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Gamifying Social Media for Users on Sustainability

-A design science research for social media platforms

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ABSTRACT (MAX. 200 WORDS):
At present, social media platforms pay more and more attention to convey sustainable concepts to users, and at the same time, gamification is a popular interaction approach to attract users, then the purpose of this research is to explore how to leverage gamification into social media to make users sustainable, and the target audiences are the enterprises of social media. The entire study is a design science research covering the questionnaire survey and interviews, this is devoted to formulating an artifact to solve the problem in this study. After conducting the empirical research, the final contribution is a framework to guide social media platforms on how to design and improve some functions through gamification to influence users to become sustainable. The framework can be mainly divided into two parts, design and verification. The design model aims to show the overall process how to follow step by step, while the verification model means to analyze the effectiveness of existing work for improvement.

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1 Introduction

1.1 Background

The time people spend on social media per day was dramatically growing between 2012 and 2019, and the number of users has also increased more than 9%, that is 321 million persons on a global scale (Statista, 2020). Social media is the platform to spread information, the information on it will have a lot of influence on users, including behavior, decision-making, habits, etc (Power & Philips-Wren, 2011). This means that more and more people may be affected by many aspects of social media, and the degree of social media's influence will increase as well. On one hand, social media can convey new ideas to users through interactive modes, including culture and beliefs, values, religion, and politics, etc (Carr & Hayes, 2015; Chukwuere & Chukwuere, 2017). On the other hand, social media influences people's lifestyle, interpersonal relationships, and consumption intentions (Kulandairaj, 2014; Rudenkin, 2018; Akbarov, 2020). Not only that, but many companies were aware of the impact of social media on users, so these companies have tried to use social media to show their sustainable strategies to users, and have achieved good results (Wheeler & Quinn, 2017; Shan, Peng, & Wei, 2019; Ruggeri & Samoggia, 2018).

Sustainability is significant for various objectives, such as the country, the enterprise, the people, and the environment (Surampalli, Zhang, Goyal, Brar, & Tyagi, 2020). The stable and sustainable development of a country could ensure the balance between environmental stability and economic development, so as to ensure the overall stability of society (Ekardt, 2020). If the sustainability of the society cannot be realized, it may lead to the decline of people's happiness and even the inability to maintain their current lifestyle (Ayers, 2017a). Also, economic growth is very important for sustainable economic development. It not only provides a pillar for the generation and development of enterprises, but also has an impact on people's life quality, including life expectancy, education, income, etc. (Kemp & Nurius, 2015). Moreover, from 2012 to 2017, content related to sustainability posted on social media has increased year by year (Calcagni, Amorim Maia, Connolly & Langemeyer, 2019). Thus, users of social media are becoming more and more accustomed to using social media to communicate sustainability, and the sustainability of social media has also attracted the attention of relevant researchers.

There were already some existing examples of social media conveying sustainable concepts and ideas to users, such as Alibaba Group's "Ant Forest" function. In 2016, Alibaba Group's Alipay, a social media platform, officially launched the "Ant Forest" function. The carbon emissions saved by users by walking instead of driving, paying fees online, buying tickets online, etc. will be calculated as virtual "green energy", which would be used to grow virtual trees in their mobile phones. After the virtual tree is grown, Alibaba would plant a real tree on earth to inspire users to behave in a low-carbon way. In 2019, "Ant Forest" was awarded the United Nations' top environmental honor in the inspiration and action category (UN Environment, 2021). By the end of May 2020, Ant Forest has more than 550 million participants, and has planted and maintained more than 200 million real trees, covering an area of more than 1,827 square kilometers (SINA, 2020).

In fact, gamification is to use game-style mechanisms to motivate people to participate in non-game environments and activities (Deterding, Khaled, Nacke, & Dixon, 2011a). Social media platforms integrating this kind of gamification have been shown to highly affect users' sustainable concepts and behaviors through the above data. Moreover, in recent years, as a developing research topic in the field of information systems, gamification has been studied on how to be used to influence people's actions and achieve sustainability (Owen, 2013). On one hand, a number of research have shown that gamification has significant persuasive power for users in multiple fields to pay attention to sustainability, including fields such as education, tourism, and even IT (Maria, Juan, Magdalena & Maria, 2020; Bruno, Miguel, Catia & Nuno, 2019; Nystrom, 2017). On the other hand, some studies have tried to combine social media and gamification to influence user habits, including education, medical treatment, and diet (Kurniawan & Widyani, 2017; Sitorus, Ferdiana & Adji, 2017; Nour, Rouf, & Allman, 2018). It can be said that the potential for gamification's impact on social media platforms and the dissemination of sustainable ideas is considerable.

Thus, the value of gamification to the sustainability of social media communication was seen. Therefore, this research is based on previous research and social media users' attitudes towards social media, gamification, and sustainability, to explore the connection between these three. This research will start from the impact of social media on users and how gamification affects users, and further explore how social media can use gamification, and how gamification can promote the sustainability of users, and finally achieve a combination of the three.

1.2 Problem statement

Sustainability is significant to economic development, social stability, and people's living standards (Surampalli, Zhang, Goyal, Brar, & Tyagi, 2020). Nowadays, people are increasingly worried about the reduction of natural resources, the impact of companies on the environment or social inequality, and individuals increasingly hope to play a more active role in the transition to a sustainable future (Handelman & Arnold, 1999). Moreover, people are becoming more and more interested in environmental issues such as climate change, sustainability, and "going green", which was reflected in the unprecedented increase in interest in new channels such as online social media (Fraser, 2011; Wenzel, 2009). Meanwhile, Torneire (2020) also pointed out that individual actions can make a significant and positive contribution to sustainable development, and individual commitment and awareness are necessary to achieve truly sustainable development. In other words, as a member of a family, a community, and a country, individuals can play a considerable role in sustainability issues (Williams et al., 2014).

And social media is a medium that allows individuals to participate in sustainability, because it has become an important part of people's lives and makes information very easy to be spread quickly (Force, 2016; Siddiqui & Singh, 2016). First of all, social media platforms, as enterprises, have the responsibility and obligation of sustainability (Ei-Zeind, 2012). As can be seen from the corporate social responsibility (CSR) and sustainability reports of social media companies, most of these social media companies, such as Facebook and Twitter, have formulated some strategies and goals for their sustainable development (Facebook, 2019; Twitter, 2020; Tencent, 2019; ByteDance, 2020). However, there is little literature showing that they have specific practices in suggesting their users to become sustainable. It can be seen

that social media is far from adequate in influencing users' sustainable ideas and behavior. However, social media plays a vital role in changing people's lifestyles (Force, 2016; Siddiqui & Singh, 2016). Williams et al. (2014) believed that social media is very useful for individuals that are committed to advancing green causes. The studies of Siddiqui and Singh (2016), Power and Phillips-Wren (2011) showed that social media can affect people's decision and willingness to do something, thus affecting everyone's lifestyle, especially young people (Wojdan, Wdowiak, Witas, Drogon, & Brakowiechi, 2021). Therefore, social media has significant potential to influence people's sustainable thinking and behavior in many ways. Firstly, social networks can put pressure on people's behavior, especially for people who are moving upwards rapidly in society (Bartiaux, 2008). The environmental news, social and environmental behaviors of companies that people discover through social media would push them to strengthen their practices (Linich, 2013). Secondly, as has been pointed out by the study from Zapico, Turpeinen, and Brandt (2009), simplifying behavior, guiding and praising behavior, and providing advice for decisions can encourage certain thoughts and behaviors of users, such as environmentally friendly behavior. Also, social media has the potential to provide instant feedback and combine it with goal setting to encourage reflection and provide information that supports action (Mankoff, Matthews, Fussell, & Johnson, 2007).

The above-mentioned ways of changing people's behavior such as promoting practice through news, encouraging sustainable behavior through simplification of behavior, guidance and praise, and providing feedback on behavior are all in line with the gamification elements proposed by Sitorus et al. (2017). Gamification, as a way to change people's behavior and motivation by stimulating people's interest, enabling people to obtain certain results or incentives (Owen, 2013), is a popular means in social media. Many studies have proved that adding gamification features to social media can achieve a variety of goals, such as attracting users' attention, increasing user loyalty and engagement, and even influencing users' behavior in social media (Bista, Nepal, Colineau & Paris, 2012; Kim, 2015; Silva, Analide, Rosa, Felgueiras & Pimenta, 2013b). Moreover, in the field of sustainability, gamification has been used as a set of incentive techniques to stimulate interests and actions that are beneficial to sustainability, such as encouraging residents to save energy through gamified reward mechanisms (Froehlich, 2015). A study by Mattila (2019) also showed that gamified applications motivate users to increase the number of green actions in their daily life. In this case, social media could use gamification to influence users' sustainable concepts and behaviors to make them sustainable.

To sum up, most studies have focused on two of the three aspects of "social media, sustainability, and gamification", but there were few studies on how social media has or should be used to influence users' sustainable behavior. Moreover, even though it can be found from life practice that some social platforms have already used gamification features to influence users. For example, Ant Forest affected the behaviors of users through gamification, encouraging users to choose to walk instead of driving in their lives, and pay bills online instead of offline. Even so, it can be seen from the above discussion that social media still lacks the ability to influence users' sustainable lifestyles, because they currently pay more attention to macroscopic sustainable strategies and lack attention to user-level impacts. Based on the above discussion, this research problem can be viewed as a research gap for IS workers to investigate the interaction between society and technology, that is, how social media affects the users to be sustainable through gamification. In order to fill this knowledge gap, the authors attempt to fully explore the nature of these connections and provide opportunities for

further research, to make better use of gamification in social media to more effectively influence users' sustainable actions and live a sustainable lifestyle.

1.3 Research purpose

The purpose of this research is to explore how to leverage gamification into social media to make users become sustainable. The knowledge contribution of this study is that by studying how social media companies influence users' sustainable lives through gamification, a framework for social media companies to follow can be drawn, and to spread the idea of achieving sustainability through gamification. This also means that the target readers of this study are mainly social media companies, and the results of this study are expected to guide them on how to design and improve some functions through gamification to influence users to become sustainable.

1.4 Research question

In summary, our research question is as follow:

What guidelines can social media follow when using gamification to influence users to become sustainable?

1.5 Delimitations

Firstly, this study focuses on social media platforms, excluding the companies who use social media platforms as a method to promote and achieve their sustainable aims. Although investigating companies using social media might be interesting, it would detract from our research purpose: to provide a framework for social media platforms to follow. In addition, Carpenter, Takahashi, Cunningham, and Lertpratchya (2016) also proposed that social platforms have a greater possibility of influencing users than other companies. Secondly, gamification is the only method that was studied in this research, which means other methods that can achieve sustainability for social media companies will not be studied in this research. Even though there are many ways to deliver sustainable ideas, gamification can be a powerful engagement tool that motivates people and increases their awareness and engagement (Lu & Ho, 2020). Finally, although sustainability is generally considered to be three aspects (Giovannoni & Fabietti, 2013), this research does not focus on one or some specific aspects of sustainability. This study only examines how such ideas are communicated to users and the impact they have.

1.6 Thesis outline

This research totally contains six essential chapters. Chapter 1 is about formulating the research gap and depicting research purpose and questions. Chapter 2 describes the

methodology of the research in detail, including the guiding methods for data collection and analysis. Then Chapter 3 is the literature review, providing the overall theoretical background, and formulating a basement framework for further research. Next, Chapter 4 is about empirical data and findings from the whole research, and Chapter 5 discussed results to obtain the comprehensive contributions of this research. Finally, Chapter 6 is the conclusion to summarize all of the actions in this work.

2 Methodology

In this chapter, the methodology used in this paper is described in detail. In Section 2.1 and 2.2, the theoretical basis of part of the methods used in this study are discussed, and then the research design, data collection and analysis methods of this article are introduced in the following parts step by step. At the end of this chapter, the scientific quality of research and the ethical issues involved in the research process are also discussed.

2.1 Design science

In the fields of information systems that are devoted to improving the effectiveness and efficiency of an organization (Hevner, March, Park & Rem, 2004), there are complementary and different paradigms, behavioral science and design science (March & Smith, 1995). Among them, design science is a problem-solving paradigm and would be used in this work, so that this work would be a design science research. The general process of conducting the design science research is to create innovative artifacts for expanding the boundaries of human and organizational capabilities (Hevner et al., 2004), furthermore, the artifacts of design science always have a deep link with contexts (Wieringa, 2014). And there is another saying that "*Design science is the scientific study and creation of artifacts as they are developed and used by people with the goal of solving practical problems of general interest.*" (Johannesson & Perjons, 2014, p. 20).

Holistically, Wieringa (2014) outlined the framework (shown Figure 2.1). It suggested that the social context means all stakeholders that would have an influence on the project or be affected by it, consisting of possible users, operators, and so on. In the central part, it split design science into design and investigation that differed from the ideas of Hevner et al. (2004). Then, the knowledge context contains existing theories from science, current designs' specifications, plain common sense, etc. (Vincenti, 1990). In conclusion, the design science project is based on knowledge to develop, and alternatively, the consequence of design science can complement knowledge. Similarly, Hevner (2007) framed the design science research overview as three inherent cycles (shown Figure 2.2). The Relevance Cycle and Rigor Cycle are respectively bridged contextual environments and knowledge base with Design Cycle. Centrally, the Design Cycle is the ongoing iteration of artifacts designing and evaluating.

In particular, March and Smith (1995) identified two main processes of design science research, *build*, and *evaluate*. The artifacts with purposes aim to address unsolved problems so that the evaluation is to check the efficiency and utility of artifacts. And Hevner and Chagtterjee (2010) redefined the process into six steps. The first one is problem identification and motivation, by scoping the research problem to justify the value of the artifacts. Then the second thing is to define the objectives for a solution to convey possible and feasible knowledge. Thirdly, it is the central step to design and develop artifacts. Among them, there are four potential artifacts that can be included, constructs, models, methods, instantiations. Constructs contribute to providing the language for defining and communicating the problems and solutions (Schon, 1984). Models mean representing the real-world situation by constructs to assist in understanding the problem and solutions (Simon, 2019). And methods are to

define the process and guidelines on how to solve the problem. Finally, instantiations cover the above three artifacts to show the feasibility and the assessment of final results (Hevner et al., 2004). Then the fourth step is to demonstrate the artifacts for solving one or more examples of problems. Fifthly, the following one obviously is an evaluation to measure how well the artifact supports a solution to the problem. Eventually, the utility and novelty of artifacts need to be communicated with the stakeholders to represent the artifact and contribute to disciplinary knowledge.

When implementing the design science research, there are some similar frameworks asserted by other scholars to guide the process as well. Johannesson and Perjons (2014) designed a framework for any design science project consisting of four major components. The first part is all logical activities with well-defined input and output. There are many overlaps between these activities and the six-step process proposed (Hevner & Chatterjee, 2010). The waterfall operations are explicating problems, defining requirements, designing and developing artifacts, demonstrating artifacts, evaluating artifacts. And then the remaining three parts are guidelines for operating activities, the selection of research strategy and methods, and relating with the existing knowledge base.

At the same time, there are seven guidelines claimed by Hevner et al. (2004) as the criteria of evaluation. Overall, the artifacts should be creative and innovative (guideline 1) in the relevant problem domain (guideline 2). The utility of proposed artifacts should be rigorously evaluated (guideline 3). The contributions should be original or novelty (guideline 4), and the artifacts should be formally represented, coherent, internally consistent (guideline 5). And the process from defining the problem to reaching the desired end could be tracked (guideline 6). Lastly, the research results and processes should be properly and effectively communicated to all interested parties (guideline 7).

As for the contributions of design science research, Gregor and Hevner (2013) proposed two dimensions, *application domain maturity*, and *solution maturity*, to assess artifacts. There are four levels: Invention (*New Solutions for New Problems*) contribution provides radical innovation manners with novel and unexpected solutions. Improvement (*New Solutions for Known Problems*) contribution is to present a huge upgrade of existing solutions. Exaptation (*Known Solutions Extended to New Problems*) contribution is to describe that the existing solution is repurposed to a new problem context for relatively weaker transformation than formers. Routine Design (*Known Solutions for Known Problems*) contribution is around the incremental innovations, but helpful for practical professional design.

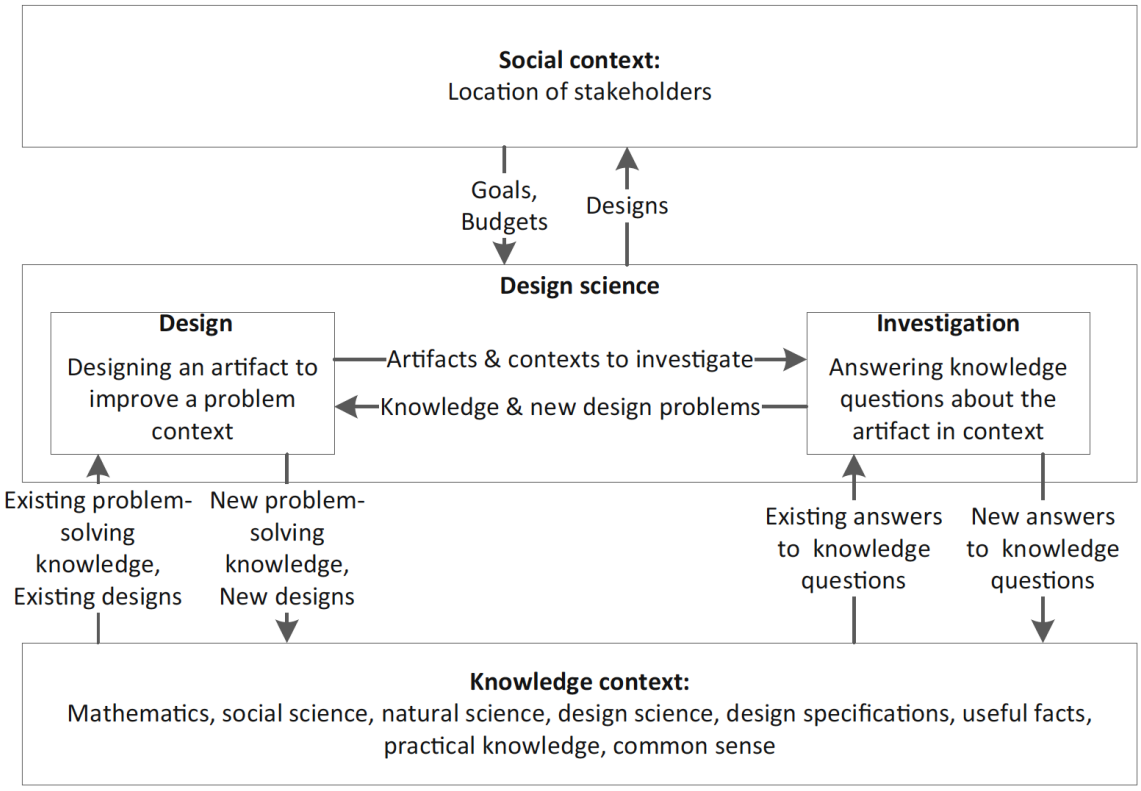


Figure 2.1: A framework for design science (Wierringa, 2014, p. 7)

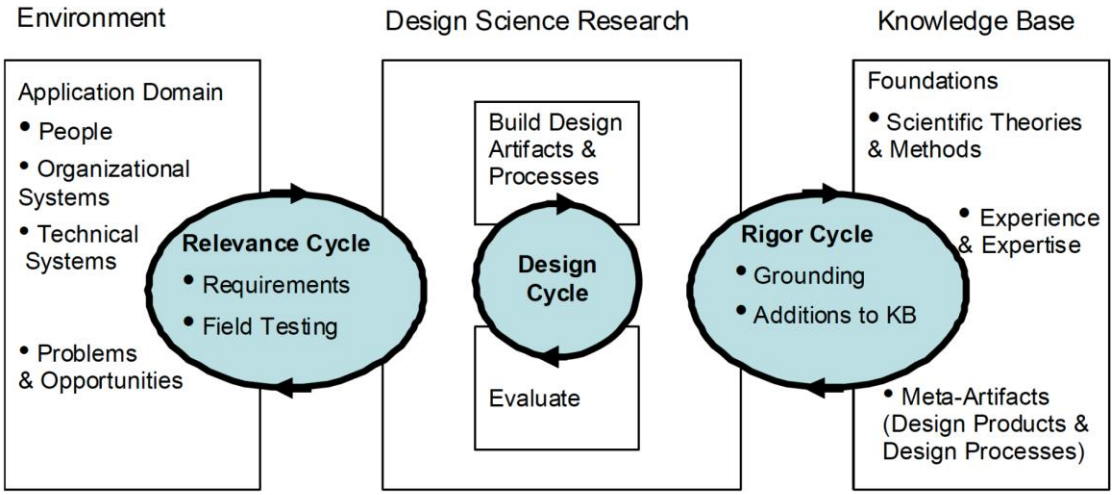


Figure 2.2: Design science research cycles (Hevner, 2007, p.88)

2.2 Prototype design

During the process of conducting the design science research, there is a need to present the idea for the evaluation. In the field of information systems, design thinking is widely defined as an analytic and creative process engaging persons, including two main purposes (Razzouk

& Shute, 2012). One is to better understand characteristics and processes, and the other one is to apply findings from the literature. Among the concepts of design thinking, the prototype is one of the most classical methods. In fact, prototypes are simple samples to represent any design idea or process (Houde & Hill, 1997). In the interaction system, prototypes are tangible models for testing and exploring ideas and gathering feedback before commercial products release (Houde & Hill, 1997). And the model of the prototype is related to three dimensions: the functions of serving (*role*); the sensory experience of using (*look and feel*); techniques and components (*implementation*). They are important aspects for how to design the prototype as the interactive artifact (Houde & Hill, 1997).

In this way, the prototype design would be the performance of design science implementation and play the function of knowledge foundation, under combining social context. In order to address practical problems, the essential goal of the prototype is to apply theories from the literature framework and collect the feedback of user experience for evaluation to develop the final artifact. In other words, the prototype design is the most suitable manifestation to represent and instantiate the initial framework by connecting real-world situations and end-users.

During the design process of the prototype, the target audience should be clarified for shaping the requirements of the prototype design. At the same time, one of the most common tools in the human-computer interaction design of outline and analysis the target audience is personas (Pruitt & Adlin, 2010). Therefore, the persona approach would be used in this prototype design to describe the user as well. In terms, personas are hypothetical archetypes, presenting real people with rigor and precision based on investigations (Friess, 2012). It can be used to communicate with stakeholders easily, and in conjunction with scenarios (Chang & Stolterman, 2008).

2.3 Research design

Since this is a design science research, it is devoted to finding a problem-solving paradigm for social media platforms to adopt by integrating gamification in order to make users live sustainably. Then, the entire research was guided by the concepts and processes of design science. From the perspective of potential artifacts, the output of this research aims to formulate a set of methods to define the process and guidelines on how to convey sustainable concepts by gamification on social media, so that the artifact of this design science research is the complete guiding framework.

All the parts of the research can be divided into three main parts. March and Smith (1995) supposed that the processes of design science research should contain the building and evaluation of the artifact, thus the first two parts are about the building of the artifact and the third part is around the evaluation of the artifact. At the same time, Hevner et al. (2004) split the building into two main sections, design and investigation. Hence, the first part of the research is designing, and the second part is the investigation.

Generally, the artifact is based on the social and knowledge context to develop for improving a problem context. According to the research gap of the literature review from the problem statement, and existing theories and current specifications in the literature review, like the features of social media, sustainability, gamification, and their twisted connections provided a

strong theoretical background to build the initial artifact that how to gamify sustainable social media platforms, and it would be depicted in detail in Section 3.6.

Then the second part is the investigation for answering knowledge questions about the artifact in context. In this work, the quantitative survey was conducted to obtain sufficient data from various types of users towards social media's sustainable gamification, since this kind of approach can quickly access a larger sample at a lower cost, and the results are relatively more objective and accurate (Recker, 2013). Then the answers of the survey investigation could elaborate the initial artifact.

Afterward, Hevner (2007) also mentioned that the Design Cycle is the iteration of artifact designing and evaluating as well. Therefore, the third part is the evaluation to check the efficiency and utility of the artifact. In order to conduct the evaluation stage, a prototype, as a case based on the initial framework and survey results, tries to solve one example of problems to perform the artifact's demonstration. Then the implementation of a qualitative approach is to measure how well the artifact supporting a solution to the problem. In particular, interviews are to collect users' opinions and reveal the meaning of behaviors by inviting interviewees to experience the prototype. Eventually, the artifact would be elaborated on by all of the previous steps, and the framework of gamifying sustainable social media can be seen as the final contribution to address the essential problem in this work.

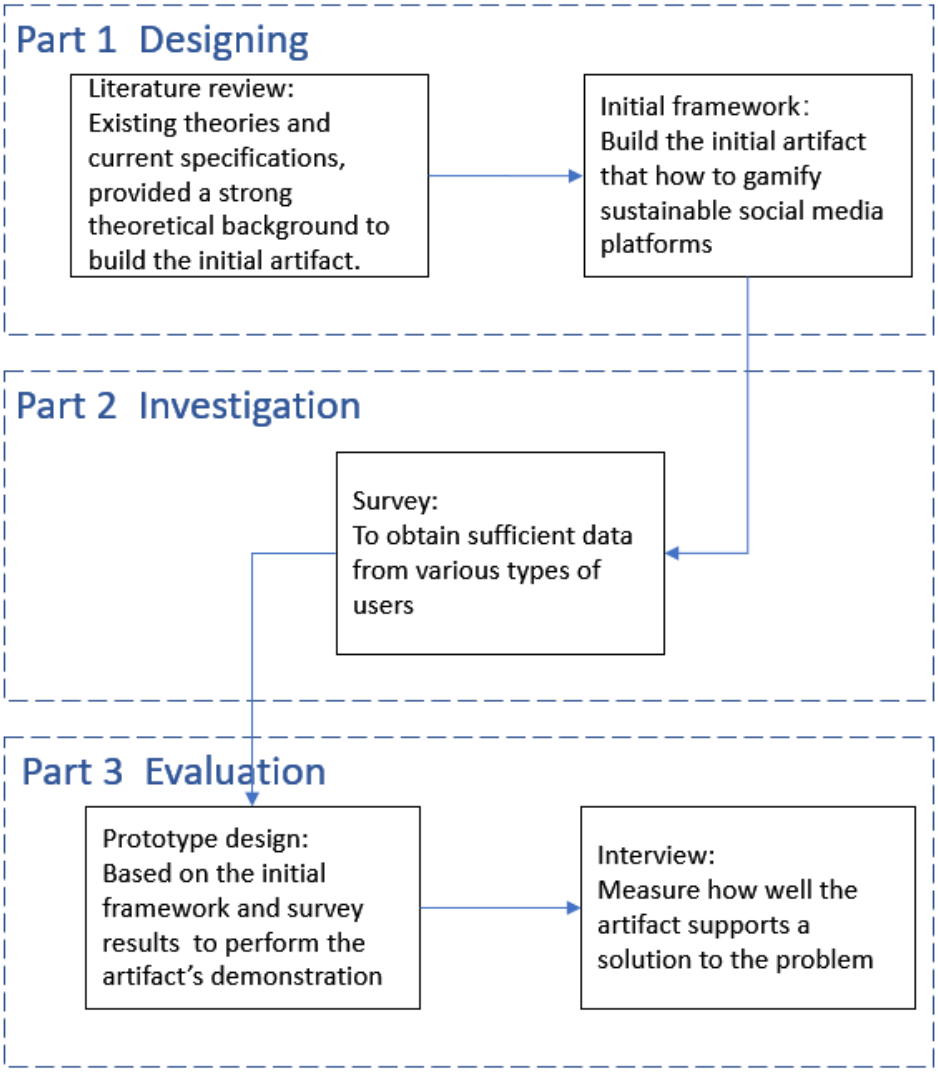


Figure 2.3: Three parts of the method in this study

2.4 Research strategy

In general, a mixed-method was used in this study. There are three main models of mixed-methods in the social sciences: convergent parallel mixed-methods, explanatory sequential mixed-methods, exploratory sequential mixed-methods (Creswell & Creswell, 2018). Explanatory sequential mixed-method was adopted in this study, which means firstly the researchers conducted the design science research by the quantitative approach, analyzed the results, and then built on the results to explain them in more detail by a qualitative approach (Creswell & Creswell, 2018). According to the explanation from Creswell and Creswell (2018), it was considered explanatory because the initial quantitative data results were explained further with the qualitative data. And it was considered sequential because the initial quantitative phase would be followed by the qualitative phase. Since this study was a design science research, before an artifact was to be derived, an investigation stage needs to be done first to provide knowledge support. After the artifact was derived, evaluations need to be done to improve or reflect on the artifact. It followed that the sequential approach was

applicable to this study, i.e., using quantitative methods to collect data in the investigation phase and qualitative methods to obtain feedback in the evaluation phase.

