorous physical exercise), or involve psychological stress, anxiety, humiliation, physical pain or discomfort to the investigator(s) and/or the participants?	○	◉
Q1d. Will the project involve **financial inducement** offered to participants other than reasonable expenses and compensation for time?	○	◉
Q1e. Will the project be carried out by individuals unconnected with the University but who wish to use staff and/or students of the University as participants?	○	◉
Q2. Will the project involve sensitive materials or topics that might be considered offensive, distressing, politically or socially sensitive, deeply personal or in breach of the law (for example criminal activities, sexual behaviour, ethnic status, personal appearance, experience of violence, addiction, religion, or financial circumstances)?	○	◉
Q3. Will the project have detrimental impact on the environment, habitat or species?	○	◉
Q4. Will the project involve living animal subjects?	○	◉
Q5. Will the project involve the development for export of 'controlled' goods regulated by the Export Control Organisation (ECO)? (This specifically means military goods, so called dual-use goods (which are civilian goods but with a potential military use or application), products used for torture and repression, radioactive sources.) Further information from the Export Control Organisation '	○	◉
Q6. Does your research involve: the storage of records on a computer, electronic transmissions, or visits to websites, which are associated with terrorist or extreme groups or other security sensitive material? Further information from the Information Commissioners Office '	○	◉

Declarations

I/we, the investigator(s), confirm that:

☑ The information contained in this checklist is correct.

☑ I/we have assessed the ethical considerations in relation to the project in line with the University Ethics Policy.

☑ I/we understand that the ethical considerations of the project will need to be re-assessed if there are any changes to it.

☑ I/we will endeavor to preserve the reputation of the University and protect the health and safety of all those involved when conducting this research/enterprise project.

☑ If personal data is to be collected as part of my project, I confirm that my project and I, as Principal Investigator, will adhere to the General Data Protection Regulation (GDPR) and the Data Protection Act 2018. I also confirm that I will seek advice on the DPA, as necessary, by referring to the Information Commissioner's Office further guidance on DPA and/or by contacting information.rights@solent.ac.uk. By Personal data, I understand any data that I will collect as part of my project that can identify an individual, whether in personal or family life, business or profession.

☑ I/we have read the prevent agenda.

9.3 Appendix E

Affinity diagrams

[Figma Affinity Diagram]