According to Wilson (2010), inductive reasoning aims at developing a theory while deductive reasoning aims at testing an existing theory. In this study, inductive reasoning was adopted to obtain a framework while deductive reasoning was used to test the effectiveness of the prototype.

Recker (2013) pointed out that the research problem is the determining factor, because it is related to the appropriate research approach for each study. The purpose of this study is to explore how social media platforms can influence users to be sustainable through gamification. In order to achieve the purpose of the research, a set of proven and effective theoretical frameworks were expected to be obtained in this research to guide social media platforms through a series of methods and guidelines to influence users to become sustainable through gamification. From this perspective, two important points need to be studied, one is to arrive at a theoretical framework, and the other is to prove that the framework is effective.

2.5 Data collection

In this study, since a mixed method based on pragmatism was used, this study adopted two different data collection methods, one is the survey method as a quantitative method, and the other one is the interview method as a qualitative method.

2.5.1 Literature selection

In order to understand the connection between social media, gamification, and sustainability, some related literature has been reviewed, which was shown in Section 3.5. The literature review is necessary to develop a new framework because the framework development should be based on the research area's current status and existing theories. And literature review can help researchers to understand the current status, existing theories, and research methods of the research area (Recker, 2013).

To ensure the reliability of the literature, literature was collected from several academic databases including LUBSearch, Google Scholar, IEEEXplore, ScienceDirect, ResearchGate, Springer.

Since the research area of this research involves social media, gamification, and sustainability at the same time, the most suitable literature for this research should include these three fields, but it did not exist in actual searches. Therefore, the collection target was expanded to include two of these areas, there are three types of query keywords: "social media" and "sustainability", "social media" and "gamification", "gamification" and "sustainability". Since not all the literature can be used, valuable literature for this study can be obtained through multi rounds of selection. That is, first select the literature by the article name, then read its abstract for a second selection, and finally select the available literature by its introduction and discussion. As stated by Randolph (2009), recording the literature retrieval process in detail can improve the transparency and transferability of research.

2.5.2 Survey

In order to achieve the purpose of this research, the framework should be applicable to most types of social media and could influence the users of most social media platforms. According to the literature, an initial framework could be established but still needs to be improved. Therefore, it is necessary to collect as much as possible the opinions of users of most types of social media.

The survey was adopted as the quantitative method. The survey was designed on Sojump and spread on some social media such as Facebook, WeChat, and Microsoft Teams. Sojump is a widely used survey platform like Survey Monkey, and the reason why Sojump was chosen rather than Survey Monkey or any other survey platform is that only Sojump is accessible for respondents in Asian countries. And the data from the respondents from Asian countries such as China is also valuable for this study because the opinions of users of different social media platforms need to be collected. Also, surveys ensure that as much data and as wide a range of data as possible was collected to obtain a comprehensive user experience and feedback on all aspects.

The purpose of the survey is to complement and validate our initial framework, in order to as the basis for prototyping. Thus, the questions in the survey are posed from the initial framework and its theoretical support. The survey questions are presented in Appendix 1.

To identify the different choice of game elements for different types of people, some background information of participants was collected by questions (1-3) to cross-analyze with other questions, and to verify whether young people are more susceptible to social media (Siddiqui & Singh, 2016). Questions 4-8 have been set to clarify the different user groups of different types of social media, and question 6 can be used to cross-analyze with other questions to give answers from other perspectives. In order to verify the reason why people reject social media advice, questions 9-13 have been set. The results of questions 12-14 can clarify the relationship between feedback and behavior change. Questions 14-21 have been set to explore people's preferences on game elements. While questions 16 and 17 can help to verify whether people are more likely to become sustainable when influenced by social environments and role models (Handelman & Arnold, 2009; Du et al., 2016; Dangelico et al., 2013; Prokesch, 2010; Mount & Martinez, 2014).

Moreover, a snowball sampling technique was used to collect samples as the sampling method. Although there is a risk of interruptions in samples, snowball sampling has a high possibility to reach some hidden population (Dudovskiy, 2018). The survey would be distributed to users of different social media, and then let them distribute to the users using the same social media platforms. The goal is to receive 200 surveys, and finally, 250 surveys were collected.

2.5.3 Interview

Based on the results of the survey, a prototype was designed, and the detail of the prototype was discussed in Section 4.3. The prototype does not involve complex technical implementations but only be used to instantiate the framework at a static level. The prototype was shown and explained to interviewees. The purpose of the prototype design is to make the framework concrete therefore, interviewees can better understand and give some specific

opinions on the prototype. Next, interviews were conducted to collect the ideas of interviewees to evaluate the framework.

A prototype was a simple experimental model of a proposed solution used to test all validate ideas, design assumptions, and other aspects of its conceptualization quickly and cheaply, and can verify the researcher's ideas (Houde & Hill, 1997). The prototype was a practical instantiation to perform the main idea of the framework drawn from the previous steps, at the same time, the framework could be verified by the prototype. JUSTINMIND, which is a designing hi-fi prototype tool for web and mobile apps, would be used for creating the prototype. This tool makes use of all existing interactions, gestures, and transitions available, and can be easily tested on real devices with real interviewees.

Interview, as the most common qualitative method, was adopted as the qualitative method in this research. According to Recker (2013), interviews allow researchers to collect a wealth of information from participants, including participants' feelings, emotions, and thoughts (Oates, 2006).

Interviews can be conducted in one-to-one, one-to-many, face-to-face or phone-based ways (Recker, 2013). Due to the impact of COVID-19, for the safety consideration of both interviewers and interviewees, interviews were conducted via Teams/WeChat or Zoom in the form of video calls. The researchers have also considered the drawbacks of video interviews. During the video call interview, the researchers would not be able to observe some of the interviewee's subtle body movements and lack some non-verbal communication, which makes it difficult for the researchers to feel the interviewee's emotions and thoughts. However, video interview, as a data collection method that was widely considered to be feasible, was still the best choice in this study, because it could not only ensure the safety of participants but could increase the willingness of respondents to participate (Nehls, Smith & Schneider, 2015).

The Quota was the sampling method to choose interviewees. Even if the quota is relatively subjective and sometimes difficult to estimate sampling errors, it could help researchers accurately find members of the sample group that meet the requirement, with high reliability (Dudovskiy, 2018). Also, since the interviews revolve around the participant's experience of using the application, a semi-structured interview method was adopted. Semi-structured interviews are suitable for understanding specific topics in participants' lives (Kvale & Brinkmann, 2009). Semi-structured interviews can not only help to focus the interview process on the subject, but also give participants more opportunities to think and express their opinions.

Five interviewees were willing to participate in the interview. The selected interviewees are young, highly educated, and commonly use social media for information, according to the target audience Persona. The details of the Persona are described in Section 4.3.1. The interviewees range in age from 23 to 30 and are mainly students with a bachelor's degree or above. Some of them have work experience. The one-to-one interview is the first choice to conduct the interview. Also, a one-to-many interview was conducted for the two interviewees Some interviewees' information and interview information were shown in Table 2.1. In order to protect the privacy of interviewees, part of their information was kept confidential according to their willingness.

Table 2.1: Interview information

Respondent	Age	Education	Major	Working experience	Duration	Date	Type
R1	23	Master	Information system	Product assistant internship half year	104 min	May 2nd 2021	One-to-more
R2	25	Master	Sociology	Product manager 1 year	104 min	May 2nd 2021	One-to-more
R3	30	Doctor	Economics	None	54 min	May 3rd 2021	One-to-one
R4	27	Master	social welfare	social welfare 3 years	81 min	May 3rd 2021	One-to-one
R5	29	Bachelor	Service Management	Board game shop owner 4 years	46 min	May 4th 2021	One-to-one

R1 and R2 have working experience as product assistants and product managers in a social media company, thus, they have the capability to provide some opinions from the product perspective. In the interview with them, they were asked more questions about the function than in the interview with other interviewees. R1 and R2 could provide some information about how to design a product to make it more effective to affect users. The interview with R1 and R2 was conducted together as a one-to-more interview, there are two reasons. Firstly, R1 and R2 are friends with each other, thus, when interviewing them together, they could feel relaxed. Secondly, during the interview they were allowed to discuss, when they have different opinions, they could question each other and produce more information, and when they reach a consensus, what they get is more representative. As Frey and Fontana (1991) point out, interactions and responses within a group can help researchers gain valuable information that is unexpected.

According to the guidance of Myers and Newman (2007), the interview should have four steps, and the four steps were followed by us in our interview. The four steps are listed below:

1. The opening
2. The introduction
3. The key questions
4. The end

In the first step, the interviewees were introduced to some of the details of our research and made them understand our research themes and objectives. And then they have informed the importance of record for our research to get permission to record the interview. To protect

respondents' privacy, they were asked if they wanted to stay anonymous and what information they were willing to reveal in our research.

Before sharing the prototype with interviewees, some questions needed to be asked to clarify respondents' attitude to sustainable information and advice on social media, and these questions should be asked again at the end of the interview to understand their changes. Then the prototype was shown to the respondent by screen sharing and then explain every page, function, operation, and button. To make sure that respondents fully understand the prototype and every function, after the each of operations, the researchers checked with respondents on their understanding of this operation. If respondents have any questions, the researchers would give them a further explanation. During the whole process of the prototype demonstration, the interviewees were free to express their opinions and feelings at any time.

In the key question step, respondents' feedback on the prototype should be collected. Before asking questions, respondents had some time to review the prototype. The interview would start when respondents were ready. Because semi-structured interviews were adopted in this study, most of the questions start with a simple and initial question, which is usually based on what the interviewee is most interested in prototyping. The researchers then listened and observed the respondents' answers, and flexibly changed the type and content of the questions depending on their answers. According to Seidman (2009), to get the real opinions of respondents, researchers need to allow ample time for respondents to think and express themselves and avoid rushing or leading them.

Before the end of the interview, some extra time would be left for respondents to express their views outside of our questions, which helped the researchers to identify some of the issues that might have missed. After the respondents had expressed all the additional feelings and opinions, some questions were asked about attitudes towards sustainable information and advice again to see if our prototype could change people's attitudes towards sustainable information on social media. Finally, interviewees were asked if there would be anything that needed to be clarified.

During the interviews, respondents were allowed to express their views during the introduction to the prototype, and the transcription of the introduction phase of the prototype was also included in the appendix. Each appendix of transcription includes Part 1 and Part 2, with part 1 being a transcription of the introduction and part 2 being a transcription of the formal interview process. Not all respondents commented on the introduction of the prototype. R3 made no comments during the entire introduction of the prototype, so the transcription of R3 in the appendix does not include Part 1.

2.6 Data analysis

Because the sequential mixed method was used, in order to process the qualitative and quantitative data at different stages, in the data analysis stage, different data analysis methods for different kinds of data should be adopted.

2.6.1 Survey data analysis

According to Saunders, Lewis and Thornhill (2012), there are four steps for quantitative data analysis. Firstly, researchers should prepare and check data to make sure the data is available for the analysis. Secondly, according to the research aim, researchers should choose suitable tables and diagrams to show the data. Thirdly, for different data should use different statistics to describe it and to find out the relationships and trends of data.

This study followed the guidance of Saunders et al. (2012) for data analysis. Power BI will be used as the application of this research to process and analyze quantitative data. Also, in order to ensure the quality of data analysis, the quantitative data used for analysis should have validity, accuracy, and completeness (Recker, 2013). Therefore, the data collected by the survey should first be cleaned up to deal with missing data, duplicate data, invalid data, etc. Secondly, Cross-tabulation was the main analysis method of this research. Cross-tabulation is the most commonly used method among a variety of quantitative data analysis methods, which can reflect the exclusion or connection between different data (QuestionPro, n.d.). According to the purpose of the survey in this study, Cross-tabulation was the most suitable method to find the connection between sustainability and game elements from users' perspectives in social media. Based on the obtained table, the correlation between different data would be clearly displayed with visualization.

2.6.2 Interview data analysis

Patton (2015) highlighted the importance of original data from an interview, explaining that nothing could substitute the original data. Therefore, the researchers used audio recording or one of the researchers used written records during the interview when the screen record is not allowed by the interviewees. After the interview, the records were saved in the cloud and also the laptops of all researchers.

Transcription was done as soon as the interview was finished. Bryman and Bell (2015) recommended transcribing interview data as soon as possible. This study used Otter.ai as the English transcription tool, and all non-English interviews were manually transcribed and translated into English by the researchers. In order to ensure the authenticity of the transcription and the protection of the interviewee's private information, all the researchers checked the transcription content and replace the private information with "****", and finally the interviewee checked and confirmed the transcription content.

There are some general methods for qualitative data analysis, such as analytical induction, grounded theory, and coding (Bryman & Bell, 2015). Researchers in this research adopted coding to analyze qualitative data. As a commonly used qualitative research and analysis method, coding can reduce qualitative data into meaningful information (Recker, 2013; Bryman & Bell, 2015). Because the purpose of the interview is to confirm and explain whether the gamification elements make the respondent's behavior or thinking about sustainability change, this research coded and simplified the influencing factors and results and used "+" and "-" to indicate whether the impact is positive or negative.

Nvivo was used as the coding tool in the interview analysis to make coding easier. All the interview transcriptions were uploaded to the Nvivo and summarise the key points from the interview. The result from Nvivo was shown in Figure 2.4. Due to the limitation of Nvivo,

sorting is only possible by the first letter. Therefore, the coding of points in the order of analysis was listed in Table 2.2.

Table 2.2: Coding scheme

Code	Description of Code
UA	User's attitude
RP	Reason for participation
IM	Influence method
RC	Room for choice
GC	Grouping and communities
EC	External cooperation
HT	Hints and tips
R	Rewards
C	Competition (Leaderboard)
SP	Sharing and promotion
D	Details

Name	Files	References
Element selection	0	0
Competition(Leaderboard)	4	8
Details	4	11
Hints and tips	3	15
Rewards	4	19
Sharing and promotion	3	10
Setting forms	0	0
External cooperation	4	9
Groups and communties	4	11
User's willingness	0	0
Influence method	4	11
Reason for participation	4	15
Room for choice	3	8
User's attitude	3	9

Figure 2.4: Nvivo result

2.7 Ethical issues

Recker (2013) brought up the importance of ethical considerations when doing research because it for instance defines how to behave in an acceptable way and what is unacceptable. The ethical aspect focuses on the moral factors, which include concepts of right and wrong, and also good and bad. By following ethical principles, researchers can get some guidance when making decisions and choices in order to improve and correct how they behave (Recker, 2013).

A key rule in ethics, especially since research in the IS field includes social science, suggests that the researchers need to take responsibility for making sure that they have permission from the participants when conducting our research (Recker, 2013). There are other ethical factors to consider when conducting research, especially when conducting interviews, that Patton (2015), Bhattacherjee (2012), and Recker (2013) highlighted. They all mention that participants should have the right to be anonymous and the researchers must ensure that there is confidentiality. This means that the researchers must make sure that the readers of this study cannot identify the participants and the researchers can do that by not describing and labelling them by their names and other information that might reveal their identity (Walsham, 2006). Recker (2013) also added that having physical interviews can sometimes make it difficult to stay anonymous. Therefore, it is necessary to ensure that confidentiality is there to protect them. It is also essential that the participants are participating voluntarily and that they have the right to withdraw anytime. Informing them about their rights and having them sign a consent form can be useful (Bhattacherjee, 2012; Patton, 2015; Recker, 2013).

Disclosure is another ethical factor to take into consideration. By being transparent and informing the participants about the purpose of the study, who the researchers are, and other necessary information, the researchers are ensuring that the participants are getting all the information they need (Patton, 2015; Bhattacherjee, 2012). Since recording the interviews

will be used in this study, it is crucial that the researchers ask for permission before doing so (Bhattacherjee, 2012). Also, these factors that have been mentioned should be tackled at the beginning of the interviews (Walsham, 2006).

When conducting a survey, ethical factors such as anonymity, voluntary participation, and disclosure should be taken into account (Patton, 2015; Bhattacherjee, 2012). Since the respondents for the survey in this study are anonymous, anonymity could be ensured. The researchers can show disclosure by explaining the purpose of the study and who researchers are on the first page of the survey and the respondents get to decide for themselves if they want to participate and they can choose to cancel it anytime.

Ethical considerations should be considered when transcribing, storing, and analysing data. Recordings and analyzed data should be stored in an appropriate and safe place and should only be saved for a limited time (Recker, 2013). The researchers should be transparent about the good and bad findings as well (Bhattacherjee, 2012).

It is also worth noting the ethical consideration when writing the research. The researchers need to make sure, as Recker (2013) suggested to acknowledge other authors by referencing correctly, to avoid plagiarism, and to use appropriate language in our study.

2.8 Scientific quality

When determining and measuring the quality of research, there are some aspects to consider. Two important ones are reliability and validity (Recker, 2013; Mohajan, 2017; Leung, 2015). Reliability measures if the results or conclusions of research will be the same when someone is doing the same research again (Bhattacherjee, 2012; Recker, 2013). This includes instruments that are being used for the research as well. For example, researchers can be a research instrument for interviews. In order to have higher reliability, they must be consistent by making sure they are all asking the same questions to the interviewees (Oates, 2006; Mohajan, 2017). It would be good for this study to create an interview guide with well-thought questions before doing the interviews.

Another example of instruments is the questions included in the survey. They need to be easy to understand for the respondents and they must be impartial and neutral. That way, the respondents are not being led to answer the questions in a certain way (Oates, 2006). All the respondents in this research would have to receive the same survey with a set of questions that are neutral, easy to comprehend, and unlikely to get misinterpreted. In the survey, each section of the questions was preceded by a description explaining to the participants the purpose of the section and, if necessary, some relevant concepts to enable them to make a better choice for their situation, as detailed in Appendix 1. By having neutral questions for the interviews as well, the researchers can be more objective and can assure that the researchers are being consistent where everyone understands and is involved in every part of the study and have good communication. As Oates (2006) mentioned, there is a chance that reliability is lacking when collecting data through a qualitative approach because the researchers can affect the interviews, which can make it difficult to conduct interviews in an objective and consistent way. Coding can also sometimes include interpretation and become subjective and affects reliability. Therefore, in this study, the three researchers can work with the coding and

the reliability can then be tested by analysing and comparing the different coders' work and see if they match (Recker, 2013).

Validity is also an important aspect of research quality and looks at whether or not the collected data and chosen instruments are actually measuring what it is supposed to measure and how suitable they are for the research (Recker, 2013; Mohajan, 2017; Leung, 2015). Leung also added that validity focuses on determining if the chosen methodology is the right one for answering the research question and if the results and conclusions that the researchers are seeking, match the research question. This means that if suitable processes have been used, and the data and findings answer the research question, then the research has validity (Oates, 2006). There are different types of validity and two of them are internal and external validity (Oates, 2006; Recker, 2013). As for the internal validity, as mentioned in previous sections, the theoretical framework obtained in this study would be instantiated into a prototype design, and qualitative data would be collected by interviewing users to verify whether the theoretical framework is effective. This method can verify the validity of the study to a certain extent. External validity, on the other hand, is about generalizability and transferability. It focuses on the generalization of research, meaning if the findings and results can be generalized to other people, times, environments, and contexts (Oates, 2006; Recker, 2013). Oates (2006) stated that having a positivist approach can give a higher validity and since the positivist approach can be used in surveys the researchers believe the research can reach a higher level of validity.

3 Literature review

This chapter is mainly to establish the theoretical foundation for further research, including two essential parts. In 3.1, 3.2, and 3.3, the concepts of social media, gamification, and sustainability were clarified, since they are the primary terms related to the deeper comprehensive frameworks. Then Section 3.4 is the theoretical framework to depict the relationships between social media, gamification, and sustainability, which provided fundamental theories to design the subsequent research. Next, in 3.5, a thematic overview of the above sections is shown in a table to obtain a clear picture of all the theoretical backgrounds. At the end of this chapter, this initial framework would be presented in 3.6 according to the aforementioned literature.

3.1 Social media

Social technology has changed previous communication channels (Lance Bennett & Iyengar, 2008; Wellman, Haase, Witte & Hampton, 2001). Now, tens of thousands of people have taken new actions through social media, including gathering in online communities to create and disseminate information, conduct social activities on the Internet and even organize political activities (Bakardjieva, 2009). In modern society, social media is indeed highly used and represents an important source of information (Michaelidou, Simagka, & Christodoulides, 2011).

Williams, Page, and Petrosky (2014) believed that social media describes a set of tools that promote interaction, discussion, and community, that is, it allows people to establish relationships and share information in virtual communities and networks, based on authenticity, honesty, and open dialogue. Kaplan and Haenlein (2010, p.61) defined social media as "*a group of Internet-based applications that build on the ideological and technical foundations of Web 2.0, and that allow the creation and exchange of User Generated Content*". This definition was widely used until Howard and Parks (2012, p. 362) gave a new definition of social media, which consists of three parts:

a) *the information infrastructure and tools used to produce and distribute content;*
b) *the content that takes the digital form of personal messages, news, ideas, and cultural products; and*
c) *the people, organizations, and industries that produce and consume digital content.*

Three years later, Carr and Hayes (2015, p.8) further defined social media from an academic perspective, namely:

> *"Internet-based, disentrained, and persistent channels of masspersonal communication facilitating perceptions of interactions among users, deriving value primarily from user-generated content."*

At the same time, they also provided a more understandable statement:

> *"Social media are Internet-based channels that allow users to opportunistically interact and selectively self-present, either in real-time or asynchronously, with both broad and narrow audiences who derive value from user-generated content and the perception of interaction with others."*

This definition showed that perceived interactivity is a necessary condition for distinguishing social media (Carr & Hayes, 2015; Li & Li, 2014). In other words, for users, considering social media, the user's perception of interactivity is crucial. This is consistent with the basic argument (Walther, 2011) that the sociality of a platform depends not only on its technical components, but also on the user's familiarity and experience with the platform. Besides, Carr and Hayes (2015) gave a table according to the above definition (see Table 3.1), which shows what belongs to social media and which is not.

Table 3.1: Examples of social media (Carr & Hayes, 2015, p.43)

Social Media	*Not a Social Media*
• Social network sites (e.g., Facebook, QQ, Google+, YouTube, Yelp, Pheed)	• Online news services (e.g., NYT online, PerezHilton.com)
• Professional network sites (e.g., LinkedIn, IBM's Beehive)	• Wikipedia
• Chatboards & discussion fora	• Skype
• Social/Casual games (e.g., Farmville)	• Netflix
• Wiki "Talk" pages	• E-mail
• Tinder	• Online news
• Instagram	• SMS/Texts
• Wanelo	• Oovoo
• Yik Yak	• Tumblr
	• Whisper

Kaplan and Haenlein (2010) classified social media from two dimensions, social presence, and self-presentation, as shown in Table 3.2. They believed that social networking sites (such as Facebook) have a high degree of self-disclosure and moderate media richness. Content communities (such as YouTube) have low levels of self-disclosure and medium media richness. The classification of social media also depends on the content of the media. The classification of social media by Kaplan and Haenlein has been recognized by many researchers and has been referred to subsequent research. Kuss and Griffiths (2017) used Kaplan and Haenlein classifications in order to study the addiction of different types of social media to users and believed that different levels of self-presentation and richness of media would lead to addictions of different reasons. Voorveld, Van Noort, Muntinga, and Bronner

(2018) made hypotheses that social media and social media advertisement engagement experience varies based on self-presentation/self-disclosure and social presence/media richness of different types of social media.

Table 3.2: Classification of social media (Kaplan & Haenlein, 2010, p.62)

		Social presence/ Media richness		
		Low	**Medium**	**High**
Self-presentation/Self-disclosure	**High**	Blogs	Social network sites (e.g., Facebook)	Virtual social worlds (e.g., Second life)
	Low	Collaborative projects (e.g., Wikipedia)	Content communities (e.g., YouTube)	Virtual game worlds (e.g., World of Warcraft)

3.1.1 Social media's history and features

Social media originated from the invention of the telegraph in 1972 and developed due to the development of computer technology and other technical foundations (Egosomwan, Prakasan, Kouame, Watson & Seymour, 2011; Hendricks, 2013; Edosomwan, Prakasan, Kouame, Watson & Seymour, 2011). In 2000, with the rise of many social networking sites, social media was highly developed. This has highly promoted and changed the interaction between individuals and organizations based on social networks, who have common interests in music, education, movies, and friendship. According to Junco, Heibergert, and Loken (2011), in 2001, Fotolog, sky blog, and Friendster came out one after another; in 2003, MySpace, LinkedIn, LastFM, tribe.net, Hi5, etc. were also launched. In 2004 and 2005, popular names such as Facebook, Yahoo!, 360, YouTube, and Cyworld all appeared (Junco, Heibergert & Loken, 2011). The era of various social media platforms is beginning to compete.

Rhee, Bayer, Lee, and Kuru (2021) believed that current social media platforms are characterized by diversified functions, and these aspects are constantly changing over time. At present, many social media platforms are no longer just classified according to their original "social" characteristics, because they are gradually understood as spaces for various activities, such as reading political news, watching media activities, and browsing fashion routes (Rhee, Bayer, Lee & Kuru, 2021). Therefore, with the continuous development of social media technology, the scope of coverage continues to grow, and at the same time, more and more people participate, resulting in the increasing influence of social media platforms. These all make the potential of social media to influence users greater.

At present, social applications have gradually migrated to mobile devices such as smartphones and tablets (Chui et al., 2012). There were already more than 1.5 billion people in the world who are members of social network services (SNS). Of the time they spend on the Internet, about one hour every five hours was spent on SNS, which can prove that the use of social applications on mobile devices has become more frequent (Chui et al., 2012). They also

pointed out that there are more than 6 billion mobile phones in use worldwide. Therefore, the high accessibility of SNS stimulated more permanent and stronger interaction between users. Kaplan (2012) believed that mobile social media fills the gap between the real world and the virtual world. This connection can be considered a broader evolution than the introduction of social media itself (Kaplan, 2012).

3.1.2 The impact of social media on users

Social media has significant potential to bring various influences to people (Kaplan & Haenlein, 2010). Kaplan and Haenlein (2010) believed that through social media, it is possible to contact the final consumer in a timely and direct manner at a relatively low cost and high efficiency. Carr and Hayes (2015) believed that social media may prompt new ways of thinking and changes in discussion and communication. Moreover, the interactivity of social media has considerable potential to convey new ideas to users through interaction modes and so on. Chukwuere and Chukwuere (2017) also pointed out that social media would affect users' culture and beliefs, as well as values, religion, "pop culture", politics, and so on.

Not only that, social media influences people's lifestyle, interpersonal relationships, and consumption intention. Kulandairaj (2014) pointed out that social media affects people's lifestyles, not only can strengthen the connection between friends, but also show their talents and creativity, and even help people make decisions, choose products or brands (Kulandairaj, 2014). Kulandairaj's 2014 study also showed that if SNS promotes a healthy lifestyle through its posts, videos and information, it would help cultivate a healthy young generation. Similarly, Rudenkin (2018) proposed that social media can potentially be used to popularize healthy lifestyles among young people through the dissemination and promotion of information on healthy lifestyle practices, so that they can act in practice. Akbarov (2020) also mentioned that the ideas conveyed to consumers by social media largely affect consumers' purchase intentions. For example, if social media continuously pushes sustainable and relevant content to a user, the user's likelihood of buying when seeing the sustainable and relevant products pushed by social media would be highly increased. Finally, some specific functions of social media could also affect people's lifestyles. For example, a study by Samiul, Satish and Zhan (2016) showed that users who frequently use location functions are more closely connected with their friends, thereby increasing daily social activities.

The impact of social media on people in different scenarios is manifold. For example, Siddiqui and Singh (2016) showed through their research that in education, social media can provide a platform for students to express their ideas easily, and can also promote communication between students and teachers, thereby contributing to the improvement of learning enthusiasm.

However, social media would also bring some negative effects. For example, wrong and inappropriate information on social media could mislead students, which has a very negative impact on students. Siddiqui and Singh (2016) also pointed out that social media has a particularly large impact on young people. During the critical development period of students, the information and opinions conveyed to them by social media have a considerable impact on their current and future thoughts and behaviors, which could be a negative impact,

depending on the way they get information on the content. For example, some young people would be influenced by useless blog content and become violent and adopt inappropriate behaviors (Ishaq, Zaki, Mat Zin, Abid, Farooq, & Ijaz, 2019). Some young people have suffered online violence from social media, and some young people thought they are addicted to social media (Pasdari, 2019). Not only is age a factor, but Kulandairaj (2014) also pointed out that users with different educational levels and genders may be affected differently by social media. Moreover, Brooks (2015) believed that extensive use of personal social media will result in lower task performance, higher technical pressure, and lower happiness for people.

3.2 Gamification

By the end of 2015, there were 40% of global 1000 organizations aiming gamification as a primary tool to achieve the business operation transformations (Pickard, 2015). At the same time, 93% of companies preferred gamification as marketing approaches (Harville, 2020), so that in 2015, the value of gamification markets was worth $1.7 billion (Pappas, 2019), furthermore, the estimation of global gamification sales revenue in 2045 would reach to $32 billion (Orbis Research, 2019). These statistics could suggest that gamification has become a popular trend and could be applied to many more other fields in the future. The external factors of the gamification popularity are converging that could involve cheaper technology, personal data tracking, and the prevalence of the game medium, and so on (Deterding, 2012). And then, the internal reasons could also contain the positive influence of gamification, for example, the completion rate of activities in MOOC with gamification strategies was 28% that much higher than the traditional design's rate around 13% (Romero-Rodriguez, Ramirez-Montoya and González, 2019), or 90% employees claimed that the leverage of gamification can make more productive (Anadea, 2018). These facts implied that the concept of gamification is well-known and worth exploring so that the conceptual definition of gamification should be declared first.

The most widespread and acceptable term of gamification is defined as "*the use of game design elements in non-gaming contexts*" (Deterding et al., 2011a), which means the power of games could be seen as a tool to enhance the engagement and participation of people to activities (McGonigal, 2011). In addition, there is another largest compendium of gamification (Owen, 2013, p.16):

> "*Gamification is the concept of applying game-design thinking to non-game applications to make them more fun and engaging. Gamification can potentially be applied to any industry and almost anything to create fun and engaging experiences, converting users into players*."

In fact, there is no distinct boundary between users and players. But, instead of transforming activities or services into games, the concept of gamification is inclined to carry out system thinking with gameness to attract users and make them positive to engage. On the other hand, another statement of defining gamification from the service marketing perspective refers to "*a process of enhancing a service with affordance for gameful experience in order to support the user's overall creation*" (Huotari & Hamari, 2012, p.25). Rather than the sole receiver, current services attempt to involve users in creating gameful experiences as co-producers to

increase interests. In a word, no matter what the definition is, the primary goal of gamification is to improve user interaction and users' behaviors by innovative thinking.

Sometimes, the boundary between "games" and "gamification" is blurry, even which should be determined by combining empirical, subjective, and social perspectives. In terms, coined by Juul (2011, p.7):

> "*A game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable.*"

Generally, the purpose of games is always entertainment and leisure, however, serious games are defined as the goal of an interactive game based on computer software that could be more than entertainment, but socially constructed meanings (Ritterfeld, Cody & Vorderer, 2009). Parallelly, the pervasive game means breaking through the traditional limitations and stretching the solid range, even to fulfill human needs and solve real-world problems (Jaakko, Annika, & Markus, 2009; McGonigal, 2011). Related to serious and pervasive games, gamification is a persuasive technology that can influence attitudes and behaviors via interactive computing systems with game-designed elements (Fogg, 2002; Petkov, Köbler, Foth, Medland, & Kremar, 2011).

3.2.1 Game design motivation, elements and patterns

Furthermore, leveraging the motivations that drive people's actions, intrinsic and extrinsic, played a significant role in the positive potentials and effectiveness of gamification (Ryan & Deci, 2000; Nicholson, 2012). By definition, intrinsic motivations are related to internal interest or enjoyment that aligns with one's inner values, while extrinsic motivations are to gain some particular outcomes or incentives, like financial compensations. Blohm and Leimeister (2013) formulated four specific methods for IT-based gamified enhancing services from the intrinsic perspective, they are increasing user satisfaction, conveying optimism, facilitating social interactions, and providing meanings. And at the same time, intrinsic motivations can systematically be activated by extrinsic motivations (Ryan & Deci, 2000), so that the performance of extrinsic motivations could be changing users' behaviors, supporting learning processes in gamification (Blohm & Leimeister; 2013).

Except for the essential motivations, the game elements are indispensable compositions that were mentioned several times for the definition of gamification. Based on the researches of Reeves and Read (2009), there are ten ingredients for great games identified, they are self-representation with avatars; three-dimensional environments; narrative context; feedback; reputations, ranks, and levels; marketplaces and economies; competition under rules that are explicit and enforced; teams; parallel communication systems that can be easily configured; time pressure, which does not mean all of them to need to be achieved at one time, they can be isolated and they are considerable references for designing gamification. As a matter of fact, these principles are too customized for traditional games to fit with gamification, Owen (2013) formulated some sustainability-focused features and mechanics for gamifying, including leaderboards, attainment levels, rewards for effort expended, recognition badges, feedback loops, credits, peer-to-peer comparison, public pledges, competitive elements. What is more, there are numerous cases that proved these game elements' useful effects for

gamification. Definitely, there are overlapping properties between two sets of rules, which is mainly to present the forms of game elements, rather than comparing them.

Rather than game-based technology, the use of game elements is also as important as elements themselves, which is the design of gamification. Deterding, Khaled, Nacke, and Dixon (2011b) framed five levels of design by classifying various game elements. The first level is the game interface design patterns that are always about interaction components, contextual solutions, or even prototypes. Then the second level is the game design patterns and mechanics concerning gameplay. Afterward, the third level is game design principles and heuristics regarding evaluative guidelines. Then the fourth one is about conceptual models of components or experience. Ultimately, the highest level is game design methods around specific practices and processes. The selection of these designs is related to the success or failure of gamification applications.

3.2.2 The frameworks of gamifying process

After the definitions and components of gamification, the process of how to integrate gamification into contexts is another vital step for applying. There are some diverse methods that are framed by different researchers. Initially, according to the book of Werbach and Hunter (2012), the six steps of the design process were proposed for implementing gamification, beginning with the business objectives and target behaviors, and then depicting the intended users, guiding the development lifecycle, and keeping the fun, finally, the last step is the deployment of game elements by defined tools. Similarly, another effective process of gamification formulated by Aparicio, Vela, Sánchez, and Montes (2012) contained four main activities. The first one is to identify the main objectives, then the transversal objectives. The third thing is about the selection of game mechanics, which is mainly to maintain previously mentioned intrinsic motivations, or say that, fulfill psychological and social needs including autonomy (the willingness of engagement), competence (the needed skills for participation), relatedness (the connection to others). Eventually, the final step is to evaluate the effectiveness of gamification implementations by some metrics or quality parameters. Nevertheless, this process is not verified so far, still in the experimental stage. Similar to satisfying the internal motivations, Nicholson (2012) proposed a user-centered mindset for meaningful gamification, and Sakamoto, Nakajima, and Alexandrova (2012) framed a value-based model comprising information, empathetic, persuasive, economic, ideological values.

Particularly, there are other frameworks focusing on achieving sustainability. In the book *How gamification can help your business engage in sustainability* (Owen, 2013), the fundamental process of gamifying a process totally consists of seven steps, which is more suitable for sustainability. Starting from announcing a challenge, then define the purpose of the challenge. Afterward, recruiting players and providing rules and boundaries. Followingly, collecting the feedback on impact and progress for displaying success. Cyclically, the iterative action is “level up” by starting again. The primary benefit of this process is to mitigate overwhelming problems in sustainability into small issues for users to overcome. However, the defect of this process is inclined to decrease the long-term relationship between gamification and sustainability. AlMarshedi, Wanick, and Ranchhod (2015) built a framework for increasing the sustainability of gamification impact (SGI), including five main parts that are kind of closed with previous ones. Control, attention, curiosity, and intrinsic interests comprised the first part called flow, which depicted a mental state involving maximum focus and immersion. As for the second part, the requirement is to build a sense of community and

interact with others, namely relatedness. Thirdly, the purposes should involve self-fulfilling goals for feedback loops. And then, the user is comfortable with controlling his/her gameful life to obtain autonomy. After engaging in all of the activities, the final part, mastery, is considered to reach higher levels than before. Furthermore, this SGI framework can be applied before or after gamification designs for developing or evaluation stages.

3.2.3 The applications of gamification

Except for these kinds of theoretical frameworks, there were some actions in gamification as well, especially for the fields of sustainability. Gnauk, Bannecker and Hahmann (2012) developed a real-time energy management system controlled by users, namely MIRABEL, combining game elements, like points, and leaderboards. Parallelly, EcoIsland was proposed by Liu, Alexandrova, and Nakajima (2011) to display a virtual island based on the use of data from family members for presenting sustainability by gamification approach. In addition to the aspects of purely environmental sustainability, gamification also contributed to education for sustainable development (ESD) (Gatti, Ulrich, & Seele, 2019). After conducting the courses by gamification approaches, sustainability-related issues with certain complexity and variety were easy to convey, and the attitudes and emotions of students were turned into performative and joyful. Moreover, the benefits also contained that the fundamental recognition of sustainability for participants was improved (Gatti et al., 2019). What is more, another application example proved that the gamification method is a kind of effective way to form sustainability and system thinking (Nordby, Øygardslia, Sverdrup & Sverdrup, 2016). In a word, no matter from which perspective, the conceptual models, or applications, or others, there is too much white space for researchers to explore and leverage.

3.3 Sustainability

Sustainability is usually discussed from three perspectives: environmental, social, and economic (Giovannoni & Fabietti, 2013). The definition of sustainability claimed by the World Commission on Environment and Development (WCED, 1987) is that contemporary humans should satisfy their needs without harming future generations to meet their needs. At the same time, sustainability is supposed as the fact that the total amount of resources passed on by the present generation to the next generation should not be less than the total amount of resources left by the previous generation to the present generation (Markandya & Barbier, 1989), or say that to deal with the gradual deterioration of environmental problems caused by human activities (Ekardt, 2020). Although sustainability is a multidimensional concept, environmental issues are still one of the most frequently mentioned aspects of sustainability (Drexhage & Murphy, 2010).

Resources can be divided into natural resources and man-made resources (Kuhlman & Farrington, 2010). Both of these resources are important for ecological sustainability and the well-being of human beings (Adams, 2006) since human beings cannot survive without limited natural resources and a complete ecosystem (Ekardt, 2020). The shortage of natural resources may result in the inability of humans to maintain their current lifestyles, and even lead to the extinction of humans (Ayers, 2017a). It can be seen that environmental sustainability plays a significant role in the long-term development of humans.

From the social perspective, social well-being issues such as social justice, racism, etc. should also be paid attention to when considering sustainability (Kuhlman & Farrington, 2010; Dempsey, Bramley, Power & Brown, 2011). There are two main factors affecting social sustainability (Ayers, 2017b). Firstly, poverty would lead to long-term resource returns and undermining environmental sustainability due to the overuse of resources for urgent survival needs (United Nations, 2000; Ayers, 2017b). Secondly, globalization would bring various problems in sustainability, for example, the globalization of resources' information may bring about conflicts between different countries, and global trades would result in the shortage of resources in countries when transaction interruption (Ayers, 2017b).

It is well known that economic development depends on resources, while it also could lead to the depletion of resources (Doane & MacGillivray, 2001), which means the relationship between economic growth and sustainability is interdependence rather than non-coexistence (White, 2013; Surampalli et al., 2020). So, enterprises are required to control the consumption rate of resources to be lower than the natural accumulation rate or find alternative resources under the situation without harming the environment (Doane & MacGillivray, 200; Ameen, Mourshed & Li, 2015). Furthermore, economic growth is not the same as economic development (Surampalli et al., 2020). Economic growth is usually used to describe the increase of the monetary value (Banerjee, Duflo, Glennerster & Kinnan, 2015), while economic development focuses on the improvement of people's quality of life (Kemp & Nurius, 2015).

3.3.1 Sustainability and user behavior

Today, the customer is not only an economic entity, but also a member of a family, community, and country (Handelman & Arnold, 1999), so social and environmental factors may be taken into consideration in their decision-making. Due to increasing concerns about the declining natural resources, the impact of companies on the environment, or social inequality, customers are increasingly seeking to play a more active role in the transition to a sustainable future.

A study by Zapico, Turpeinen and Brandt (2009) pointed out that encouraging users to become environmentally friendly can be achieved by a) Making low carbon behavior easier; b) Guiding users through the process of different habits; c) Praising and encouraging users' sustainable behavior; d) Providing suggestions when and where users make decisions. Also, Lin and Huang (2012) pointed out that many people have no clear connection to how their daily behaviors cause ecological impacts. Even so, the ecological impacts of people's behaviors still exist. There are several studies that can describe the environmental behavior that affects people. Stern (2000) proposed that behaviors that are important to the environment can be classified from the perspective of intention-oriented (*environmental intention*) or impact-oriented (*environmental impact*). The former measures the willingness to improve environmental conditions, and the latter measures the impact on environmental quality, such as energy use. Gatersleben, Steg, and Vlek (2002) found that the intentional measures of environmental behavior are related to differences in values. However, impact-oriented measures are more relevant to sociodemographic characteristics. In addition, in the theories that influence people's behavior, values are one of the most discussed topics in the literature. Values are the normative standards of life-guiding principles and are regarded as driving forces that influence people's behavior. However, Lin and Huang (2012) explained in their research that, for example, the main influencing factors of consumers' buying behavior

of green products are indeed psychological benefits, desire for knowledge, and seeking novelty. From this perspective, values are indeed very important, but they are not the only driving force that influences people's sustainable behavior.

Moreover, corrective actions can be provided by providing information to draw people's attention to changing people's behavior (Bartiaux, 2008). Mankoff, Matthews, Fussell, and Johnson (2007) believed that social media has the potential to provide instant feedback and combine it with goal setting to encourage reflection and provide information that supports action. Mankoff et al. (2007) proposed that different ways of presenting information may increase the possibility of people adopting new attitudes, behaviors, and practices. However, Bartiaux (2008) pointed out that in order to change people's behavior, information must be verified with people's acquaintances or other people who are considered valuable. Otherwise, the information seems to be forgotten or ignored soon. Besides, Poortinga et al. (2004) pointed out that in general attitude variables, relying on motivational factors can only explain a small number of environmental behavior differences. However, background factors such as personal opportunities and abilities determine a stronger dependence on environmental behavior (Poortinga et al., 2004). Also, another way to influence people's behavior is to propose practical solutions to individuals. Sustainable Consumption Roundtable (Great Britain) believed that putting forward practical solutions to people's daily lives would bring about changes in behavior. These people can then formulate new norms and then spread to wider changes to promote environmental behavior (Roundtable, 2006).

In addition to the above, breaking conventions and re-adjusting certain practices and behaviors with higher environmental attention can change current behaviors (Haider, 2012). Social networks can put pressure on people's behavior, especially for people who are moving upwards rapidly in society (Bartiaux, 2008). The environmental news, social and environmental behaviors of companies that people discover through social media would push them to strengthen their practices (Linich, 2013). Social media is currently being used as a platform where people give tips, talk about difficulties, and sometimes even admit failures in adopting new environmental behaviors (Haider, 2012). For example, a blog is a social media tool that allows users to participate in talking about their environmental life, and people can expand certain tips or suggestions in it (Haider, 2012). Blogs can allow users to form the practice of the concept of sustainable daily life (Haider, 2012). In summary, the potential of social media to influence users and promote sustainable behaviors in their lives is huge.

It is worth noting that there are a series of obstacles to changing people's behavior. One of them is the background factors that can limit individual abilities and opportunities (Poortinga, Steg, & Vlek, 2004). Poortinga et al. interpreted the concept of quality of life as a variable in environmental behavior changes, and people tend to associate the acceptability of adopting certain environmental practices with energy-saving measures and their values (Poortinga et al., 2004). Bartiaux (2008) pointed out that to change people's behavior, society needs to deal with ambiguities such as changing emotions and practicing fragmentation in daily life. Besides, Bartiaux (2008) believed that all new practices require social support from families, social networks, and policies.

3.4 Theoretical background

3.4.1 Social media and sustainability

A study by Ballestar et al. (2020) showed that sustainability is an important and fashionable issue at present, and this fact is reflected in the dialogues generated on social networks, mainly related to environmental sustainability. In this case, social media as an enterprise has the responsibility and obligation to practice sustainable development, which is also part of the corporate social responsibility (CSR) of a company (EI-Zeind, 2012). At present, more and more organizations and researchers are realizing what role social media is playing for sustainability. Some companies are glad to share their sustainable attitudes and results on social media (Reilly & Hynan, 2014). Moreover, some communities and websites try to guide families to live a green life rather than focus on the big green "picture" of sustainability (Williams et al., 2014).

It can be seen from its sustainability report or CSR report that some well-known social media platforms attach significant importance to sustainability. Facebook tried to solve some social problems by building a global community (Zuckerberg, 2017), and listed in the "*Sustainability Report 2019*" how they are reducing their environmental impact and future sustainability plan (Facebook, 2019). At the same time, Twitter often uses official accounts to publish some socially sustainable and ecologically sustainable content, which has attracted widespread attention from users (Twitter, 2020). Similarly, from the 2019 CSR report of Tencent (the owner of WeChat), Tencent has made contributions to five aspects of sustainability: society, ecology, culture, economy, and public services (Tencent, 2019), but there is no specific example and explanation. ByteDance (the owner of TikTok) promised in their CSR report that they would provide more high-quality content about culture, education, etc. Also, it is mentioned in the report that they care about the sustainable development of employees, partners, and the environment (ByteDance, 2020). As can be seen from the above reports, most of these social media companies have formulated some strategies and goals for their sustainable development. However, most social media companies do not have specific sustainability practices at the user level. Therefore, although social media is recognized as the most popular media today, there are still few studies on its interface with sustainability issues.

As an enterprise, social media platforms can learn from the practices of general enterprises on the road to sustainable development to explore more possibilities. Du, Yalcinkaya, and Bstieler (2016) believed that sustainability issues, due to their complexity and multi-stakeholder concerns, require companies to give up a certain degree of control and accept key internal and external processes such as open innovation activities. Dangelico, Pontrandolfo, and Pujari (2013) also mentioned that external integration capabilities are critical to the success of enterprises. Similarly, Prokesch (2010) also believed that companies cannot solve sustainability issues alone, but need to cooperate with external stakeholders, who "*will allow you to gain internal expertise that cannot grow quickly*". In this case, social media can make full use of external knowledge, content, and creativity to carry out powerful and open innovation activities (Mount & Martinez, 2014). At the same time, social media-driven open innovation has grown rapidly in the form of online channels because of its potential to leverage diverse knowledge and promote innovation in a wider network of users and partners (Mount & Martinez, 2014). In this way, not only can the interests and social responsibilities of the enterprise be satisfied, but also the innovation ability of the enterprise can be enhanced.

3.4.2 The role of social media in sustainable user's practices

People are becoming more and more interested in environmental issues such as climate change, sustainability and "going green", which is reflected in the unprecedented increase in interest in new channels such as online social media (Fraser, 2011; Wenzel, 2009). Under this circumstance, dissemination of the true "sustainable picture" requires going beyond traditional media channels (Williams et al., 2014). Social media represents an important tool, a bottom-up method of disseminating information widely (Aguilera, 2013). Zapico et al. (2009) believed that social media has a powerful, universal persuasive power that can be used to disrupt users' habits and influence users to make decisions. Some social media platforms have realized that they can make users sustainable through their own influence and have taken some practice.

For example, the application "Ant Forest" developed by Alipay under the Alibaba Group was awarded the UN's highest environmental protection honor incentive and recognized in the 'Inspiration and Action' category. (UN environment program, 2019). Users can record their low-carbon and green footprints in their daily lives in the Ant Forest, such as taking public transportation or paying online utility bills. Ant Forest would reward everyone with "green energy" for every environmental protection action. When users have accumulated a certain amount of energy, Alipay company would plant a real tree in the real world. Users can view their trees in real-time via satellite. In addition to being able to "plant trees", users can also "protect trees". Moreover, Ant Forest's newly launched "protected area" program allows users "adopt" a certain scale of nature reserves on the application platform and protect the environment in different ways. In this process, Ant Forest also uses the power of digital technology to explore the path to ecological poverty and improve the lives of local people. Through social media, some applications could use game-like functions to trigger competition, cooperation, and recognition, thereby better inducing and persuading users to pay attention to sustainability issues (Zapico et al., 2009). This is a kind of gamification to achieve sustainable guidance for users, which would be discussed in detail in the following sections.

Another example is from the research by Williams et al. (2014). Williams et al. believed that social media is very useful for individuals that are committed to advancing green causes. Many social media networks have developed online communities and held competitions to stimulate users' interest in sustainability, such as rewarding users for developing environmental protection programs, carbonrally, and so on. Williams et al. also pointed out that green websites and blogs with educational purposes are very good ways to promote sustainability. Moreover, household-level scenarios have also been mentioned. For example, through social media platforms, users can rent items online instead of buying them; second-hand items can be auctioned online, etc., which potentially saves users money while improving sustainability. Finally, Williams et al. (2014) also proposed that social media sites could help users calculate their environmental impact and reduce their footprint by providing various green tools to guide users to live a "greener" life by changing their behaviors.

3.4.3 Using gamification to improve sustainability

According to Owen (2013), although a great deal of environmental problems and the importance of sustainability have already been known by people, some people reject changing their behaviors to reduce the effect on the environment. There are two main reasons. Firstly,

there are different environmental problems in different areas for different reasons, and people do not know what action should be taken. Secondly, some environmental problems have long-term effects, and people cannot realize them. These opinions and attitudes cannot be changed in the short term, then there has to be another way to persuade people to change their lifestyle to become less resource-intensive and carbon-footprint-heavy. Therefore, some researchers have tried to use gamification to change people's behaviors.

Nyström (2017) believed that gamification and persuasive technology can efficiently persuade people to adopt some sustainable behaviors, such as reducing the consumption of resources and choosing environmentally friendly modes of travel. Applying gamification to a persuasive system for sustainability can have some unexpected results, but that needs the gamified persuasive system constantly updated to adapt to the changes of situations, depending on the assessment of the system and contextual changes (Nyström, 2017). Nyström further explained that in order to design a successful gamified persuasive system, it's necessary to check three domains: Holistic view/complexity, Metric/assessment and User participation/designing. These three domains could help to understand the complexity of designing these sociotechnical systems and the need for the systems to be able to evolve and change over time. Although applying gamification to applications can efficiently guide users, Nyström (2017) pointed out that most applications did not take full advantage of gamification. The usage of gamification is not only to involve the game elements into the application but consider how to combine the game mechanics with the application when designing the application.

For example, Cardoso, Ribeiro, Prandi and Nunes (2019) tried to use gamification to change people's travel habits in Madeira. They worked with the bus company in Madeira to develop a gamified application to attract people to choose sustainable travel modes. This application adopted two gamified methods, "rewards" and "adventures". The "reward" game would provide points for those who choose to travel in an environmentally friendly way. The more environmentally friendly the way of travel, the more points users can earn, and the points can be exchanged for money. Also, users could obtain interesting information through the "adventure" game in specific places such as scenic spots or bus stops. They could collect and read special content by NFC function of mobile phones, turning the travel route into an "adventure trip". According to Cardoso et al.'s (2019) statement, the positive effect of these two gamification methods have been verified after application testing.