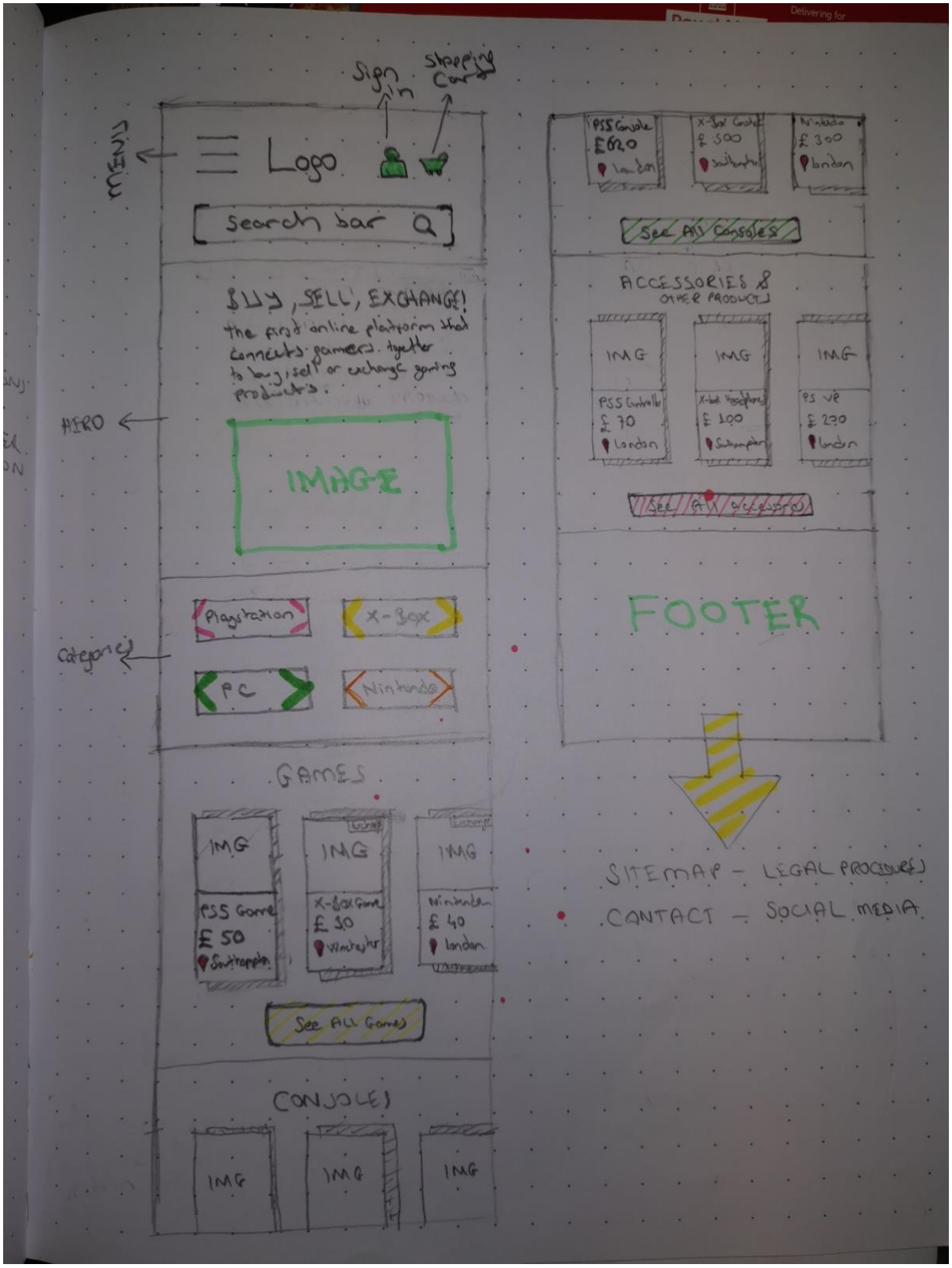
Excel Qualitative Coding

[Excel Qualitative Coding]

9.4 Appendix F

9.5 Appendix G

[Sketches]



9.6 Appendix H

First and Second Usability Test Questions and Responses

9.7 Appendix I

Empathy Map

User Journey Flows

TASK OFFER EXCHANGE FOR GRAN TURISMO 7 PLAYSTATION 5 GAME

Timelines	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	step 7	step 8	step 9
Actions	Open App	Login/Sign- Up	Click Playstation	click playstation 5 Games	Click Gran Turismo Game	Click on offer Exchange	Tick on item lyou intend to offer	Click on Send	click on back to shopping
Interfaces	Mobile App Icon	Form Field	Playstation Button	Playstation 5 Game card	Gran Turismo Game Card	Offer Exchange Button	Check box	Send Icon	Back to shopping link
Channel	Phone	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App
Experience	😑	😑	😑	😑	😐	🙂	🙂	🙂	😌

TASK LIST A GAME FOR SELLING AND EXCHANGING

Timelines	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 9	
Actions	Open App	Login/Sign- Up	Click menu	click selling & exchanging	Click on List an item	Create your listing	click on list your item	click on profile	
Interfaces	Mobile App Icon	Form Field	Menu Button	Selling & Exchanging	List an Item Button	Form Field	List your item button	Profile Icon	
Channel	Phone	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	
Experience	😑	😑	😑	😑	😐	🙂	🙂	😌	

TASK BUY ASSASSIN CREED VALHALLA PLAYSTATION 5 GAME

Timelines	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9
Actions	Open App	Login/Sign- Up	Click Playstation	click playstation 5 Games	Click Assassin creed valhalla Game	Click on Buy now	fill your payment details	Click on Pay Now	confirm your order and click on back to shopping
Interfaces	Mobile App Icon	Form Field	Playstation Button	Playstation 5 Game card	Assassin creed valhalla Card	Buy Now Button	form Field	Pay Now Button	Back to shopping Button
Channel	Phone	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App	Mobile App
Experience	😑	😑	😑	😑	😐	🙂	🙂	🙂	😌

9.8 Appendix J

USABILITY SESSION TRANSCRIPTS

9.9 Appendix K

Unmoderated Usability Session Videos

9.10 Appendix L

System Usability Scale Questions and Responses