Another example is from Waseda University. The researchers at Waseda University have developed a gamified application named "Eco Island", which was designed to persuade users to reduce their carbon emissions and finally achieved a significant result (Zapico et al., 2009). Users can form a family and live on an island. Every island must be set with a carbon dioxide emission target, which determines the height of the sea level of the island. If a family's carbon dioxide emission over the target, the island would be submerged. Therefore, if one member of the family emitted too much carbon dioxide, other members should control their carbon dioxide emission to save their island. Different islands can trade with virtual currency to solve emergency situations. Zapico et al. (2009) pointed out that one of the characteristics of this application is to strengthen the influence and connection between people, and the connection of people could also guide people to participate in sustainability. According to Owen (2013), some people reject the sustainable lifestyle because they believe that facing huge problems, personal behavior is insignificant. However, gamification can strengthen the connection between people, gamification shows people that their impact is not individual, but as part of a group, a community, a nation, etc (Owen, 2013).

Gamification could not only change people's behavior but also change people's mind. One example is the use of gamification in education to help students to establish the perceptions of sustainability. Games could offer a special and powerful learning environment, which could make the learning process smooth (Gee, 2007; Schaffer, 2008; Dewey, 1916). Gee (2007) further points out that gamification is a method that combines "learning in practice" and "learning in time". Nordby et al. (2016) used gamified education methods to teach elementary school students the knowledge of sustainability. They use causal loop diagrams and three games to guide students to think about the relationship between human and natural. Students need to make decisions to achieve the goal of environmental sustainability, social sustainability and economic sustainability. In a word, gamified education makes students more engaged in the course, and students who experienced gamified education have a more clear and systematic understanding of sustainability according to the feedback from the survey (Nordby et al., 2016).

Georgina, Quist and Hamari (2021) pointed out that gamification and backcasting can efficiently appeal to stakeholders to work together to solve sustainability issues. Georgina et al. (2021) attempted to better combine game mechanics with sustainability to achieve changes in participants' thoughts and behaviors. Backcasting refers to the assumption of an ideal future and then looking back from the future to make corresponding plans to achieve the ideal future, and gamification could enhance the effect of backcasting (Vergragt & Quist, 2006). Based on gamification and backcasting, Georgina et al. (2021) developed the Gameback framework as the Figure 3.1. The aim of the Gameback framework is to change the participants' behavior and make them reflect on their behaviors to change their minds. The Gameback framework is based on the game design element RECIPE (Reflection, Exposition, Choice, Information, Play, and Engagement), which could promote participants to think individually to establish a connection with daily life and the world outside the game to achieve long-term change. There are four stages when using the Gameback framework. First, integrate retrospective information into gamification, so that participants can reflect on the information during the game and selection process. For future expectations or problems, they want to solve, the framework can help participants perform the necessary analysis and take action. Through gamification of rewards to develop expectations for the future, the rewards of the game will attract more participants, which will trigger more reflections from participants during the game. Finally, participants can make choices based on reflection to achieve a sustainable lifestyle.

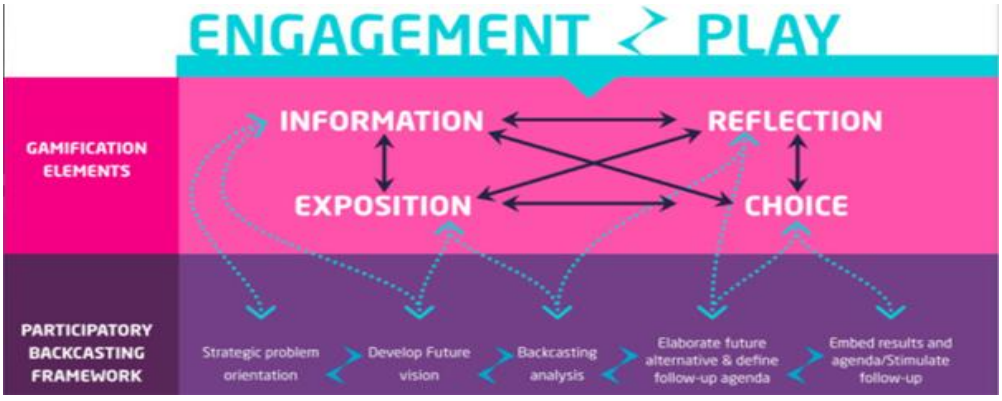


Figure 3.1: The Gameback framework (Georgina, Quist & Hamari, 2021. p.5)

3.4.4 Social media's adoption of gamification

Obviously, gamification is widespread at present. In fact, the popularity of gamification cannot do without the combination and backdrop of three elements (Kim, 2015). They are the general usage of smartphones, the enormous growth of mobile webs, the frequent adoption of social media. This indicates that social media is one of the important compositions for the foresting of gamification, alternatively, gamification is able to capture users' attention, improve users' engagement, and even influence users' behaviors in social media as well (Bista et al., 2012; Kim, 2015).

On the other hand, when integrating gamification into social media, there are three main stakeholders that need to be considered (Sitorus et al., 2017). Firstly, the developer has a core role in conducting gamification concepts including the design of focus and habits that could be the presentation of social media applications and the selection of game elements. Secondly, the user aims to use social media to assist in establishing connections between other users, and this feature can be exactly supported by gamification. The third stakeholder is about beneficiaries. Nowadays, social media is not only the platform for communication, the information of attracted users in social media is significant for beneficiaries to leverage. Therefore, based on gamification, beneficiaries can be corporate with developers to obtain real data from real activities. To sum up, the adoption of gamification in social media is primarily to make users' activities more valuable (Sitorus et al., 2017).

During the process of applying gamification for social media, there are a total of three main classifications that could be summarized. Initially, instead of utilizing game elements, some social media features are the same as game-like elements (Pellikka, 2014). The first one is the connection between users. No matter becoming "friends" or "following" others on Facebook or Instagram, the central goal is to enhance the communications. Then the second thing is rating users' activities both positive-only and positive-and-negative two forms. Parallelly, the sharing functionalities covering internal or external are another point, which means sharing the public posts to friends' feeds or can be linked or accessed to cross-sits. Essentially, these features are very similar to the game elements that build the atmosphere of community and strengthen the link with different users.

Then the second main category is to apply game design elements to engage users in social media. Sitorus et al. (2017) condensed a total of twenty-five game elements, except for *feedback* (keep interaction), they are divided into five major sorts (see Table 3.3), activity, ability, payment, status, and sharing, so that the twenty-four elements respectively contain *goal* (motivate users to process), *narrative* (storylines or plots to guide users' emotion or curiosity to finish activities), *task list* (activities to go), *competition* (show the ability of user, e.g., one versus one), *league* (with certain roles in a system for competition), *co-operation* (grouping for the common goals); *strategy* (do the activities creatively), *constraint* (within the limited time or conditions), *carefulness* (for the first time performance); *point* (e.g., progress, rewards), *badge* (be signed for the unique status), *virtual goods* (can be obtained or consumed in virtual form), *key feature* (be triggered by certain conditions), *real rewards* (money or tangible things), *penalty* (when wreak the system); *statistics* (the data of activity, used as comparison), *leaderboard* (the status for social community), *avatar* (picture or animation for the emotion of profile owner), *level* (motivate upgrading for competition), *progress* (progression of status), *history* (record users' habits or preferences), *social graph* (a relation of social network); *telling people* (sharing activities or status), *charity* (get points or virtual goods from others). All of these features are the design elements of gamification that

can be leveraged by social media. At the same time, the research of Pellikka (2014) also summarized various game mechanics and dynamics for social media services, similarly including statistics and points; badges and tasks; virtual goods and space; competition, co-operation, and challenges; progression. Among them, “statistics” are inclined to the most common and popular spanning, and then badges are always awarded to users for recognizing who performed better in collaborative projects.

Table 3.3: Game elements (Sitorus et al., 2017)

Category	Elements
Feedback	Feedback
Activity	Goal
	Narrative
	Task List/Challenge
	Competition
	League
	Co-operation
Ability	Strategy
	Constraint
	Carefulness
Payment	Point
	Badge
	Virtual goods
	Key feature

	Real reward
	Penalty
Status	Statistic
	Leaderboard
	Avatar
	Level
	Progress
	History
	Social graph
Sharing	Telling people
	Charity

In addition to the above two approaches, directly introducing full-fledged games could be seen as a variant or part of gamification. According to the content analysis of some social media (Pellikka, 2014), multiple cases have introduced such incorporations. For example, users can play published games inside Facebook, the core functionality of Reddit was a game, and one of the channels in Twitch.tv collaborated with a Pokemon game. As a matter of fact, there is no distinct boundary between games and gamification, as long as maximum the value of users' activities in social media. Furthermore, when social media platforms combine with gamification, the positive consequences are obvious to observe.

In particular, gamification as a solution offers the opportunity for better user engagement by translating the traditional enthusiasm from game psychology into social media platforms (Dorling & McCaffery, 2012), so that the combination of gamification and social media can play a positive role in many other fields. For instance, the use of social media and mobile gaming can be seen as a relatively satisfactory approach to improve the vegetable intake for young adults, by posting food pictures or recipes that would be ranked, and earning badges mechanic (Nour et al., 2018). In addition, it also worked on the aspects of medicine rotations.

Based on fostering the community for students and teachers by the consolidation of gamification and social media, the experiments with control variables proved that the participation of medical students progressively was boosted (Grangeia, de Jorge, Cecilio-Fernandes, Tio & de Carvalho-Filho, 2019). Similarly, the results of another research over 3 years suggested the efficiency of students in medical courses with social media tools and gamification was improved in the case of no change in the number of learning hours (Mesko, Győrffy & Kollár, 2015). What is more, the implementation of social media and gamification was a good method as well to enhance the development of vulnerable children and parental engagement in parenting programs (Love et al., 2016).

Undoubtedly, gamification provided various observed benefits for social media platforms (Hamari & Koivisto, 2013), even containing some services about real-life contexts (Hamari & Eranti, 2011). Specifically, one kind of social media that location-based services and mobile GIS are beneficial from gamification to attract users (McKenzie, 2011). Nevertheless, there are some unignored challenges for gamification in social media that are formulated by Bista et al. (2012), covering bootstrapping, monitoring, and sustainability. First of all, in the bootstrapping phase, gamification aims to gather and engage users, generally, gamification performs well, but when moving to the later phases, the monitoring phase for observing users' activities, and the sustainability phase for keeping users, which are worthy challenges for gamification to overcome.

3.5 Thematic overview

By summarizing the previous literature mentioned above, the important concepts in the research can be kept consistent (Kvale & Brinkmann, 2009). Thus Table 3.4 summarizes the concepts from previous literature.

The literature review of this research includes two parts. The first part includes three basic themes for this research, social media, gamification and sustainability. In the first part, the concepts of three basic themes used in this research were described. Besides the concepts, the first part includes the reason why these three themes are important to research. The different perspectives of three basic themes were clarified in the first part to help researchers to clarify the research direction.

In the second part, the three basic themes were combined to get three new themes. The combination of social media and sustainability illustrates the significance of using social media to make users sustainable. The combination of gamification and sustainability shows the possibility of using gamification to achieve sustainability. The combination of social media and gamification provides guidance on how to use gamification elements in social media platforms.

Table 3.4: Thematic overview

Theme	Notions	Main literature
Social media	● Concepts of social media ● Classifications of social media ● Features of social media	Kaplan & Haenlein,2010; Carr & Hayes, 2015; Rhee et al., 2021; Chui et al.,

	• Social media's impact on users	2012; Kulandairaj, 2014; Rudenkin, 2018; Akbarov, 2020; Samiul et al., 2016; Siddiqui & Singh, 2016; Ishaq et al., 2019; Pasdari, 2019; Brooks, 2015
Gamification	• Concepts of gamification • Game design motivation and patterns • The frameworks of gamifying process	Deterding et al., 2011a; McGonigal, 2011; Owen, 2013; Juul, 2011; Huotari & Hamari, 2012; Reeves & Read, 2009; Deterding et al., 2011b; Werbach & Hunter, 2012; Aparicio et al., 2012; AlMarshedi et al., 2015
Sustainability	• Concepts and aspects of sustainability • The importance of sustainability • Association between sustainability and user behavior	Giovannoni & Fabietti, 2013; WCED, 1987; Ekardt, 2020; Ayers, 2017b; UN, 2000; Doane & MacGillivray, 2001; White, 2013; Surampalli et al., 2020; Gigi, 2021; Zapico et al., 2009; Stern, 2000; Gatersleben et al., 2002; Bartiaux, 2008; Roundtable, 2006
Social media and sustainability	• What social medias have done for sustainability • Social media corporate with external stakeholders to achieve sustainability • The role of social media in sustainable user's practices	Reilly & Hynan, 2014; Williams et al., 2014; Du et al., 2016; Dangelico et al., 2013; Mount & Martinez, 2014; Williams et al., 2014; UN environment program, 2019; Zapico et al., 2009
Gamification and sustainability	• Using gamification to improve sustainability	Owen, 2013; Nyström, 2017; Gee, 2007; Schaffer, 2008; Dewey, 1916; Nordby et al., 2016; Georgina et al., 2021
Social media and gamification	• The combination of social media and gamification • Gamification elements	Bista et al., 2012; Kim, 2015; Sitorus, 2017; Pellikka, 2014; Sitorus et al., 2017; Dorling & McCaffery, 2012;

3.6 The Initial framework

Followed by the process of Section 2.3, this section is the results of the first part of the whole research according to the above literature. In Section 3.2.2, there are different frameworks of gamifying processes. For example, the six steps of the gamification process proposed by Werbach and Hunter (2012) contains clarifying business objectives, target behaviors, intended users, development lifecycle, fun, defined tools. Aparicio et al. (2012) emphasized four main things of gamification processes, including identifying main objectives, transversal objectives, the selection of game mechanics, and evaluation. Similarly, Owen (2013) suggested the fundamental gamifying process into seven steps, covering announcing a challenge, defining the purpose of the challenge, recruiting players, providing rules and boundaries, collecting the feedback on impact and progress, displaying success, and starting again. In addition, the SGI framework elaborates some points of the gamifying process about flow, relatedness, feedback loops, autonomy, and mastery (AlMarshedi et al., 2015).

Merging the same steps of these gamifying framework, the initial artifact, gamified sustainable social media framework were structured into the following seven steps, including the identification of the problem, the definition of objectives, the delineation of players, the selection of game mechanics, the deployment of game elements, the demonstration for collecting feedback, the analysis of the effectiveness. At the same time, the characteristics of social media, gamification, and sustainability in Section 3.1, 3.2, 3.3, and the relationships between social media, gamification, and sustainability in Section 3.4 are filled into each step by the categorizing and analysis of researchers. Consequently, the initial framework of how to convey sustainable concepts by gamification on social media would be presented here.

The first step is the identification of the problem. The goal of this part is mainly to announce challenges that need to be gamified and justify the value of solutions. For sustainable contexts, the challenge is to explore how to leverage gamification in social media to make users sustainable. This scope of the challenge can motivate stakeholders to understand the context and to pursue potential solutions. At the same time, the scope of relevant resources and knowledge could be defined, so that the following stages can be performed smoothly.

The second step is the definition of objectives. In fact, the objectives fully contain two parts. The first one contains the main objective and transversal objectives of the activity that researchers want to gamify (Aparicio et al., 2012). The main objective is to promote sustainable concepts to users based on the features of social media. Underlying the main objectives, the transversal objectives are specifically defined by capturing the interests of persons. Particularly, social media need to maintain the relationship between users and networks for the long term, since users can gain values from interaction when they create and exchange self-generated content based on the Internet, that is, perceived interactivity (Kaplan & Haenlein, 2010; Carr & Hayes, 2015). At the same time, designing as many possible sorts of gameplay is another transversal objective, the reason is that Rhee et al. (2021) claimed that the diversity of interaction approaches can attract as many users as possible.

In fact, objectives are related to *auto* (self) and *telos* (goal or purpose) (AlMarshedi et al., 2015), above objectives belong to *telos*, and as a kind of measurements, they are significantly meaningful for feedback, but fulfilling goals (*auto*) for users are as important as *telos*. Therefore, the second part of the purpose is setting the goal for players when applying gamification, which can transform players' experience into a rewarding journey and relate it

to the achievements (AlMarshedi et al., 2015). And mastery is another performance of self-rewarding, which means the desire of getting better from newbie to regular, and finally to enthusiast (AlMarshedi et al., 2015). In other words, this is an alternative form of players' goal involving autonomy that a user can control the widgets and relatedness that the basic needs of interaction.

Afterwards, the third step is the delineation of players, which is related to previous problems' identification and objectives definition and has an important influence on recruiting players for collecting feedback. Different persona depictions would lead to the totally different selection and deployment of game design elements so that it is one of the significant factors in this framework. And according to the research of Siddiqui and Singh (2016), people with relatively lower ages can be emphasized in this context, because social media play an influential role on young people.

The fourth step is the selection of game mechanics to provide rules and boundaries for solutions. Previously, various classifications of game design elements were mentioned, furthermore, there are considerations of selecting game mechanics from the perspective of social media features, including the classifications, attached devices, and scenarios. In particular, social media is distinguished from the degree of richness and self-presentation's degree (Kaplan & Haenlein, 2010), so that the enterprises of social media should determine the specific usage of game elements according to their circumstances. And the mobile end of social media can stimulate longer-lasting and more interactions among users due to the increasing frequency of mobile phone usage (Chui et al., 2012; Kaplan, 2012). In addition, the consumption scenarios played a significant role in users' concepts (Kaplan & Haenlein, 2010; Akbarov, 2020). Therefore, considering social media types, the user devices and applying scenarios can promote the functionalities of gamification.

Then the fifth step is the deployment of game elements. In the beginning, enterprises should not consider the sustainable issues separately, social media platforms could cooperate with external stakeholders and make full use of external knowledge and contents to create innovative activities to perform sustainability (Du et al., 2016; Dangelico et al., 2013; Prokesch, 2010; Mount & Martinez, 2014). Once the thoughts of drawing supports from the external are perceived, the whole deployment of game elements would be more macroscopic. Similarly, the user is not only an economic entity, but also a member of a family, community, and country (Handelman & Arnold, 1999), therefore the influencing factors of social and environmental may be taken into involvements when deploying game mechanics to strengthen the connection between members for instructing the sustainable actions (Zapico et al., 2009). In addition, the physical and psychological benefits, such as simply saving money, the desire for knowledge and novelty, also can promote users to perform sustainably (Williams et al., 2014; Lin & Huang, 2012). What is more, some companies prefer to share their sustainability outcomes on social media, which would potentially modify users' attitudes and actions as well. As a consequence, not only leveraging external stakeholders and grouping users can be beneficial to the deployment, but also the big-size companies' sustainable attitudes and users' relevant benefits should be also involved when allocating game elements.

The sixth step is the demonstration for collecting feedback. The direct approach of demonstration is to create prototypes by applying the above theories to represent and explain the gamification usage in detail. Then for the collection of feedback, it can get the help of a four-stage Gameback framework (Georgina et al., 2021). The first stage is to allow participants to reflect arguments about whole gamification processes, and then help

participants perform the necessary analysis and take action for further expectations. Afterwards, the third stage is to recruit more participants for more reflections by the rewards of gamification. Finally, participants can make more sustainable choices of lifestyle based on reflections. Thus, user behaviors can generate more reflections, complementarily, reflections can promote actions, which formulates a cycle for feedback collection. Furthermore, the potential of instant messaging in social media also can encourage reflections (Bartiaux, 2008; Mankoff et al., 2007).

At the same time, the impacts on user behaviors also include the following three aspects. Initially, social media widely is a bottom-up method of disseminating information to disrupt users' habits and influence users' decisions (Aguilera, 2013; Zapico et al., 2009), so that people can be attracted by sustainable content continuously (Fraser, 2011; Wenzel, 2009). Secondly, gamification also can transform people's thinking and mindset. In the context of sustainability, gamification is always leveraged to establish and convey the concepts of sustainable development for the education of students (Gee, 2007; Schaffer, 2008; Dewey, 1916; Nordby et al., 2016), apparently, the mindset can directly influence user behaviors. Thirdly, there are many specific proposals to encourage users to become environmentally friendly, such as, making low carbon behavior easier, providing suggestions for specific scenarios, and so on (Zapico et al., 2009), these things can directly guide user behaviors.

Eventually, the last action is the analysis of the effectiveness. Combining with the results of the sixth step, the analysis of the effectiveness of gamification applications can be based on fun, quality indicators and satisfaction, and service quality (Aparicio et al., 2012). Nyström (2017) suggested an evaluation for measuring the gamification design from three aspects. The holistic domain is about the view of judging the whole complexity of the designing patterns. Meanwhile, the second domain is the metric assessment, and the third domain is around the evaluation from the participants' perspectives. There are overlappings between these three areas. For example, Sánchez (2010) defined metrics associated with the playability combining with questionnaires by user tests or heuristics evaluation by experts. Depending on the evaluation of the system, the gamification persuasion system could adapt to changes in the situation by constantly updating (Nyström, 2017). As a matter of fact, the design process is always iterative, which means the endpoint is the starting point for the next level-up (Owen, 2013), the result of effectiveness analysis would provide the foundation for the next design process.

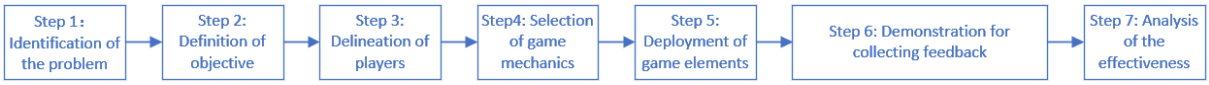


Figure 3.2: The model for designing gamified social media

4 Result

The following chapters present the empirical research results of this article. Here, the data collection results of this research are displayed, analyzed and discussed. First, 4.1 shows the results of the survey. The results of the survey are discussed in Section 4.2. Based on the results and discussion of the survey, the prototype design is carried out in Section 4.3. According to the prototype, the interviews are conducted, and the results of the interview and its discussion are shown in 4.4.

4.1 Survey result

A total of 250 pieces of data was collected for this study, detailed results and some calculation methods of the values can be found in Appendix 2. The data collected from the survey were analyzed on two platforms: the questionnaire platform, Sojump, which comes with its own analysis tools, and also the data analysis platform, powerBI. Some cross-analysis of the data could not be achieved on Sojump, and these data were downloaded and imported into powerBI for further cross-analysis. Therefore, the raw data first needed to be coded to facilitate the analysis. See Table 4.1 for specific coding methods. Since not all columns need to be analyzed, only the columns that have been analyzed in PoweBI are displayed in the table. In the next sections, the survey results are counted and analyzed based on the classification of the questions.

Table 4.1: Data preparation in PowerBI

Question number	Shorthand in PowerBI	The original question in the survey
1	Age	Your age
2	Education	Education background
3	Gender	Gender
6	Time	How many hours per day do you spend on your favorite social media?
9	Follow sustainable news	To what extent do you follow the sustainability-related news shared on social media?

10	Follow sustainable advice	When you receive sustainable advice from social media, are you willing to follow?
12	Understand the impact	Would you like to know the specific impact of your actions on sustainability?
13	Change behavior according to impact	Would you like to change your behavior after you understand the sustainability impact of your behavior?
14	Change behavior according to feedback	Would you be more likely to engage in sustainable behavior if you were given more detailed feedback?
16	Follow organizations	Do you follow or participate in sustainable activities that are posted on social media in conjunction with organizations that you are interested in?
17	Group work	Would you be more willing to participate in sustainable activities in groups between family or friends?
21	Gamified advice	If social media convey sustainable advice by your favorite game elements, would you be more willing to accept it?

4.1.1 Background information (1-3)

The basic information of the sample is mainly three: age, gender, and educational background. From Figure 4.1, it can be seen that the participants of this survey are mainly young people aged 15-25 years old, accounting for 45.6%. Next, people aged 26-35 years old account for 23.2%. The ratio of male to female participants are approximately balanced, with slightly more females. The educational background of the participants is mainly bachelor's and master's degrees, with 119 bachelor's students and 58 master's students.

The above three factors would be cross-analyzed with other survey questions in the following sections to get more valuable results.

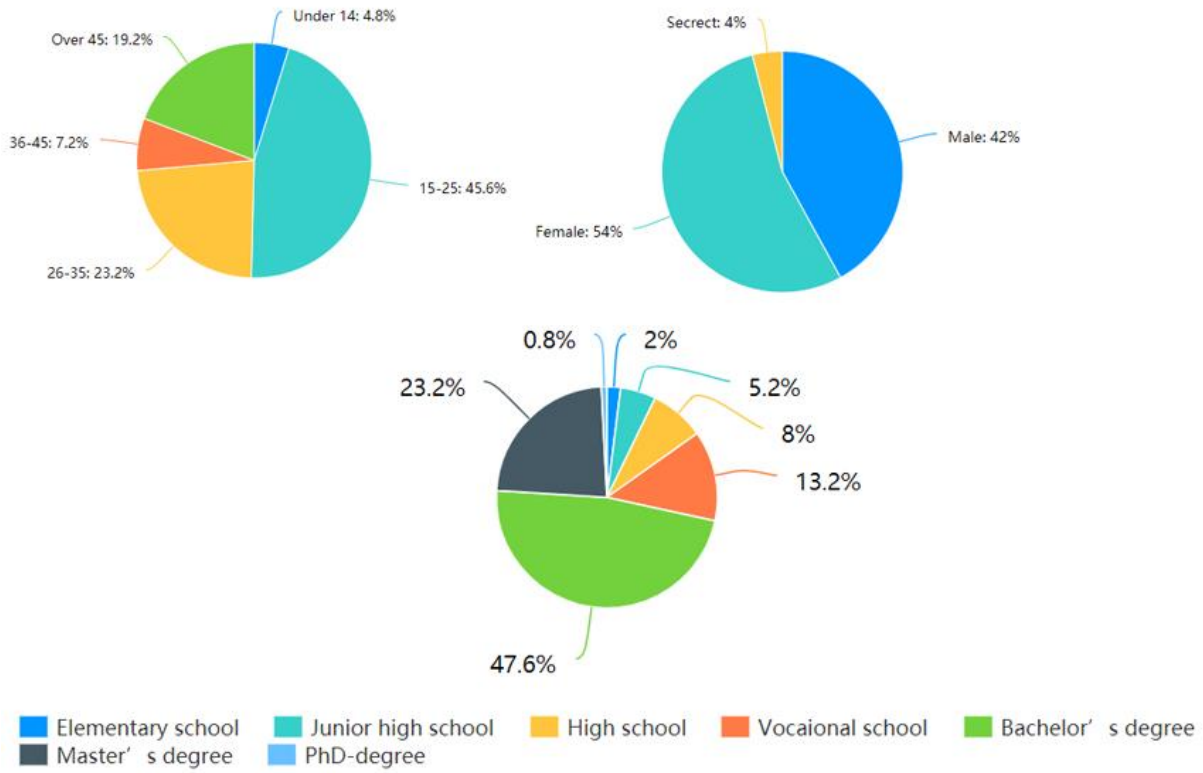


Figure 4.1: Age, gender and education background

4.1.2 The different types of social media and their impact on users (4-8)

Favourite social media

In general, as shown in Figure 4.2, the most popular type of social media for most participants is "social network site", which is the type of social media represented by Facebook and WeChat. Then there are "content community" and "collaborative project", and finally "online QA site", "virtual social worlds" and "virtual game worlds". Moreover, people of different age groups prefer different types of social media. For example, people under the age of 14 like content communities the most, and as people get older, people like social networks more, as shown in Figure 4.3.

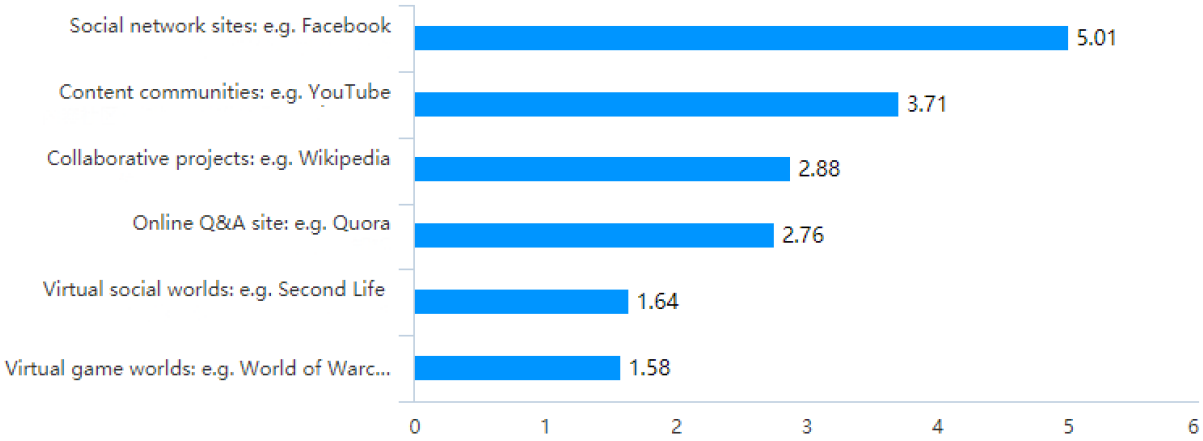


Figure 4.2: Favourite social media

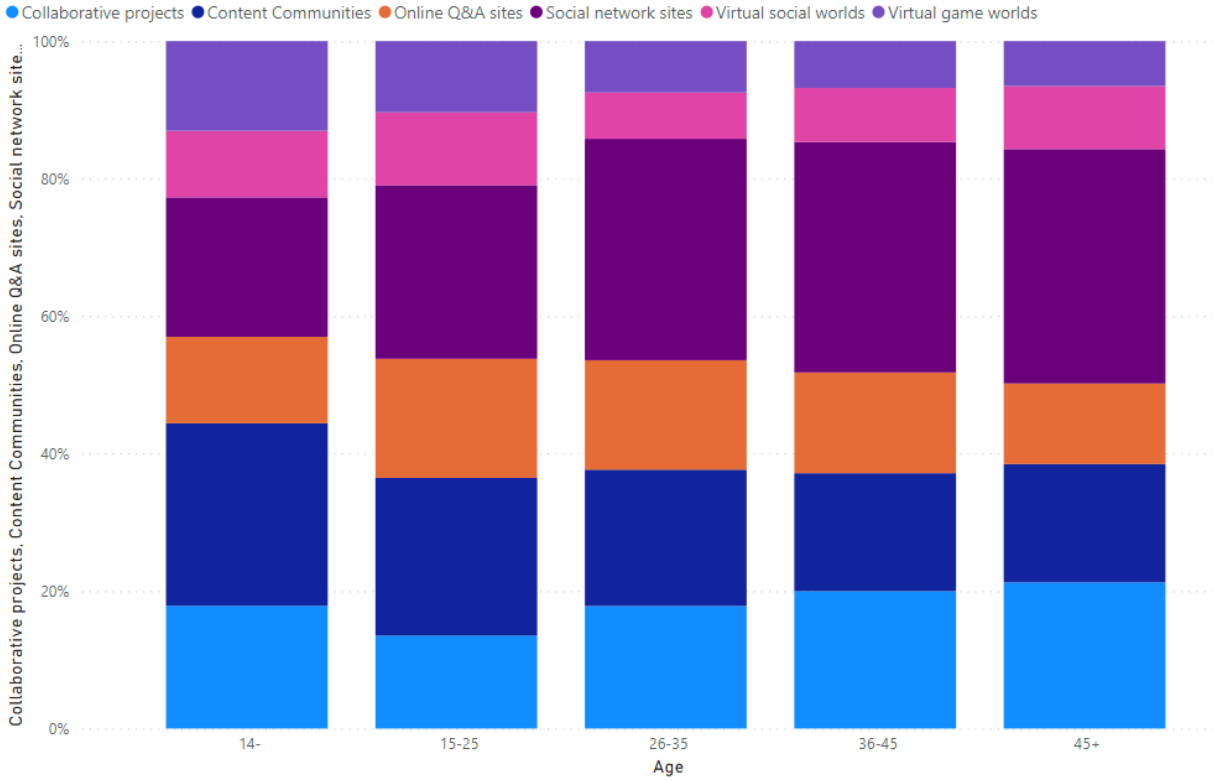


Figure 4.3: Age and favourite social media

Social media for obtaining information

It can be seen from Figure 4.4 that participants mainly obtain information from the three types of social media, social network site/content community/collaborative project, but through cross-analysis with age, it can be found that the type of social media for young people to obtain information is mainly the content community. As the age grows, the proportion of content community usage declines. The elderly prefers to use collaborative projects to obtain information, as shown in Figure 4.5. Similarly, through cross-analysis with educational background, it can be concluded that with the increase of education level, people obtain less and less information from the social network, and more and more information from the online Q&A sites, see Figure 4.6.

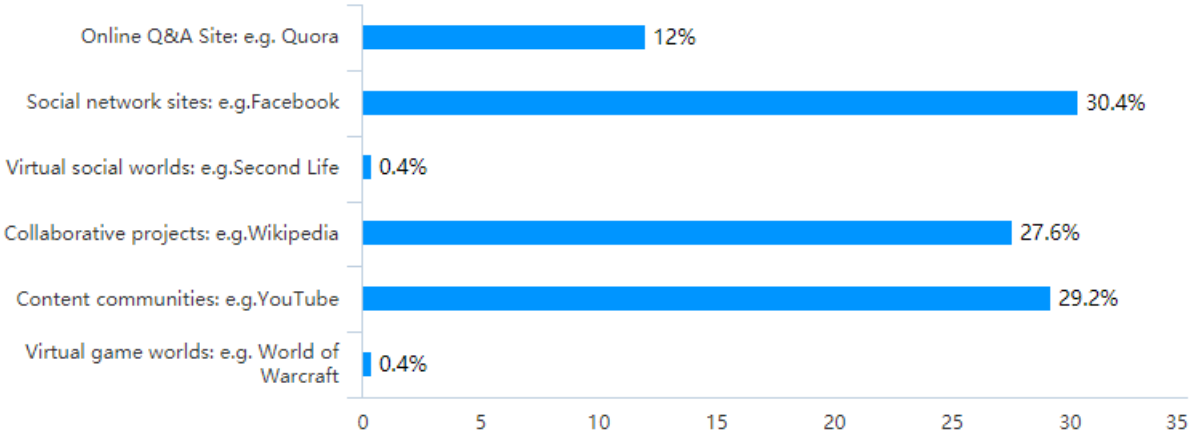


Figure 4.4: Which of the above types of social media do you use most to get information

X\Y	Online Q&A Site: e.g. Quora	Social network sites: e.g.Facebook	Virtual social worlds: e.g.Second Life	Collaborative projects: e.g.Wikipedia	Content communities: e.g.YouTube	Virtual game worlds: e.g. World of Warcraft	Count
Under 14	0(0.00%)	2(16.67%)	0(0.00%)	3(25%)	7(58.33%)	0(0.00%)	12
15-25	16(14.04%)	38(33.33%)	0(0.00%)	15(13.16%)	44(38.60%)	1(0.88%)	114
26-35	8(13.79%)	16(27.59%)	0(0.00%)	17(29.31%)	17(29.31%)	0(0.00%)	58
36-45	3(16.67%)	4(22.22%)	1(5.56%)	7(38.89%)	3(16.67%)	0(0.00%)	18
Over 45	3(6.25%)	16(33.33%)	0(0.00%)	27(56.25%)	2(4.17%)	0(0.00%)	48

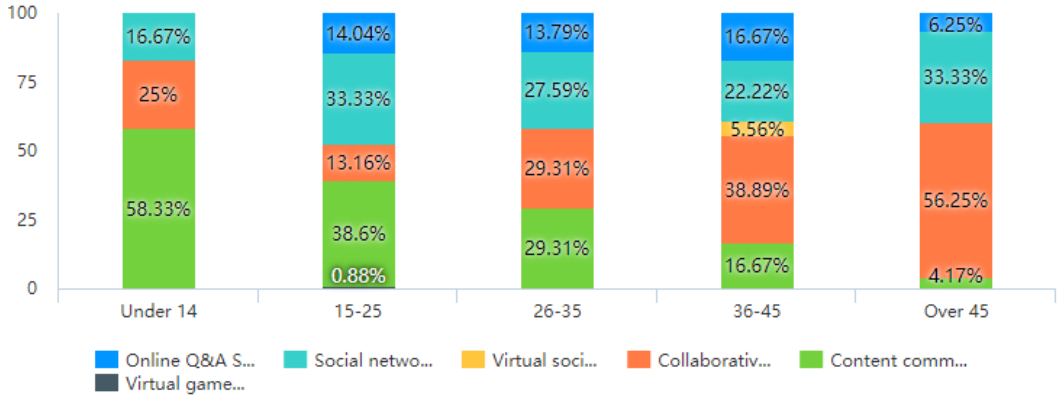


Figure 4.5: Cross-analysis: age and social media that obtaining information

X\Y	Online Q&A Site: e.g. Quora	Social network sites: e.g.Facebook	Virtual social worlds: e.g.Second Life	Collaborative projects: e.g.Wikipedia	Content communities: e.g.YouTube	Virtual game worlds: e.g. World of Warcraft	Count
Elementary school	1(20%)	2(40%)	0(0.00%)	1(20%)	1(20%)	0(0.00%)	5
Junior high school	0(0.00%)	2(15.38%)	0(0.00%)	3(23.08%)	8(61.54%)	0(0.00%)	13
High school	0(0.00%)	9(45%)	0(0.00%)	7(35%)	4(20%)	0(0.00%)	20
Vocational school	2(6.06%)	12(36.36%)	0(0.00%)	10(30.30%)	8(24.24%)	1(3.03%)	33
Bachelor's degree	14(11.76%)	37(31.09%)	1(0.84%)	35(29.41%)	32(26.89%)	0(0.00%)	119
Master's degree	12(20.69%)	14(24.14%)	0(0.00%)	12(20.69%)	20(34.48%)	0(0.00%)	58
PhD-degree	1(50%)	0(0.00%)	0(0.00%)	1(50%)	0(0.00%)	0(0.00%)	2

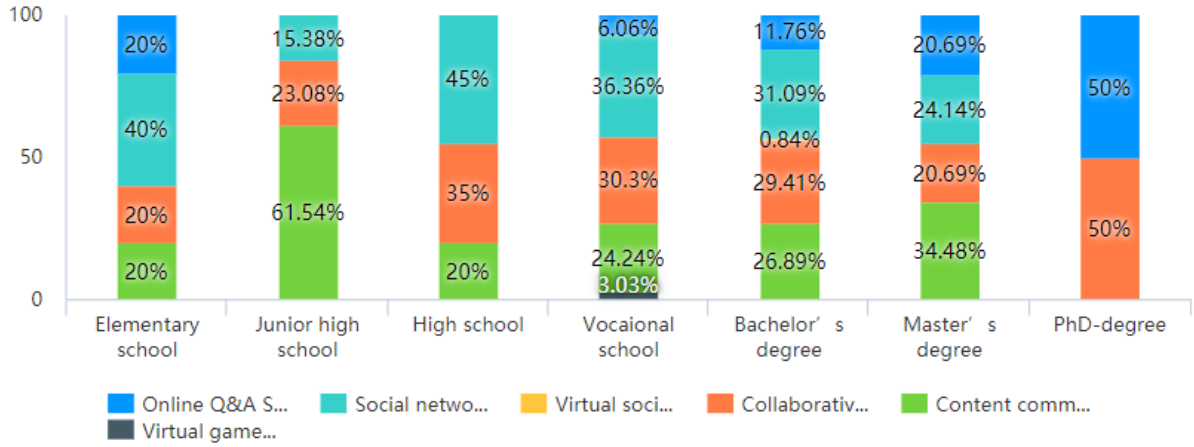


Figure 4.6: Cross-analysis: education background and social media that obtaining information

PC/mobile and duration of use

Most participants usually use social media on mobile and spend 1-3 hours on social media every day, as shown in Figure 4.7. Also, young people (15-35 years old) use significantly longer time than older people (over 36 years old) (the reason why people under 14 use social media for a short time may be due to parental control/school pressure Etc.), see Figure 4.8. Moreover, the factor "duration of use" can also be cross-analyzed with many other factors, which would be described later.

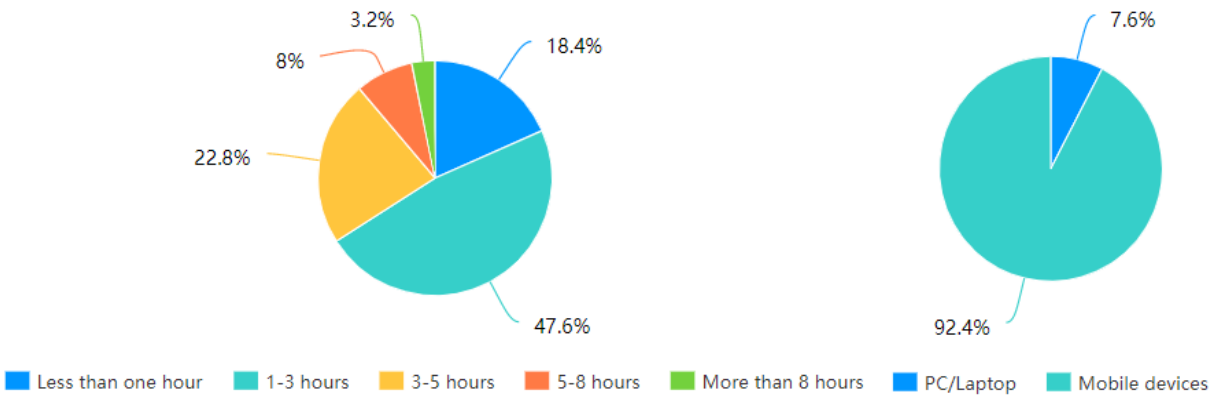


Figure 4.7: PC/mobile and duration of use

X\Y	Less than one hour	1-3 hours	3-5 hours	5-8 hours	More than 8 hours	count
Under 14	10(83.33%)	2(16.67%)	0(0.00%)	0(0.00%)	0(0.00%)	12
15-25	9(7.89%)	52(45.61%)	33(28.95%)	14(12.28%)	6(5.26%)	114
26-35	3(5.17%)	32(55.17%)	17(29.31%)	4(6.90%)	2(3.45%)	58
36-45	5(27.78%)	11(61.11%)	0(0.00%)	2(11.11%)	0(0.00%)	18
Over 45	19(39.58%)	22(45.83%)	7(14.58%)	0(0.00%)	0(0.00%)	48

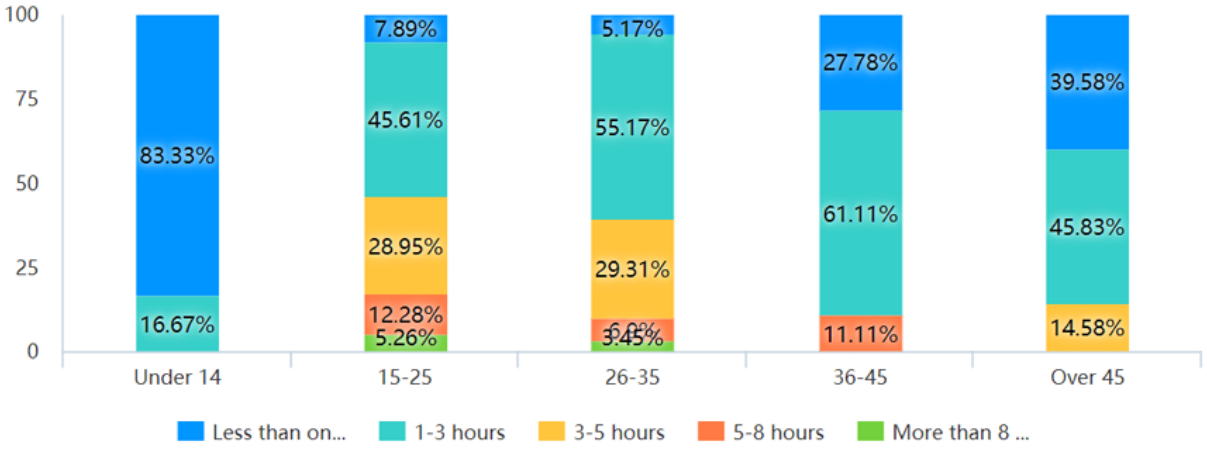


Figure 4.8: Cross-analysis: age and duration of use

Social media changes in habits

More than half of the participants believe that social medias have changed their consumption and learning habits in the long term, as shown in Table 4.2. At the same time, more than 30% of participants believe that their travel habits, eating habits and social habits have been changed, while less than 10% of participants believe that any of their habits have not been affected by social media. When cross-analyzed with educational background, as shown in Figure 4.9, as the education level increases, the more the learning habits are affected and changed. Similarly, when cross-analyzed with the duration of use, the basic trend was found to be that the longer the time spent using social media, the more habits were changed, as shown in Figure 4.10.

Table 4.2: Social media changes in habits

Options	Count	Percentage
Learning habits (online and offline course, learning place, learning time, learning duration, learning methods, etc.)	141	56.4%

Travel habits (transportation choice, driving habits, etc.)	99	39.6%
Eating habits (food choices, cooking methods, eating places, eating healthy, reducing food waste, etc.)	96	38.4%
Consumption habits (payment methods, changes in shopping types, online and offline shopping, consumption level, etc.)	144	57.6%
Social habits (social etiquette, etc.)	88	35.2%
Living habits (save water, save electricity, etc.)	52	20.8%
Not affected	24	9.6%
Number of Participants in this question	250	

X\Y	Learning habits (online and offline course, learning place, learning time, learning duration, learning methods, etc.)	Travel habits (transportation choice, driving habits, etc.)	Eating habits (food choices, cooking methods, eating places, eating healthy, reducing food waste, etc.)	Consumption habits (payment methods, changes in shopping types, online and offline shopping, consumption level, etc.)	Social habits (social etiquette, etc.)	Living habits (save water, save electricity, etc.)	Not affected	Count
Elementary school	0(0.00%)	1(20%)	1(20%)	0(0.00%)	0(0.00%)	0(0.00%)	3(60%)	5
Junior high school	7(53.85%)	6(46.15%)	8(61.54%)	7(53.85%)	7(53.85%)	4(30.77%)	1(7.69%)	13
High school	8(40%)	4(20%)	6(30%)	11(55%)	4(20%)	5(25%)	2(10%)	20
Vocational school	10(30.30%)	13(39.39%)	17(51.52%)	16(48.48%)	7(21.21%)	5(15.15%)	5(15.15%)	33
Bachelor's degree	76(63.87%)	52(43.70%)	45(37.82%)	75(63.03%)	43(36.13%)	26(21.85%)	11(9.24%)	119
Master's degree	38(65.52%)	22(37.93%)	18(31.03%)	34(58.62%)	26(44.83%)	12(20.69%)	2(3.45%)	58
PhD-degree	2(100%)	1(50%)	1(50%)	1(50%)	1(50%)	0(0.00%)	0(0.00%)	2

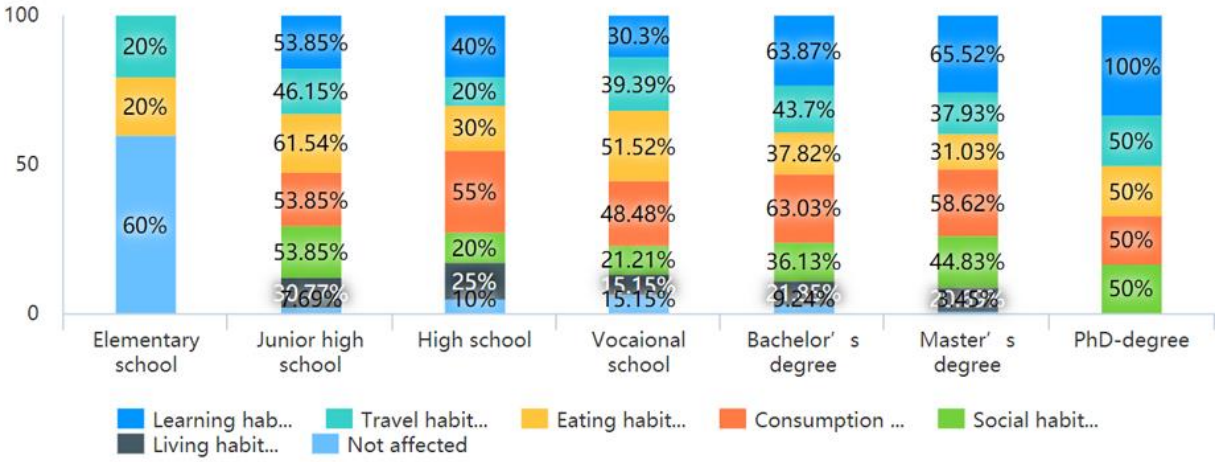


Figure 4.9: Cross-analysis: education background and habits changed by social media

X\Y	Learning habits (online and offline course, learning place, learning time, learning duration, learning methods, etc.)	Travel habits (transportation choice, driving habits, etc.)	Eating habits (food choices, cooking methods, eating places, eating healthy, reducing food waste, etc.)	Consumption habits (payment methods, changes in shopping types, online and offline shopping, consumption level, etc.)	Social habits (social etiquette, etc.)	Living habits (save water, save electricity, etc.)	Not affected	Count
Less than one hour	21(45.65%)	15(32.61%)	21(45.65%)	17(36.96%)	10(21.74%)	8(17.39%)	8(17.39%)	46
1-3 hours	66(55.46%)	48(40.34%)	39(32.77%)	68(57.14%)	42(35.29%)	22(18.49%)	12(10.08%)	119
3-5 hours	38(66.67%)	26(45.61%)	24(42.11%)	40(70.18%)	26(45.61%)	17(29.82%)	2(3.51%)	57
5-8 hours	13(65%)	6(30%)	9(45%)	15(75%)	8(40%)	4(20%)	0(0.00%)	20
More than 8 hours	3(37.5%)	4(50%)	3(37.5%)	4(50%)	2(25%)	1(12.5%)	2(25%)	8

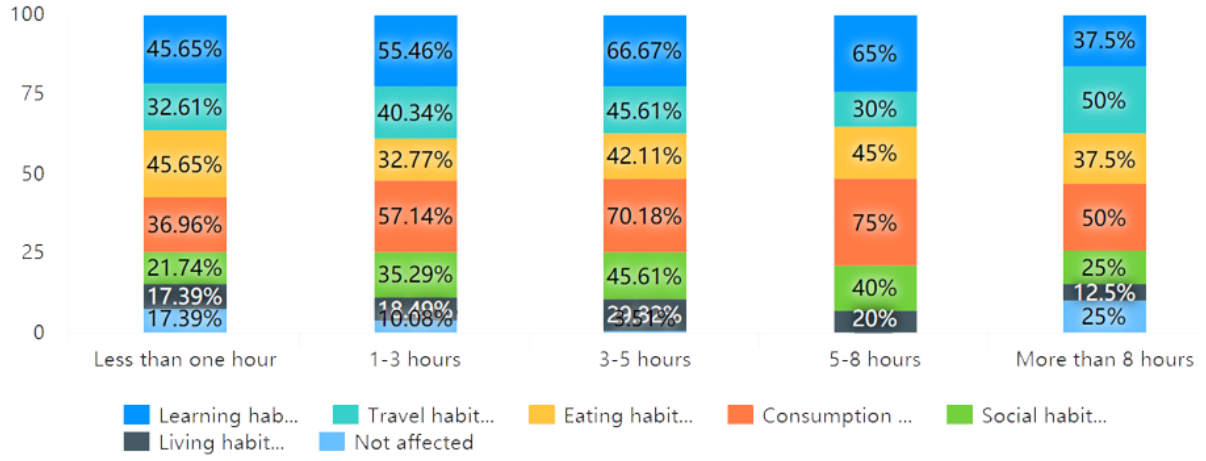


Figure 4.10: Cross-analysis: duration of use and habits changed by social media

4.1.3 Users' attitudes towards sustainability messages on social media and their willingness to change their behavior based on the messages (9-13)

Following sustainability news, changing behavior based on suggestions

The mean value of participants' attention to sustainability-related messages posted on social media is 2.99, in the range of 0-5, as shown in Figure 4.11(a). It can be observed that most of the participants select the more neutral symbol of 3. Similarly, when receiving sustainability advice on social media, the mean value of participants' willingness to accept the advice to change behavior is 3, and the participants' choices are mainly on 2-3, as shown in Figure 4.11(b). Among them, after cross-analysis with age, it is found that participants aged 15-25 are more willing to follow sustainable advice, as shown in Figure 12. After cross-analysis with the duration of use, it is found that, excluding those with a duration of more than eight hours, the basic trend is that the longer the duration of use, the more willing to follow sustainability-related messages, see Figure 4.13.

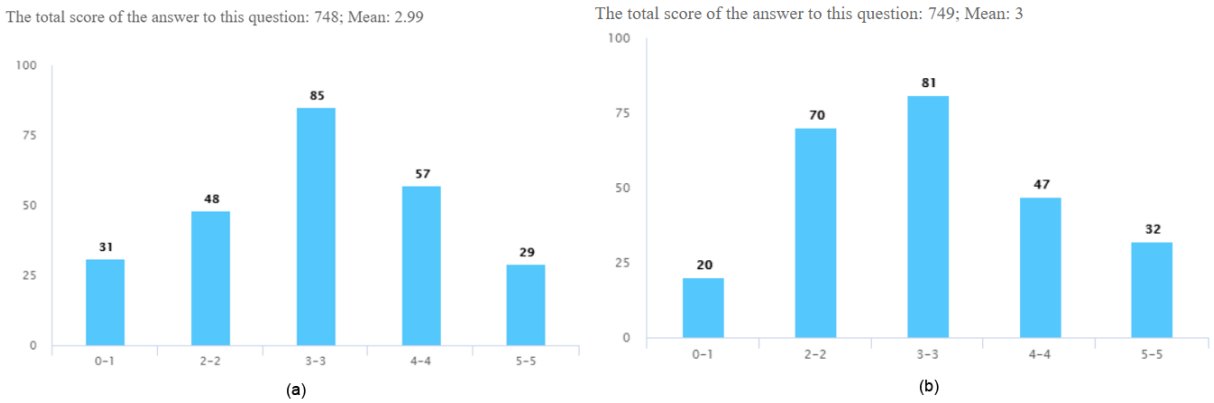


Figure 4.11: Following sustainability news and changing behavior based on suggestions

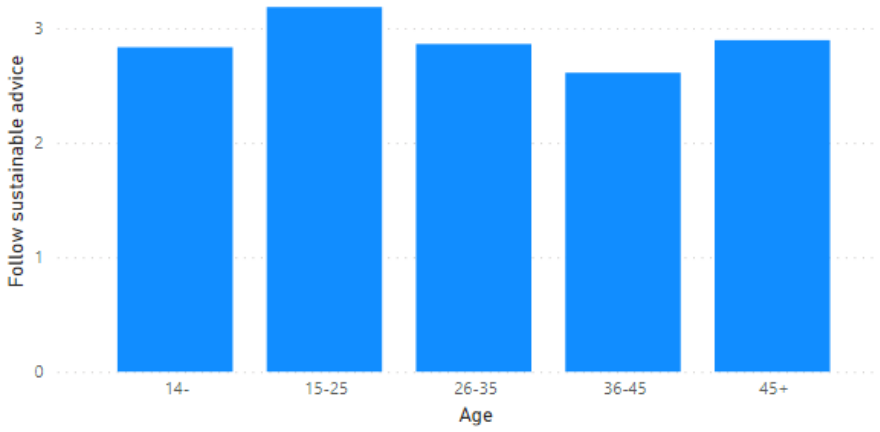


Figure 4.12: Age and follow sustainable advice

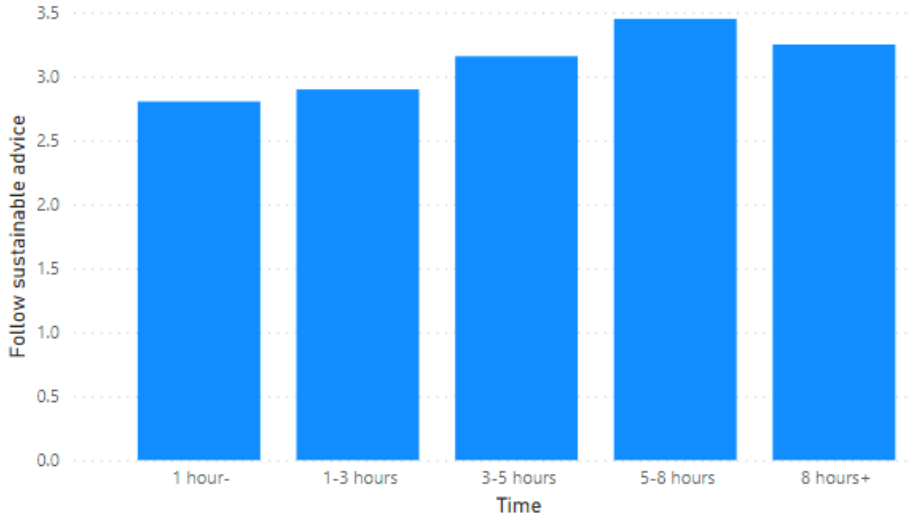


Figure 4.13: Duration of use and following sustainability news

Reasons for not taking action

As shown in Table 4.3, when people are continuously guided by social media, the main reason for not taking action is not knowing what they can do, not knowing what impact their actions can have, and thinking that their own efforts cannot help solving this problem.

Table 4.3: Reasons for not taking action (a)

Options	Count	Percentage
It is not relevant with my life	37	14.8%
I don’t know what I can do about this problem	137	54.8%
I don’t know how much influence my actions can have	104	41.6%
My personal contribution can't improve the situation/problem	103	41.2%
Can’t bring me real benefits	27	10.8%
Number of Participants in this question	250	

Willingness to learn about the impact of actions

The mean value of participants’ willingness to want to know the specific impact of their actions on sustainability is 3.49, which is in the range of 0-5, see Figure 4.14. It is noteworthy that the participants’ choices are mainly on 3-5. Also, a cross-analysis with age reveals that willingness is decreasing with age, see Figure 4.15 (Age). Similarly, the cross-analysis with the education background reveals that willingness is higher for junior high school students, bachelor’s degree students and master’s degree students, see Figure 4.15 (Education).

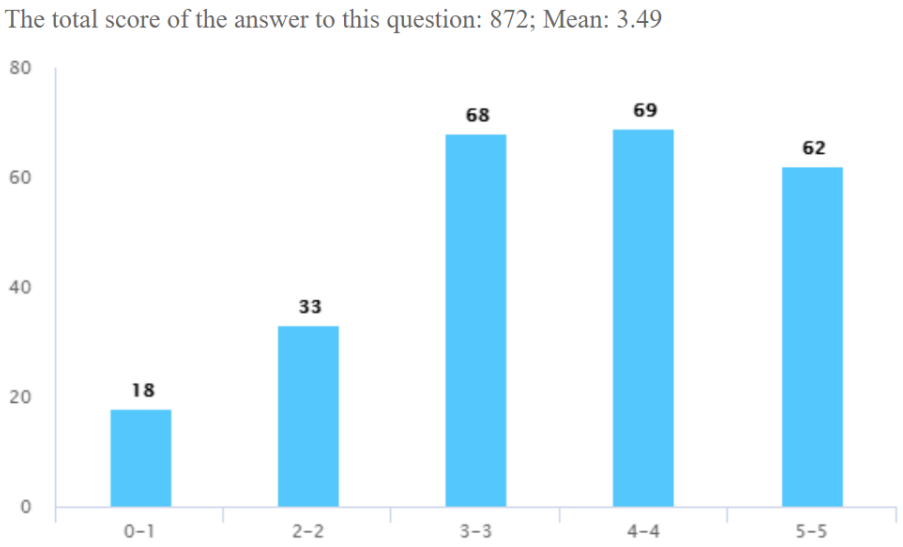


Figure 4.14: Willingness to learn about the impact of actions (a)

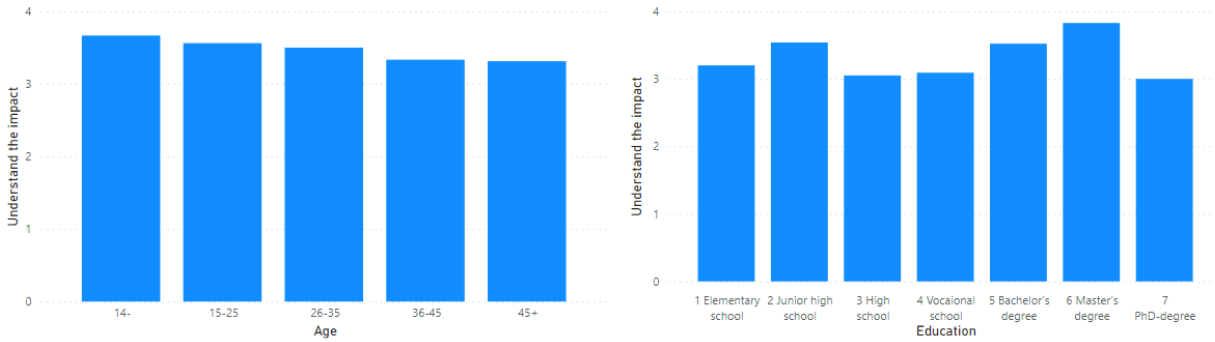


Figure 4.15: Willingness to learn about the impact of actions (b)

Willingness to change behavior

After participants understood their impact on sustainability, the mean value of willingness to change their behavior is 3.54, in the range of 0-5, as shown in Figure 4.16. Participants' choices are mainly concentrated in the range of 3-5. And cross-analysis with education level revealed that excluding elementary and middle school, the basic trend is that the higher the education level, the higher the willingness level, see Figure 4.17.

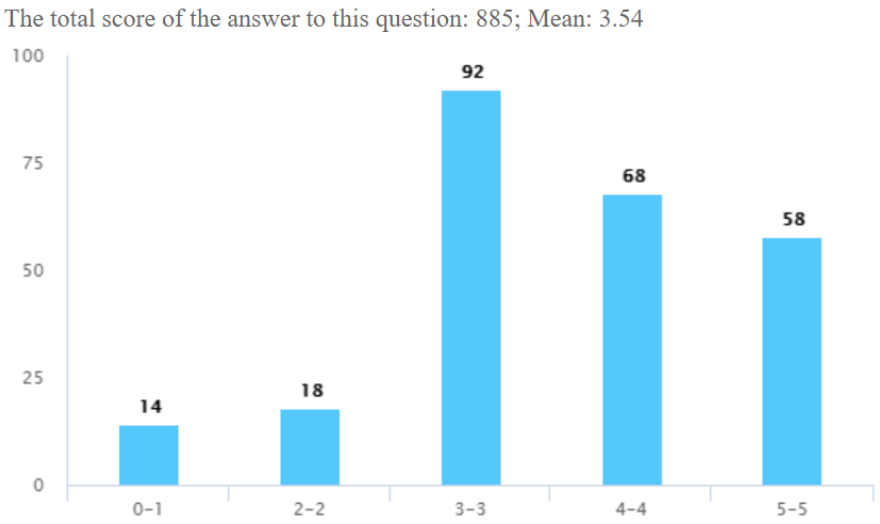


Figure 4.16: Willingness to change behavior

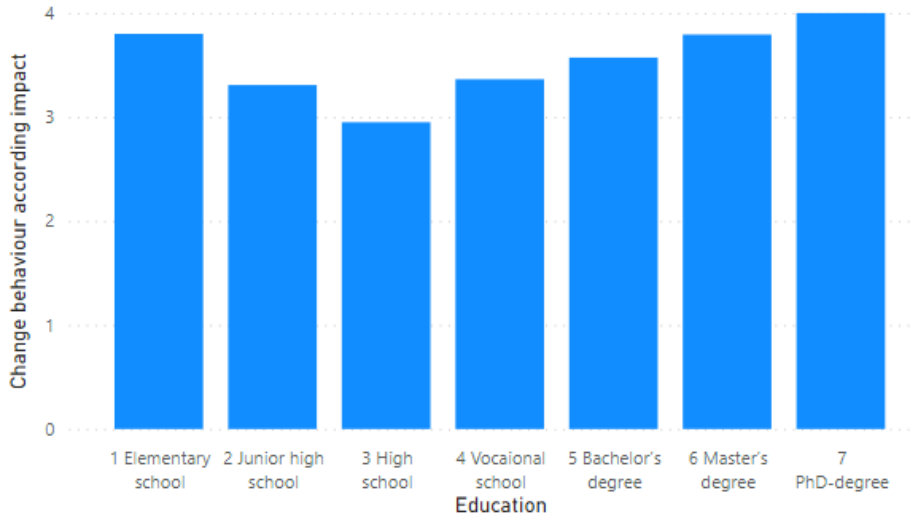


Figure 4.17: Education and willingness to change behavior

4.1.4 Users' perceptions of gamification on social media and their attitudes towards the sustainability of social media through gamification. (14-21)

Feedback

If more detailed feedback could be received, participants' willingness to change their behavior averaged 3.76, which is in the range of 0-5, as shown in Figure 4.18. And participants' choices are mainly in the range of 3-5. Moreover, a cross-analysis with the duration of use shows that the longer the duration of use, the higher the willingness to change behavior, see Figure 4.19.

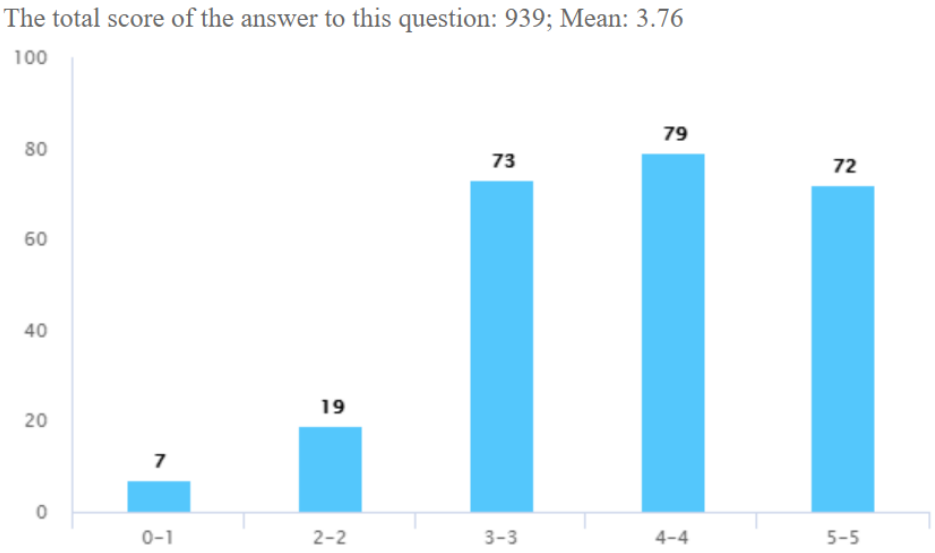


Figure 4.18: Feedback

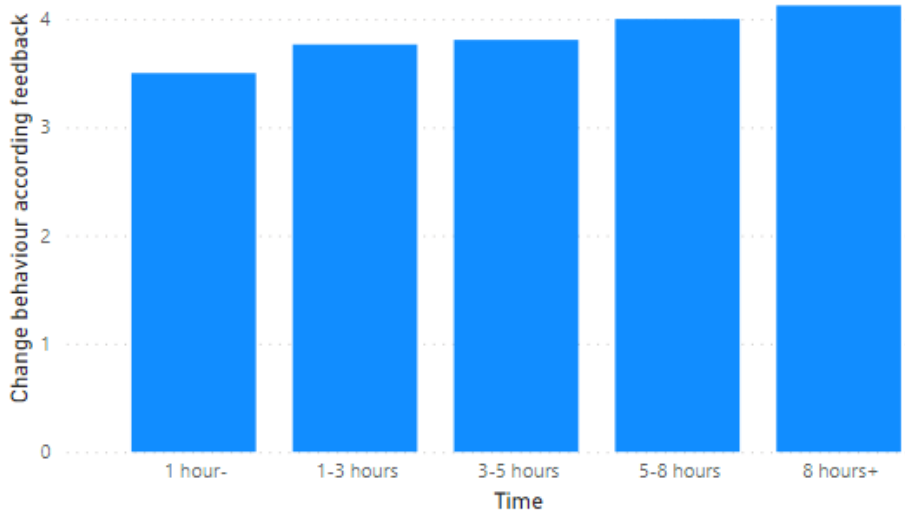


Figure 4.19: Duration of time and feedback

How to be more willing to accept

It can be seen from Table 4.4 that suggestions, rewards and social scenarios would greatly increase the user's acceptance of social media suggestions, and interesting ways, detailed feedback and examples would also be affected to a certain extent. Only three people chose not to accept it anyway. If cross-analyzed with age, it could be found that young people under the age of 35 pay more attention to interesting ways of persuasion than people over 35, see Figure 4.20. When cross-analyzed with the education background, it was found that with the increase in education level, people pay more and more attention to reward, see Figure 4.21. When cross-analyzed with gender, it was found that females pay more attention to social scenarios than males, see Figure 4.22.

Table 4.4: Reasons for not taking action (b)

Options	Count	Percentage
Social scenarios (e.g., news shared by friends and family, people around you are using it, etc.)	114	45.6%
Examples (e.g., celebrity endorsements and advice, etc.)	72	28.8%
Rewards (e.g., money, voucher rewards, virtual items rewards, physical rewards, honors, etc.)	117	46.8%
Suggestions or opinions that are relevant to your current life (e.g., exam information for candidates, treatment information for patients, etc.)	147	58.8%

Detailed feedback (e.g., immediate feedback on the impact of your actions)	96	38.4%
Interesting ways of persuasion (e.g., games, stories)	105	42%
I don’t accept it anyway	3	1.2%
Number of Participants in this question	250	

X\Y	Social scenarios (e.g., news shared by friends and family, people around you are using it, etc.)	Examples (e.g., celebrity endorsements and advice, etc.)	Rewards (e.g., money, voucher rewards, virtual items rewards, physical rewards, honors, etc.)	Suggestions or opinions that are relevant to your current life (e.g. exam information for candidates, treatment information for patients, etc.)	Detailed feedback (e.g., immediate feedback on the impact of your actions)	Interesting ways of persuasion (e.g., games, stories)	I don't accept it anyway	Count
Under 14	7(58.33%)	5(41.67%)	5(41.67%)	4(33.33%)	3(25%)	7(58.33%)	0(0.00%)	12
15-25	51(44.74%)	32(28.07%)	64(56.14%)	81(71.05%)	51(44.74%)	50(43.86%)	1(0.88%)	114
26-35	22(37.93%)	18(31.03%)	23(39.66%)	32(55.17%)	25(43.10%)	27(46.55%)	1(1.72%)	58
36-45	11(61.11%)	7(38.89%)	8(44.44%)	12(66.67%)	5(27.78%)	5(27.78%)	0(0.00%)	18
Over 45	23(47.92%)	10(20.83%)	17(35.42%)	18(37.5%)	12(25%)	16(33.33%)	1(2.08%)	48

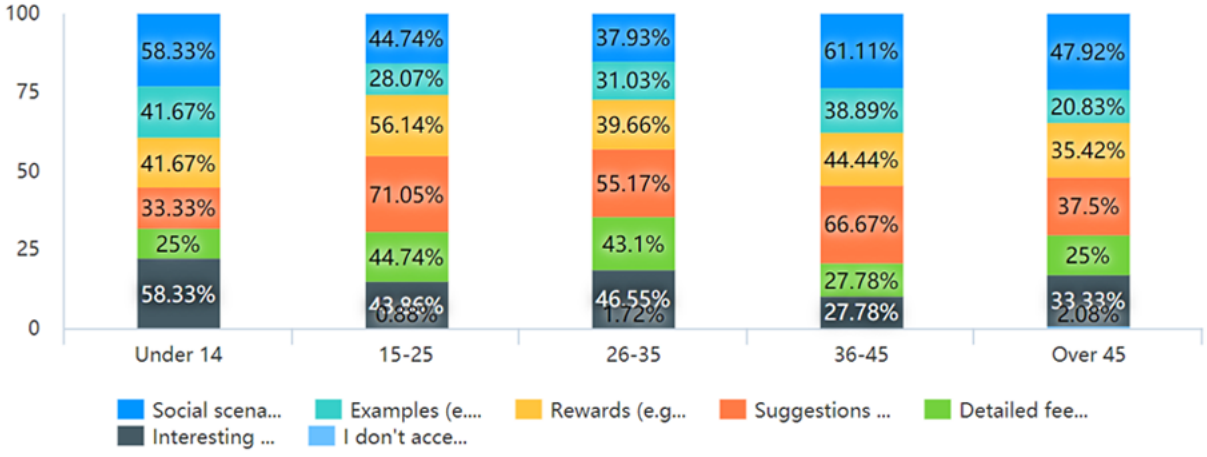


Figure 4.20: Cross analysis: age and how to be more willing to accept

X\Y	Social scenarios (e.g., news shared by friends and family, people around you are using it, etc.)	Examples (e.g., celebrity endorsements and advice, etc.)	Rewards (e.g., money, voucher rewards, virtual items rewards, physical rewards, honors, etc.)	Suggestions or opinions that are relevant to your current life (e.g. exam information for candidates, treatment information for patients, etc.)	Detailed feedback (e.g., immediate feedback on the impact of your actions)	Interesting ways of persuasion (e.g., games, stories)	I don't accept it anyway	Count
Elementary school	3(60%)	1(20%)	1(20%)	1(20%)	0(0.00%)	1(20%)	0(0.00%)	5
Junior high school	7(53.85%)	6(46.15%)	5(38.46%)	5(38.46%)	4(30.77%)	8(61.54%)	0(0.00%)	13
High school	4(20%)	6(30%)	7(35%)	9(45%)	6(30%)	5(25%)	1(5%)	20
Vocational school	14(42.42%)	9(27.27%)	15(45.45%)	14(42.42%)	9(27.27%)	13(39.39%)	1(3.03%)	33
Bachelor's degree	58(48.74%)	37(31.09%)	57(47.90%)	80(67.23%)	50(42.02%)	51(42.86%)	1(0.84%)	119
Master's degree	27(46.55%)	13(22.41%)	30(51.72%)	37(63.79%)	26(44.83%)	26(44.83%)	0(0.00%)	58
PhD-degree	1(50%)	0(0.00%)	2(100%)	1(50%)	1(50%)	1(50%)	0(0.00%)	2

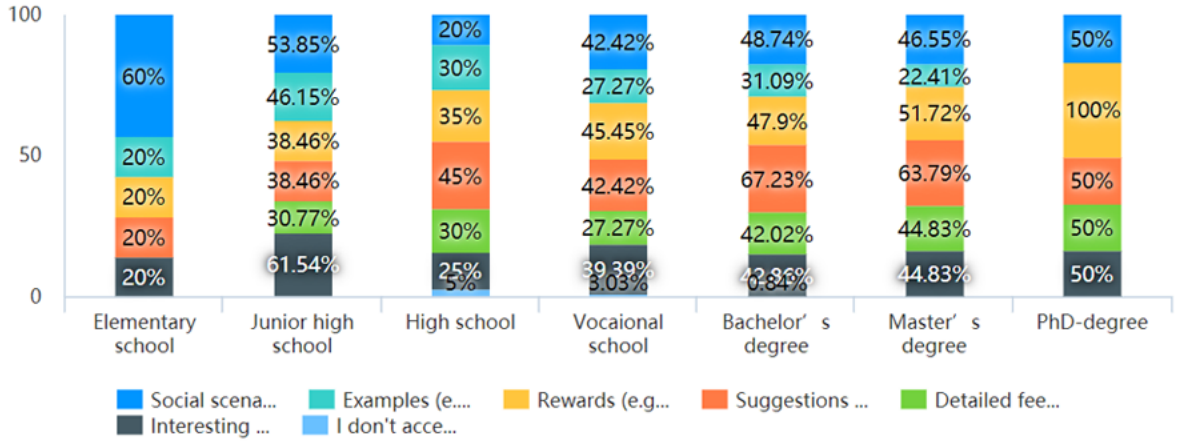


Figure 4.21: Cross analysis: education background and how to be more willing to accept

X\Y	Social scenarios (e.g., news shared by friends and family, people around you are using it, etc.)	Examples (e.g., celebrity endorsements and advice, etc.)	Rewards (e.g., money, voucher rewards, virtual items rewards, physical rewards, honors, etc.)	Suggestions or opinions that are relevant to your current life (e.g. exam information for candidates, treatment information for patients, etc.)	Detailed feedback (e.g., immediate feedback on the impact of your actions)	Interesting ways of persuasion (e.g., games, stories)	I don't accept it anyway	小计
Male	36(34.29%)	26(24.76%)	52(49.52%)	60(57.14%)	39(37.14%)	42(40%)	1(0.95%)	105
Female	75(55.56%)	45(33.33%)	61(45.19%)	84(62.22%)	55(40.74%)	57(42.22%)	2(1.48%)	135
Secret	3(30%)	1(10%)	4(40%)	3(30%)	2(20%)	6(60%)	0(0.00%)	10

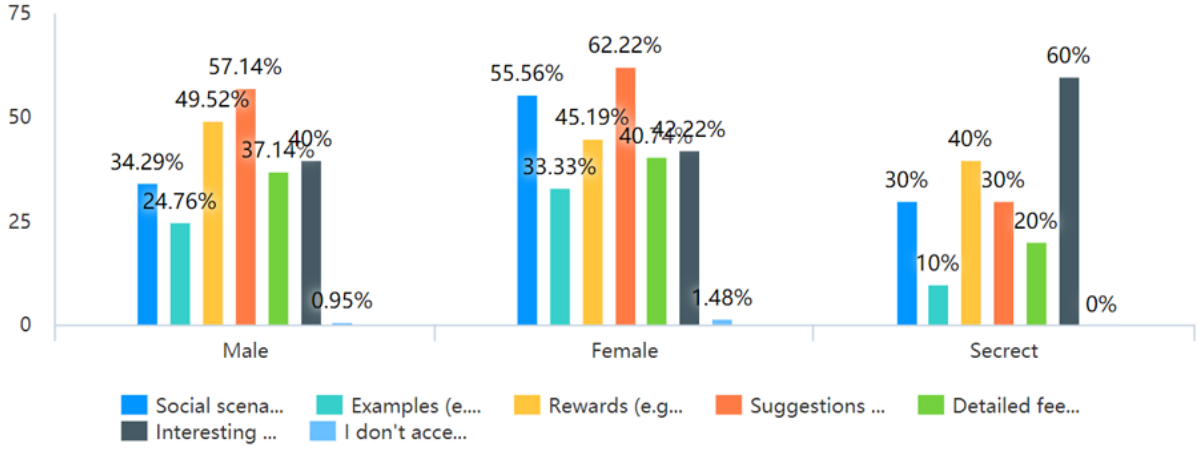


Figure 4.22: Cross analysis: gender and how to be more willing to accept

Role Models and Celebrities, Community

The mean value of participants' willingness to participate in sustainable activities posted by interested organizations and celebrities is 2.77, in the range of 0-5, as shown in Figure 4.23(a). The main choices are on 3. In contrast, the mean value of participants' willingness to participate in sustainable activities in the community is 3.34, with the main choices on 3-5, see Figure 4.23(b). Cross-analysis with age shows that young people under 35 years old are more willing to participate in sustainable activities in the community than those over 35 years old, see Figure 4.24.

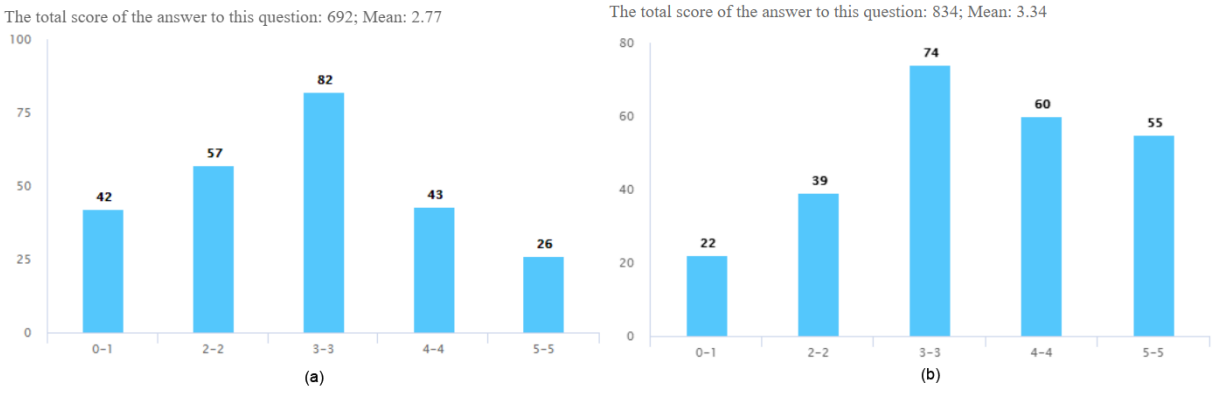


Figure 4.23: Role Models and Celebrities, Community

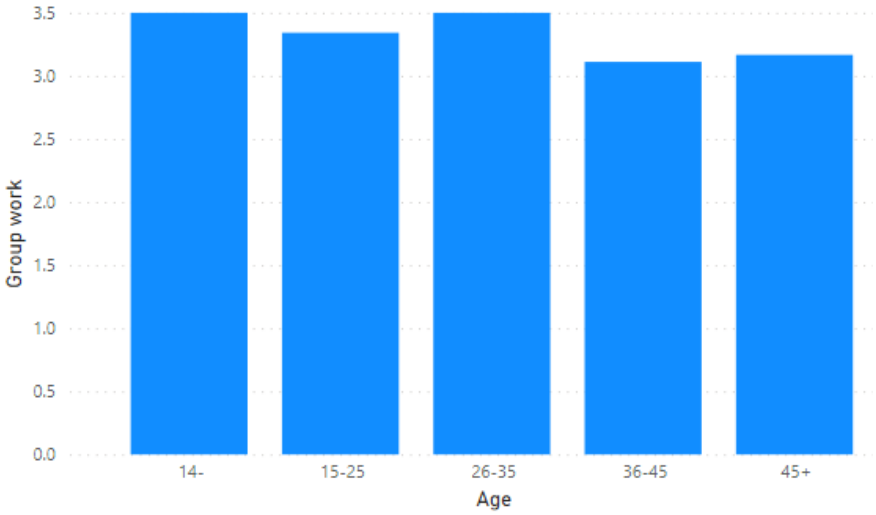


Figure 4.24: Age and community

Gamification elements

It can be seen from Table 4.5 that the participants have a certain understanding of various gamification elements in the question. Cross-analysis with gender reveals that men generally understand gamification elements better than women, as shown in Figure 4.25. For the most common gamification elements, the top three are activity, payment and ability, as shown in Figure 4.26, and these three gamification elements are also the most popular among users, as shown in Figure 4.27.

Table 4.5: Understanding of gamification elements

Options	Count	Percentage
Feedback	71	28.4%
Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family)	130	52%
Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion/)	115	46%
Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty)	135	54%
Status (Statistic/Use duration statistics/ subscription number statistics;	115	46%

Leaderboard; Avatar; Level; Progress; History; Social graph)		
Sharing (Telling people; Charity)	88	35.2%
Number of Participants in this question	250	

X\Y	Feedback	Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family)	Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion/)	Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty)	Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)	Sharing (Telling people; Charity)	Count
Male	29(27.62%)	61(58.10%)	55(52.38%)	62(59.05%)	52(49.52%)	33(31.43%)	105
Female	40(29.63%)	66(48.89%)	58(42.96%)	68(50.37%)	62(45.93%)	52(38.52%)	135
Secret	2(20%)	3(30%)	2(20%)	5(50%)	1(10%)	3(30%)	10

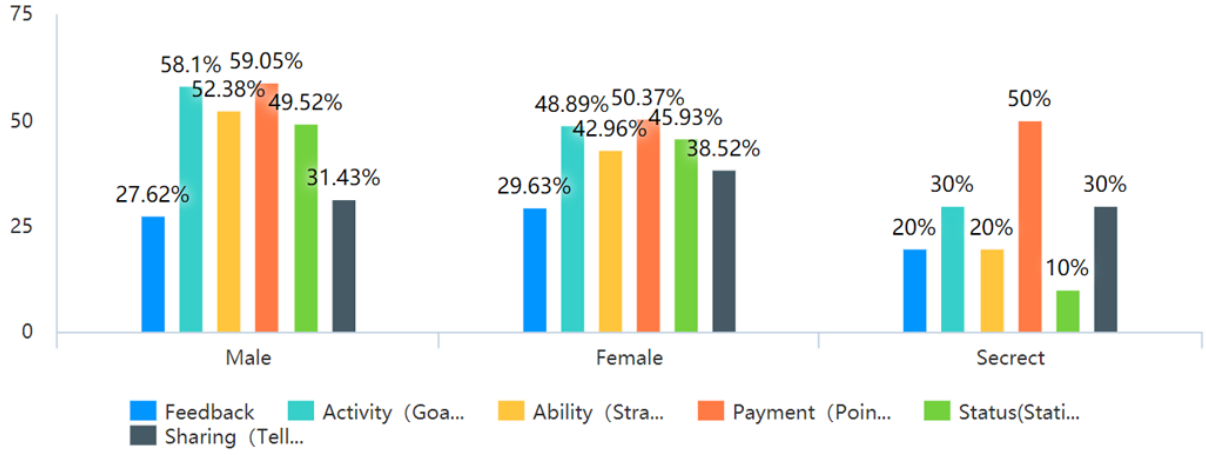


Figure 4.25: Cross analysis: gender and understanding of game elements

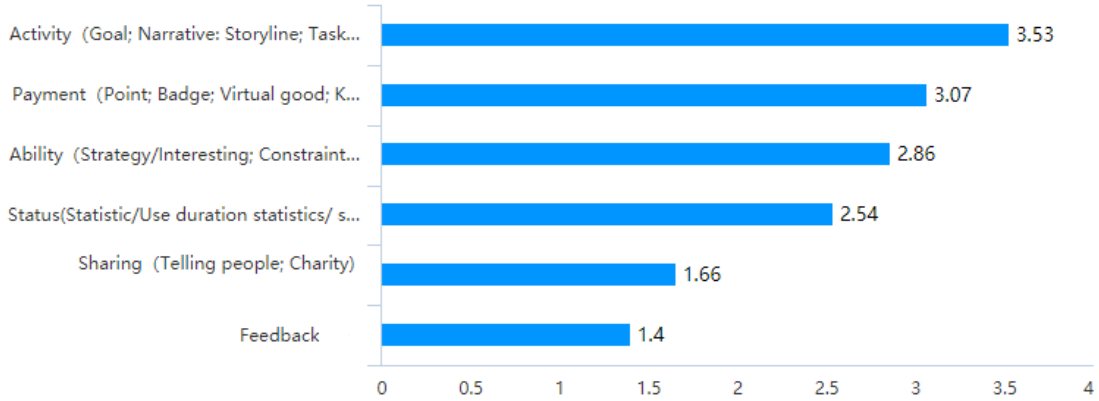


Figure 4.26: Common game elements

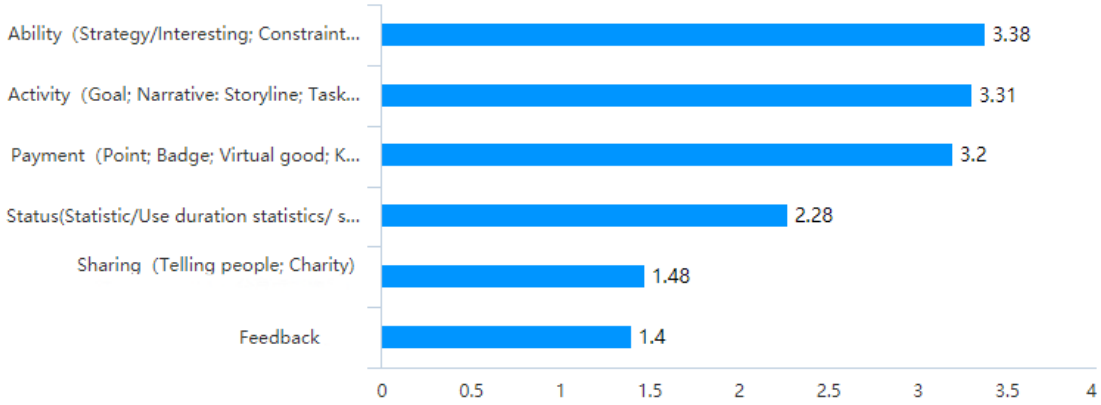


Figure 4.27: Favourite game elements

Social media uses gamification to convey sustainable

The mean value of participants' willingness to use social media to communicate sustainable ways through gamification is 3.41, which is in the range of 0-5, among which the options are mainly concentrated in the range of 3-5, as shown in Figure 4.28. Cross-analysis with age shows that young people under the age of 35 have a higher willingness, as shown in Figure 4.29 (Age); cross-analysis with education background shows that excluding junior high school students and PhDs, the basic trend is, the higher the education level, the higher the willingness, as shown in Figure 4.29 (Education).

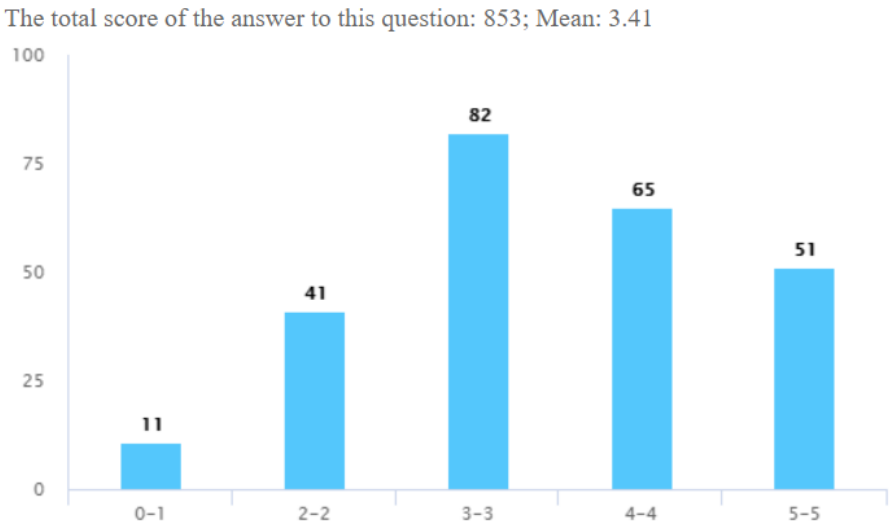


Figure 4.28: Social media uses gamification to convey sustainable

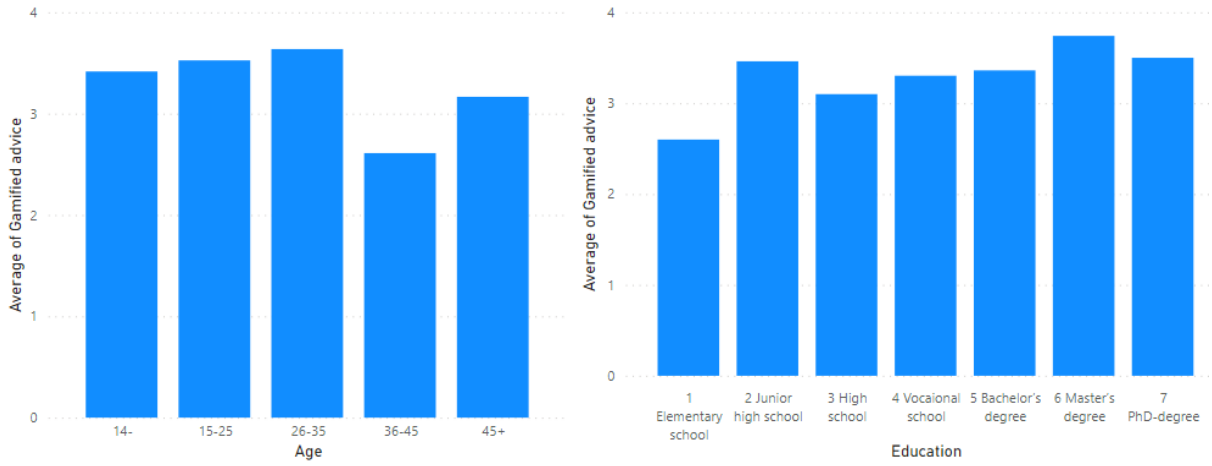


Figure 4.29: Age, education background and gamified sustainable advice on social media

4.2 Survey findings

The survey shows that people do not pay much attention to sustainable news on social media and have a low willingness to change their behavior according to the sustainable advice provided by social media. This is contrary to the views of Fraser (2011) and Wenzel (2009). Thus, it can be inferred that it is necessary to encourage users to increase their awareness of sustainability-related messages on social media. This further demonstrates the importance of using interesting gamification methods to drive awareness of sustainability. Also, the survey result shows that when people are continuously guided by social media, the main reasons for not taking action are not knowing what they can do, not knowing what impact their actions can have, and thinking that their own efforts cannot help solving this problem. This is consistent with arguments by Poortinga et al. (2004). Therefore, in the process of using gamification to make users sustainable, social media should take these three reasons into full consideration and reflect on whether these three problems have been well solved in the evaluation stage. For specific methods, the suggestions were given by Zapico et al. (2009), Lin and Huang (2012), Roundtable (2006), and Mankoff et al. (2007) are very suitable for solving the above problems.

Most users are willing to understand the impact of their actions on sustainability, and they are willing to change their behavior after understanding that. This confirms the viewpoint of Handelman and Arnold (1999), and also illustrates the huge potential of social media for guiding users to live a sustainable life. Moreover, it shows that most people are more willing to accept sustainable information on social media through gamification, especially young people. This also validates the ideas of Siddiqui and Singh (2016) and suggests that gamification may be more appealing to young people.

Further, people would be more willing to accept the suggestions of social media through some specific means. According to the survey, three methods: suggestion, reward and social scenarios would increase the willingness of users to accept. These are among the 25 game elements identified by Sitorus et al. (2017) and are also included in Reeves and Read's (2009) top 10 game elements. In short, these three approaches can serve as highly acceptable

gamification methods and should be taken into account when designing gamification for social media.

Social media contains different user profiles, and these different types of users have different characteristics of using social media and different ways of being influenced by sustainable information on social media. Firstly, most people spend 1-3 hours a day on social media, and young people spend a little longer time than older people. This is another example that young people may be more influenced by social media than older people. Secondly, junior high school students, undergraduates and masters are more willing to understand the impact of their actions on sustainability. Young people are more willing to accept the sustainable information on social media through gamification, the higher the education level, the higher the willingness to accept. And young people pay more attention to interesting ways of persuasion than older people. People with higher education levels pay more attention to rewards. This shows that people with different education levels have different acceptances of sustainable information on social media and different ways of being guided. In other words, social media companies should design different ways of gamification for their primary users. Similarly, the result shows that women pay more attention to social scenarios than men. This could also serve as an inspiration for the design of gamification features for social media. For example, if a social media company is primarily targeting women, then it might want to consider creating more social scenarios to encourage women to engage in sustainable activities. Another finding is that men are more aware of gamification than women, which may mean that if a social media company is primarily targeting men, it might be a good idea to design richer and more fun gamification. This is also consistent with Rhee et al.'s (2021) discussion on the characteristics of social media.

As for the selection of game mechanics, firstly, people like to use social media on mobile devices. This means that when designing gamified elements to make users sustainable, social media may need to consider more gamified design on mobile devices to facilitate users' use of some gamified features in non-computer environments. This is also in line with the statement of Chui et al. (2012) on social media. Then, users have different levels of preference for different types of social media. According to the survey result, the most popular type of social media is social networks. Young people like content communities, while older people prefer social networks. Moreover, users get information from different types of social media, but most of them get information from social networks, content communities and collaborative projects. Also, young people like to get information from the content community, and older people like to get information from a collaborative project. Also, people of different educational backgrounds use different types of social media to obtain information. Those with higher education like online Q&A sites and content communities, and those with lower education like social networks. Therefore, social media companies can design personalized gamification for different age groups according to their types. For example, if one social media is considered a content community, then it may need to design more gamification to attract and guide young people. Similarly, an online Q&A site may need to design gamification elements that could engage and influence highly educated users. As for the selection of game elements, for example, as mentioned in the previous paragraph, highly educated people pay more attention to rewards, while young people pay more attention to interesting persuasive methods.

Regarding the choice of specific gamification elements, according to the survey result, first of all, the three most common and favourite gamification elements by users are activity, payment, and ability. According to SitoRus et al. (2017), these three categories contain more

detailed gamification elements, and social media companies can appropriately select elements that are in line with their own characteristics. Also, most people are not very interested in sustainable activities related to organizations and celebrities they are interested in, but they are more interested in sustainable activities in the community, especially for young people. With this in mind, social media can take full advantage of social features when designing gamification features and integrate sustainability-related information into the community to attract and encourage more people to participate.

In terms of user behavior changes, in general, most people believe that social media has changed their behavior habits in the long term, especially their consumption habits and study habits. As the level of education increases, learning habits are affected and changed more. This first confirms the views of Kaplan and Haenlein (2010), Kulandairaj (2014) and Siddiqui and Singh (2016) and proves that social media can change various behaviors of users in the long run. Then, social media companies can consider influencing users' behavior habits in different scenarios. In particular, in learning and consumption scenarios, they can convey sustainable information to users through gamification, which may have a more targeted and effective impact on users. Moreover, the survey shows that the longer users use social media, the more behavioral habits and types of changes affected by social media. Furthermore, the longer users use social media, the higher their willingness to change their behavior based on feedback to become sustainable. At this point, it seems that social media can be a very effective way to make users sustainable by designing some gamification features that allow them to spend longer. However, as previously mentioned by Siddiqui and Singh (2016) and Kulandairaj (2014), extensive use of personal social media will result in lower task performance, higher technical pressure, and lower happiness for people, so social media companies need to take this into full consideration when designing gamification features. Lastly, it also shows that if receiving detailed feedback, most people will be more willing to change their behavior to help achieve sustainability. Feedback is one of the most important game elements according to SitoRus et al. (2017), and some researchers also pointed out that feedback is an effective way to persuade users (Reeves & Read, 2009; Owen; 2013; Johnson, 2007; Sitorus et al., 2017). Therefore, social media companies should give full consideration to the importance of feedback in their gamification design and provide users with adequate and detailed feedback at appropriate times to encourage sustainable behavior.

There are some other findings that are worth discussing. First, in all the scale questions, women have higher average values than men, which means that women pay more attention to sustainable information on social media than men and are more willing to accept suggestions and understand influences. But for the last question: "*If social media uses gamification to convey sustainable information to you, are you willing to accept it?*" Although the average value of women is still higher than that of men, the gap is smaller. This may be because women pay more attention to sustainability-related messages on social media than men, but men are more interested in gamified elements, so when social media conveys the information of sustainability through gamification, men's acceptance increases significantly. It also shows that gamification is an effective way to make users sustainable. One conclusion that can be inferred from these findings of gender is that social media can choose appropriate ways to present information related to sustainability and different gamification elements according to the characteristics of their target user groups. For example, a social media platform with a predominantly female audience, such as SHEROES, might need to pay more attention to women's appetite for gamification and sustainability information.

Secondly, the two types of social media, virtual game world and virtual social world, are not the main channels for users to obtain information. Because they already have rich game elements, the significance of this framework lies in how to use their game elements to convey the concept of sustainability to users.

4.3 Prototype design

In this part, the aim of the prototype design is to verify the artifact's efficiency and utility, therefore the prototype is a demonstration to explore the problem-solving paradigm, in other words, the performance of the prototype is to gather feedback from interviews and evaluate the initial framework. By following the definite steps of the initial artifact, and based on the empirical survey data, the prototype was designed to solve an example problem, details as follows.

4.3.1 Persona

As has been mentioned in Section 3.1.2, the persona approach was used in this prototype design for depicting the user and shaping the requirements of users. The reason is that not any social media platform can target all types of users, so when conveying an idea about the problem-solving paradigm, the persona method was required to represent one kind of user for developing products. Based on the previous literature review of users' features, and users' preferences formulated by questionnaire survey, one persona was shaped. Anna is a twenty-one-year-old girl studying in a university for the bachelor's program (shown in Figure 4.31). Usually, she uses mobile phones to browse Facebook to obtain information daily for about 1-3 hours. Influenced by the program's courses, Anna would like to perceive sustainable news and suggestions especially for the individual, at the same time, she also wants to know the results and feedback when those sustainable actions are taken. However, she is not willing to spend additional time to achieve these things, in other words, all of Anna's motivations should be fulfilled when she uses social media. Meanwhile, the frustrations of Anna totally contain two sides. The first thing is that much information and suggestions are too ambiguous to follow and implement physically. Specifically, the information architecture is not well-structured enough so that the wire flow is kind of messy and sustainable information is hard to find, and as the advertisements of collaborated companies, some sustainable news is always displayed for contributing to the company's revenue rather than promoting sustainable behaviors. On the other hand, the second barrier is the dogmatic and boring representation approach for user interfaces and interactions, most of the persuading components are antiquated so that it is easy to lose interest to follow.

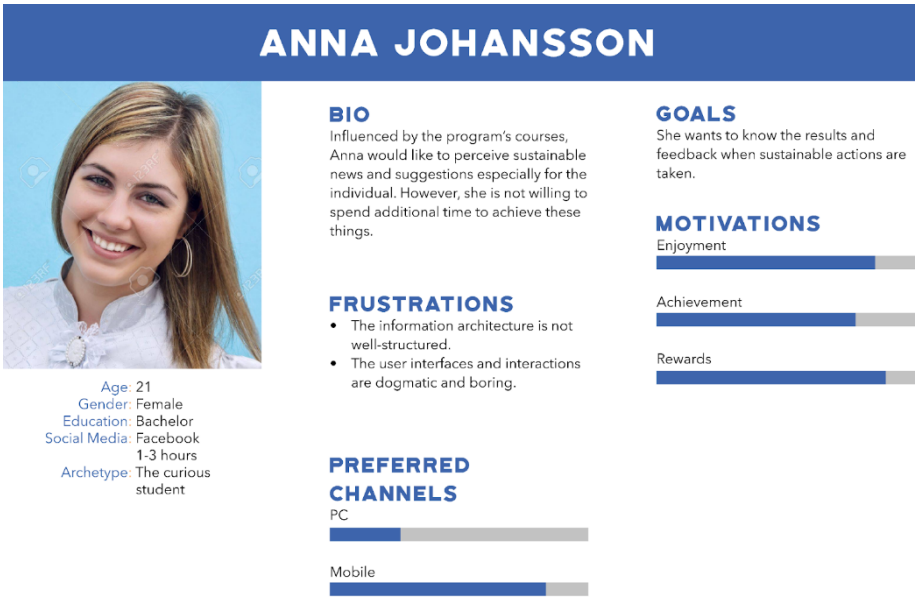


Figure 4.30: Persona

4.3.2 Process

Initially, the first step was the identification of problems. According to the survey results, there were three main challenges from the users' perspective. In particular, users always pay less attention to sustainable news when they receive information from social media platforms, and they are reluctant to change their behaviors by following the sustainable suggestions social media provides. In fact, the reasons for the low desire of users were that they think that the individual power is tiny, and the impact of specific sustainable actions is vague to define. Therefore, the three challenges of this prototype were how to allow people to pay more attention to sustainable news, describing the power of individual aggregation, conveying the social and environmental changes caused by particular behaviors.

Afterward, the second step was the definition of objectives. Obviously, the main objective was persuading social media users to be more sustainable based on the features of social media itself by the interactive approach of gamification. Then the transversal objectives can be divided into two aspects. For social media companies, the goal should emphasize the long-term sustainability and colorful gameplay rules, when they promote sustainable concepts to their target audience. While the objectives of users always focus on achievement. It could be the accumulative points or any form of rewards, even could be the complete mastery process for grasping sustainable knowledge and practicing sustainable manners.

Once the problems and objectives are clarified, the next part was to delineate the user or player. Section 4.3.1 was a good example to stand for social media users. Holistically, for the adoption of this framework, social media companies were users to use this framework to raise awareness about sustainability using gamification. But in this step, the outline of the user was the social media users. As long as social media companies perceive the social media users' images and requirements, they can finish further steps better. To sum up, in this prototype design the presentation of the user or player was the Persona in Section 4.3.1.

Then the fourth step was to select the game mechanics, which was essentially relevant to the specific social media platform and users' behaviors related to social media and gamification. On one hand, the social media type, the attached device, and the scenarios are the considerations for game element selection. In order to instantiate this selection process, Facebook was chosen as an example to present gamification implementation, because based on the survey findings, social network sites were not only users' favorite social media classification, but also one of the most common ways to obtain information, and at the same time, Facebook was one of the most representative applications in social network classification. In addition, there were many habits that would be changed for the long term. Combined with the survey results and Facebook's characters, consumption and travel scenarios can be used to apply game elements. In addition, the mobile end was for presenting the outcome.

Afterward, the fifth step was conducted around the deployment of selected game design elements from the previous step, which totally can be planned from four aspects as has been stated in the previous framework. From the perspective of leveraging external stakeholders and organizations, Facebook could get support from recycling companies and charities to reuse goods that are not easy to sell on the second-hand Marketplace. Then secondly, Facebook can allow the user to invite friends in groups to participate in activities or challenges to present the strong power of the group or community, compared with the individual. Thirdly, in the sponsored section of Marketplace, Facebook should be inclined to choose companies with sustainable attitudes or present sustainable news and information, which can solve the Persona referred problem that it was not easy to obtain sustainable news and information. The last thing was about the users' relevant benefits no matter from the physical or psychological aspect. Thus, the physical or virtual goods could be the rewards of participating in sustainable activities on Facebook.

Then the sixth section was the demonstration for collecting data or say the physical presentation of the prototype. The way of doing it was to practically create a prototype for evaluation including expectations and reflections, and the objects for collecting feedback are the researchers of this work. Actually, the central point of the feedback around whether the user would be influenced by gamifying social media to be more sustainable. Further, users' behaviors can be determined by the following three aspects. They were users' habits and decision-making process, users' mindset about sustainable issues, users' acceptance of sustainable behaviors. The outcome of these three aspects can be subjectively perceived by researchers. It was preferred to the most intuitively subjective feelings and thoughts that users hold about sustainability concepts after experiencing gamification in social media, even if the answer was somewhat subjective.

Ultimately, the final step was the analysis of the effectiveness of the prototype. Since the consequence of this gamification process was a kind of solution of problems, then this step aimed to evaluate the problems of the first step whether to be addressed. The three challenges were around users' attention to sustainability, individual aggregation's strength, the influence of users' behaviors on the environment. The act of the effectiveness analysis can be assessed by researchers about feelings and ideas from these three sides.

4.3.3 Outcome

After the above steps, some points and ideas were defined, so that the game elements were selected and integrated into the prototype design to achieve the gamification goals. From the top three game design elements categories, *challenge*, *competition*, *co-operation* elements in Activity, *strategy*, and *constraint* in Ability, *point*, *badge*, and *virtual goods* in Payment were selected. In addition, *statistics*, and a *leaderboard* of Status, and *telling others* of Sharing, and Feedback were used in Facebook for gamification as well.

Overall, the points system was formulated to represent the level of users' sustainability. The points were deducted into the accumulative *stars*, the user can use different ways to collect *stars* and then exchange some rewards, including physical goods and virtual goods. The physical goods can be encouraging sustainability goods, like reusable bags, or some products made by biodegradable materials, while the virtual goods could be coupons or the premium or membership of video platforms. The methods of collecting *stars* can be categorized into three, explained as follows, but there were only some mechanisms of collecting approaches and improving the sustainable awareness of users, instead of performing how to calculate the stars by which types of specific algorithms.

The first functionality was about the second-hand Marketplace in Facebook. If the user published the second-hand product and it was bought by others, or successfully bought certain goods, he or she would gain the corresponding *stars*. But unfortunately, some second-hand products were not easy to be sold because of the terrible abrasion, inappropriate price or other things. When it happens, the publisher can choose to give it to the cooperated recycling company for free or donate it to charities, he or she can receive double *stars* of the original amount. What is more, Facebook pay was encouraged to use for trades. No matter receiving transactions or paying bills by Facebook, the user can obtain some *stars*. And the number of *stars* can be automatically converted into badges to present the honor of the seller or buyer for strengthening the personal image.

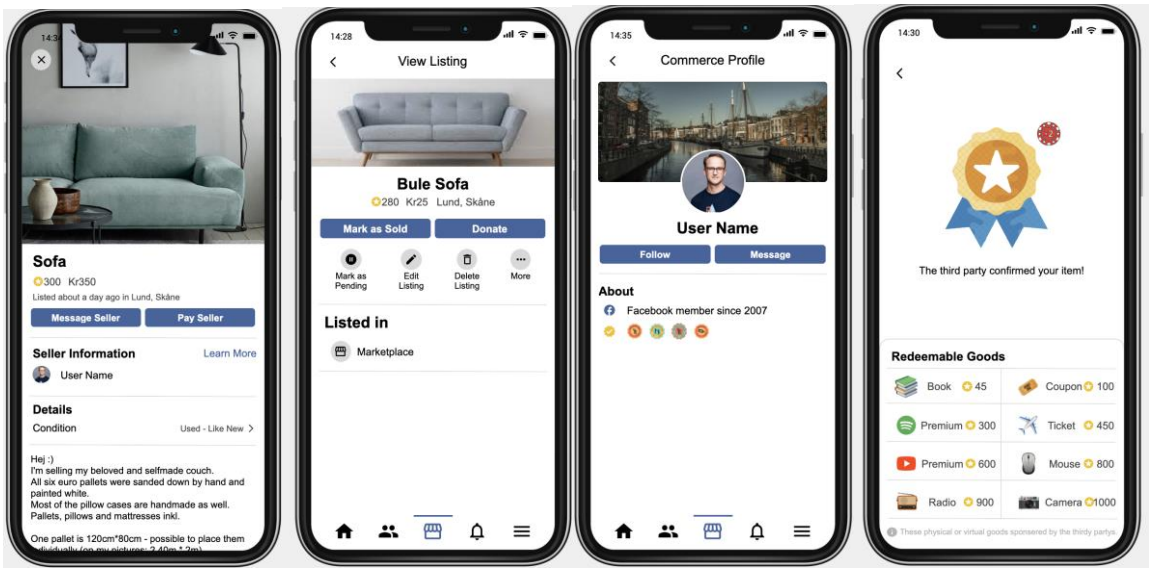


Figure 4.31: Product info (buy) Product info (sell) Seller profile Collecting stars

Furthermore, except for local listings, buy and sell groups were used to publish second-hand products as well at the Marketplace of Facebook, so there is a leaderboard of *stars* to present

the whole *stars* of the group for competition. Whenever a transaction is concluded, the number of *stars* corresponding to the product will be accumulated to the group. This sort of accumulation can show the influence of groups to mobilize the enthusiasm of members. In addition, at the homepage of Marketplace, there is a section for sustainable news sponsored by advertisement providers. Although this section aims at the profits of Facebook, it also can optimize the rank of providers with sustainable attitudes, so that users can perceive sustainable information easier and clearer.

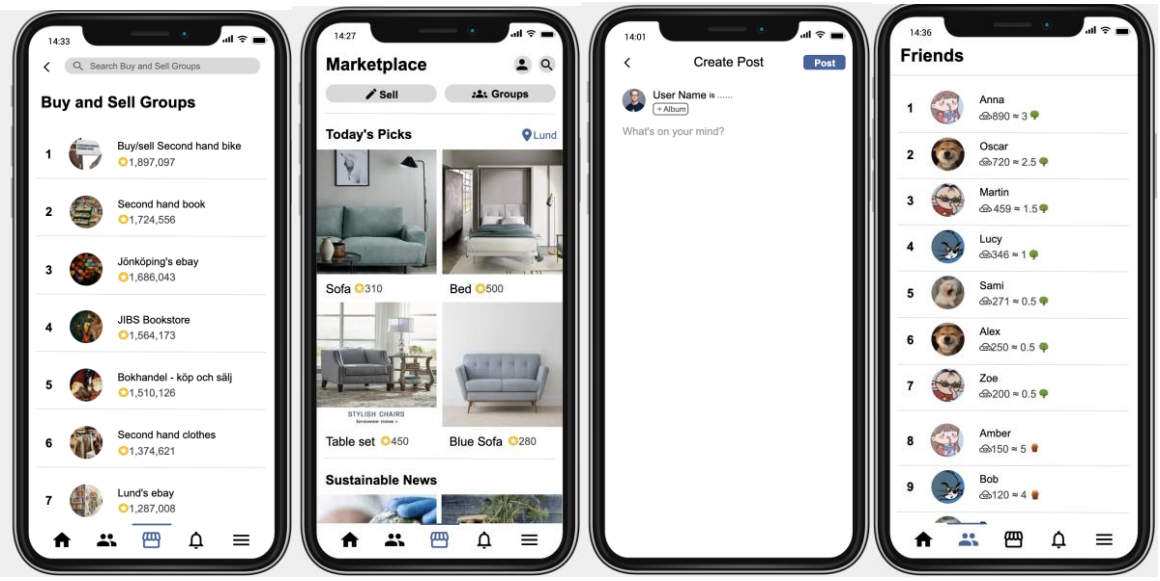


Figure 4.32: Group leaderboard Marketplace homepage Creating post Friends leaderboard

And the second functionality was about creating posts in the community. When the user types the content of the post, the intelligent inspection algorithm can recommend some related sustainable hashtags to label the behaviors and prompt carbon emission. The user can choose to participate in the topic discussion and display the carbon emission or record the process of carbon emission saving. On the other hand, the user can close this kind of reminder, if he thinks it is annoying, which can be seen as a statistics of game elements to present the status, or the feedback for the specific behaviors. In fact, sometimes, the user cannot be aware of the effect of their own activities, as a result, this kind of statistics can help users to realize whether their behavior is environmentally friendly, and commonly disseminate the carbon emissions produced by different behaviors. At the same time, in the friends' community, there is a leaderboard to display the amount of carbon emission saved, the top of the leaderboard can receive the *stars* as well.

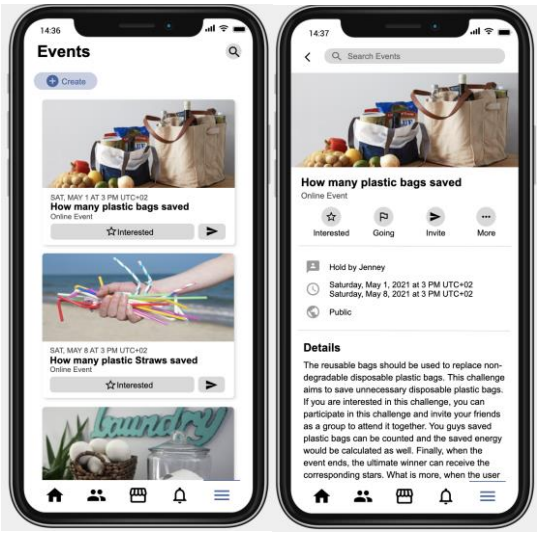


Figure 4.33: Events Event detail

Thirdly, the user also can initiate challenges about sustainable issues or saving energy within the set period constraints in the creating events section on Facebook. They can tell people and invite friends as a group to cooperate to finish the challenge together. After the end of the challenge, the carbon emissions saved by each group will be calculated. Finally, participants can get different degrees of rewards depending on the contributions, which was a way to encourage users to join in events first. Meanwhile, if a participant posts the process of finishing tasks, they would get a certain number of *stars* as well.

4.4 Interview result & findings

It can be seen from the results of this interview that the interviewees explained the possible impact of gamified social media on users from multiple perspectives. After summarizing, 13 keywords were concluded in total, which can be divided into three aspects: user's willingness, influence method and element selection. Next, these three aspects were analyzed and explained.

4.4.1 User's willingness

In this part, some factors that affect users' acceptance of social media sustainability-related recommendations are analyzed and introduced. In the last part, the interviewee's own opinions on the degree of freedom to choose whether to accept sustainable-related information on social media.

User's attitude

Among the interviewees, interviewees R3, R4 and R5 all clearly expressed their attitudes towards social media and sustainability, and their attitudes towards social media and sustainability are very different. R3 stated that she was concerned and positive about sustainability-related matters, but she was not affected by social media. As previously

proposed by Carr and Hayes (2015), the channel for R3 to obtain information is the online news, which is generally not considered as social media.

"I don't particularly care about these things (social media), but if you tweet it to me, I will read it. I usually watch some news media, if it tweets about something happening in India or sustainable reports or something, I usually go to it. (R3)"

R4 is highly dependent on social media, but less dependent on games, and does not pay attention to sustainability-related information and activities:

"I'm very dependent on social media. I don't really like games. I'm not interested in sustainability at all, but I'm interested in protecting animals. (R4)"

Both R3 and R4 believed that the influence of social media is limited and believe that they would not be affected by much from social media. R5 is different from R3 and R4. R5 has a positive attitude towards social media, gamification and sustainability, so R5 is willing to participate in activities related to these three aspects. Moreover, the rich and diverse functions would further arouse his interest in participating.

"I trade a lot of second-hand items, and I pay much attention to environmental protection. For example, I usually use public transportation and I like to buy things without additional packaging. (R5)"

It can be inferred from this that the user's attitude towards any of the three points of social media, games, and sustainability would affect the user's subjective acceptance of sustainability-related information from social media. Even if the user holds a positive attitude towards two of these points and a negative attitude towards one point, the user may be subjectively resistant. Therefore, the user's original attitude plays a very important role on a subjective level, and the more positive people are, the more willing they to take the initiative to participate. This is consistent with the views of Gatersleben et al. (2002), and Lin and Huang (2012). Conversely, negative attitudes would make users mentally resistant to social media communicating sustainability through gamification. But this does not mean that gamified social media is meaningless for people with negative attitudes, which would be discussed further in the following sections.

Reason for participation

Although the interviewees R3 and R4 indicated that they are subjectively unwilling to participate in or follow the opinions or activities from social media, this does not mean that R3 and R4 would not participate at all.

"Yes. I don't particularly care about these things (social media), but if you tweet it to me, I will read it. I usually watch some news media, if it tweets about something happening in India or sustainable reports or something, I usually go to it. (R3)"

"When you see sustainable things on social media, would you be willing to accept or follow them? (Researcher)" "Yes, but not all. For example, For the donation function, just like Facebook now has a function, when a friend's birthday, you can launch some activities to raise some money for elementary schools and so on. I will not participate in this kind of activity. (R3)"

It can be seen that R3's subjective wishes may cause her not to actively follow sustainable content on social media, but if it is shared by friends, R3 is also willing to follow social media information or activities to a certain extent.

"No, because I don't believe in this, no matter how fun it is, I just play it. I usually play games just to kill time, not to mention this kind of gamification is not fun. Most of the time, the game is just for me to kill time because I don't want to do business. And my level of playing games is not high, so the appeal of games to me is not long-term. I think gamification is to integrate sustainability-related concepts into the game, such as a sustainable mini-game on social media, such as environmental protection Lianliankan, to help users identify which is combustible waste and which is non-combustible waste; Or which is environmentally friendly materials, which is not environmentally friendly materials, etc. At that time, there was a king of minds, and it was also a small game similar to the one I mentioned earlier, which was very popular at that time. The feature of this game is that even if you are not interested, you will remember it in your mind. I think this is very important. For me, the most important thing about the game is to have visible growth, this (prototype) is not enough in this regard. (R4)"

For interviewee R4, although he clearly stated that he is not interested in sustainability, and for him, playing games is just to kill time, he also said that in the process of the game, he still obtains certain information from it, for example, sustainability-related knowledge. Therefore, if the degree of gamification is increased to make it more interesting, it is possible to involve users and obtain relevant information. This is consistent with the motivation of human behavior mentioned by Ryan and Deci (2000) and Nicholson (2012). At the same time, interviewee R2 also expressed similar views.

"My focus is still whether it is fun, as long as it is fun, I will participate in it. (R2)"

According to the respondents' motivation to participate in sustainability, although respondents are willing to participate in most cases, it is usually not for direct sustainable purposes, but for other purposes, such as social purpose, entertainment, or disposal of unused second-hand products or collection as mentioned in R5.

"It can't be found in the market because it is too old and I can't find a new one anymore, but it is the most economical and cost-effective product that can meet my requirements. (R5)"

"Yes, I quite like this. Everyone encourages reusing and recycling. For me, as long as this thing is not broken, I would not replace it with a new one. So even if it is second-hand, as long as it can be used, I would continue to use it. (R5)"

At the same time, R5 also made it clear that even if he cares about sustainability, this is often not his main motivation for his sustainable behaviors.

"But most of the time I trade second-hand stuff mainly because it is cheap. For me, sustainability may only account for 20 to 30%. (R5)"

It is inferred from this that when users use a certain sustainability-related function on social media, it is usually to meet some of their other needs rather than directly related to sustainability, such as the social, entertainment, or second-hand trading mentioned above. This is consistent with the arguments of Kaplan and Haenlein (2010), and Kulandairaj (2014) However, it is difficult to meet the specific needs of users with pure sustainability-related

goals. This may be explained by Poortinga et al. (2004) and Bartiaux's (2008) theory of the barriers to changing people's behavior. Therefore, when designing functions, it should be considered to integrate sustainability-related elements and content into other functions and participate in sustainability as users achieve their more purposeful needs. Not only that, the addition of sustainability elements would be more attractive to those who originally care about sustainability, and it could also encourage users who do not care about sustainability to participate in this process. However, in the process of integrating sustainability, care should be taken not to increase the complexity of the original function too much, because both R2 and R3 mentioned that complex functions may cause users to lose their willingness to use it. This also confirms the point put forward by Zapico et al. (2009) that encouraging users to become sustainable needs to make low carbon behavior easier.

"Facebook is essentially a quick-sharing application. When you design the chain longer and more complex, users' willingness to use it will decrease. You should not require the users to fill in that much data. (R2)"

"Can you talk more about what you think this prototype is not enough to attract you? (Researcher)" "Because it is really complicated for me. For example, I have to create an event first and then realize it. (R3)"

Influence method

Most of the ways and reasons that users participate in sustainability based on the aforementioned are based on purposes that are not related to sustainability. Therefore, as pointed out by R3 and R5, when using social media to communicate sustainability, one should consider subtly influencing users, and should not rush or force users to accept sustainability.

"Well, this kind of change should be imperceptible, and users shouldn't be forced to do so immediately. The way to do this may be better, and I will choose to do it when possible. For example, some food delivery apps allow you to make some options. You can choose whether to use disposable tableware or not. I think if I order food at home, I will choose not to use it; but when I eat at the company, I have to. Providing some options can make the subtle influence better. I just want to complain to Starbucks, why they use paper straws and I can't bite them. In the optional case, I still prefer to use plastic straws, although I know it is not environmentally friendly. (R5)"

According to R5, changing the user's behavior too forcefully or suddenly may cause the user's disgust, which may make the user subjectively more negative about sustainability, which would have an adverse effect on sustainability.

Respondents also gave various opinions on how to influence users in specific ways. R5 proposed that when integrating sustainability into social media, it should be as natural as possible and not too stiff. This requires that in the functional design, more attention should be paid to the combination of function and sustainability in more detail so that every part of sustainability and function is more relevant. For example, when choosing disposable tableware, reminder: If you do not choose disposable tableware, you can How much to reduce wood logging, which is similar to the view put forward by R1.

"...Try not to have that kind of stiffness in the process of use, just like forcibly adding something, it is good for users to feel natural and reasonable...(R5)"

"There are many places that remind me that I can be sustainable. Almost every action or function can remind me that I can make related sustainable operations. The usage is also very simple and does not require me to do any additional operations. (R1)"

Not only that, but R4 also pointed out the limitations of using gamification to achieve long-term sustainability goals.

"There are many daily tasks in mobile games, and they are constantly updated and constantly have new exciting points. Although there is a set of feasible gameplay methods, it is difficult to achieve sustainability. The scale of the launch of mobile games is very large, with different new mobile games coming out every year, but most of them may be over after a year or two. Most of the excitement of mobile games is short-term, and the game itself is basically unsustainable. After the player has played to the end and practiced to the top-level account, he will feel bored and start to quit; if it is a sustainable-related game, The user will feel that it is done, and there is no need to continue. I think that if you just use the elements of the game, the effect of the game will not be achieved, but the game will make the sustainable effect become very short-term. (R4)"

From the perspective of R4, in order to encourage players to continue playing, online games need to constantly set new goals or challenges for players, because a single goal would lose its appeal to players after completion, and long-term goals would make players lose motivation. This is one of the limitations of games, but it is one of the strengths of gamification on social media platforms, especially when it comes to engaging users. Therefore, in response to this situation, if a social media platform wants a user who does not have an awareness of sustainability to stick to a sustainable life for a long time, they need to split a big goal into multiple small goals, and constantly set new goals to keep users' enthusiasm.

Moreover, in order to encourage users to participate in sustainable-related activities for a long time, R1 and R5 believe that a series of goals and rewards should be set for users to motivate them to participate. In this way, even if a user is not very interested in sustainability, he or she would be willing to participate in order to get rewards or a sense of accomplishment. This is also consistent with the views of Zapico et al. (2009).

"It would be better if users can get rewards after turning on this sustainable mode. That is to say, a user can get stars after turning on this thing for the first time, and then they can use the stars to exchange for items. (R1)"

"Does this gamification effect continue to keep you doing this? (Researcher)" "Yes, since I use this function, for example, the first successful transaction will get some titles and rewards, and then prompt others to achieve the next one. (R5)"

Room for choice

Based on the analysis mentioned earlier, it can be understood that not everyone has a strong dependence on social media, and not everyone likes gamification and sustainability. For those who are not interested, forcibly instilling sustainable-related thoughts and content may cause users to resent and lead to counterproductive effects. Therefore, interviewees R1, R2, R4, and R5 all believe that users should be given ample room for choice, allowing them to choose what they want to show and what they want to see on social media.

"Most people don't care about this thing. They don't really want to do it or are very disgusted. We should not push them to the disgusting side. It's not necessarily that people who want to do this will click in and post such things. Users should have the right to make their own choices. (R1)"

"Positive feedback can also be retained, but users must first have the right to choose. There should be a place for users to open and display their carbon footprint, and it should not be blocked. (R2)"

"For example, everyone is playing this carbon emission ranking. Then, there is a social butterfly, the things he does every time are not sustainable, so what should he do? He doesn't want to change his behavior, and he doesn't want to turn it off. This is too forced. He may not be a low-carbon expert, he may be a fake low-carbon expert, he may be a gourmet expert, he may be specialized in barbecue, that is, the kind of barbecue with high carbon emissions, and he may be the kind of person who hates vegetarianism. (R4)"

"It won't be annoying. A user who has the concept of sustainability, will certainly not feel annoyed, he will think that it is a small tool to help him be more sustainable. But if you are disgusted with this feature, you can just turn it off, it won't disrupt anyone's life. (R5)"

However, in order to promote sustainability, related functions should be promoted, and to a certain extent, users are encouraged to open sustainability-related functions. According to R1, a feasible method is that when users decide whether to turn on sustainability-related functions, social media platforms should give users sufficient prompts about the results of the switch and the significance of turning on the function. In addition, in order to encourage users to turn on sustainability-related functions, rewards can be set for first turning on functions. This connects and merges the various gamification elements proposed by Reeves and Read (2009), Sitorus et al. (2017) and Owen (2013). Not only that, but there are also similar function designs in the case mentioned by Willianms (2014) and Cardoso et al. (2019) and the GameBack mentioned by Georgina et al. (2021).

"There are many places that remind me that I can be sustainable. Almost every action or function can remind me that I can make related sustainable operations. The usage is also very simple and does not require me to do any additional operations. (R1)"

"It would be better if users can get rewards after turning on this sustainable mode. That is to say, a user can get stars after turning on this thing for the first time, and then they can use the stars to exchange for items. (R1)"

4.4.2 Performing ways

In order to influence the users of social media, social media needs to adopt some specific methods. Methods often mentioned in interviews include cooperation between groups and communities, and external organizations. In this part, the analysis is based on the interviewee's perception of these methods.

Groups and communities

According to the interviewees, the behaviors of users on social media are largely based on groups and communities, not just individual behaviors. All interviewees stated to a certain

extent that one of the main activities on social media is interaction with friends or communities. This first conforms to the definition of the characteristics of social media by researchers such as Carr and Hayes (2015) and is also consistent with the group theory proposed by researchers such as Handelman and Arnold (1999).

"This brings me back to the point I just said. It is an emergent property. Once you have this idea, you will want to find a group. This is not the nature of the individual, but the nature of the group, which is why I have to distinguish between personal and community. (R1)"

"I would want to see what my friends are doing, which would arouse my interest in the process… I think it mainly depends on what my friends have posted, or whether the activity is of interest to me, it is not how your design itself is designed, but what users are doing based on this design. (R2)"

"I don't particularly care about these things (social media), but if you, as my friend, send it to me, I will read it. (R3)"

"The only way I can participate is when my friends post new posts, and then I go to "like" them. (R4)"

*"I think there should be a local group transaction or a different kind of group transaction, and they can be encouraged to participate in the corresponding group transaction, in which case I would like to participate more. For example, when I'm in Lund, I want to trade in ***'s local group. (R5)"*

Therefore, interaction with friends and communities is a very important reason for users to use social media. According to R4, based on the interaction between friends and communities, users can be prompted to do some specific behaviors, especially those related to sustainability.

"...In fact, in this case, the users of social media are not necessarily individuals. It can be organizations, shops, sustainable groups, and internet celebrities. They can use the function of "creating events" better. Ordinary users and fans as readers can just check these messages. For example, there may be certain rewards for you giving a "like" or "forwards". In this way, you can actually add more sustainable activities for the interaction between internet celebrities and their fans, and add more interactive things...(R4)"

R4 also pointed out that the impact of individual behavior on sustainability was limited, so sustainability should be a collective matter. This is consistent with Owen (2013)'s view that people should be aware of the significance of collective contributions to sustainability, which can increase users' willingness to participate in sustainability and increase the effect of sustainable activities.

"What do you want to be sustainable? How much can you waste in your entire life alone? Someone drove a tank for one day, then all the efforts you have done were gone! How many people's energy savings are equivalent to the carbon emissions produced by the eleven US aircraft carriers going out in one day? Sustainability is just a trick to make money. No matter how good it is, it's just to make Facebook earn hundreds of millions more. Do you know what greenwashing is? Big companies use sustainability as a gimmick, and then cover up their unsustainable activities. I think you are also greenwashing, sorry. Sustainability is a systemic issue. It does not mean that the minority needs to be awakened, or how to awaken the

minority. And social media does not cover enough. For example, your country has 1.4 billion people, but only half of the Internet users, right? What about half of it? (R4)"

At the same time, according to R1 and R2, group activities also have a greater influence on the effectiveness of promoting activities.

"...Regarding verification, how can we ensure that this matter is true and reliable? That is, is there any way to monitor that a participant does a certain activity? (R1)"

"I think everyone exists in a community, and everyone supervises each other, which has played a role in verification. (R2)"

The activities in the group would be supervised by the members of the group. If someone falsifies in the group activities, other participants in the activity would spontaneously resist the counterfeiter and the information released by him, forming good group supervision.

Therefore, it is necessary to integrate sustainable functions or activities into communities or groups. It can not only increase people's willingness to participate, but also people can more clearly recognize the impact of their own behavior, which is helpful to the cultivate users' sustainable thinking.

External cooperation

In addition to integrating sustainability into group activities, cooperation between social media and external organizations can also be of great help in guiding users to focus on sustainability. Unlike community group activities, cooperation with external organizations can bring extra benefits. As mentioned by Du et al. (2016) and Danglico et al. (2013), the ability of social media to cooperate and integrate with external institutions is crucial to its own success.

First, based on the functions of different organizations, cooperation with organizations can broaden the scope of activities that can be held. For example, R1, R2, and R5 mentioned that if you cooperate with charity organizations, recycling companies, and second-hand stores, the possibility of social media platforms holding second-hand product reuse activities can be improved. Moreover, according to R3 and R5, the cooperating organization can also provide some support for the social media platform to hold activities, which can be material or technical. According to R4, cooperating with some famous people can attract fans of some celebrities to participate in activities.

Therefore, cooperation with external organizations can bring diversified benefits, and social media can also find specific organizations to cooperate according to the needs of functions.

4.4.3 Element selection

After the social media platform has determined how to achieve its goals, the next step is to choose the appropriate gamification elements. During the interview, the interviewees spontaneously mentioned some gamification elements without a specific explanation by the researchers. The researchers inferred that these elements are more important to the interviewees and users are more susceptible to these factors. The specific explanation and analysis are in the following section.

Hints and tips

Hints and tips were emphasized by R1 and R2, and R4 and R5 also mentioned that tips on social media have a certain impact on them. According to the interview results for R1 and R2, the prompts can be flexibly used in various functions to achieve different purposes. For example, hints and tips can be used to guide the user's behavior or make suggestions for the user's behavior.

"For the payment, now you have cash and Facebook pay. Actually, I never used it before, but as a sustainable payment method recommended by the app, there should be more guidance for users to encourage people to use it. Now you have extra points for online payment, but you need to let users know it. Maybe you can set a popup window to suggest users use Facebook pay and tell users what they can get if choosing this. (R1)"

R2 mentioned that hints or tips can be used to popularize knowledge. And there are many ways, including small print and pop-up notifications, or others.

"...users need to be told what impact their actions have caused. Our daily activities are generating carbon emissions, and social media should spread this knowledge to users by notifying the consequences. (R2)"

Therefore, hints and tips can be carried out through rich display methods to inform users of the necessary information, thereby having an impact on users. Moreover, when designing the specific display method of hints and tips, it is necessary to make appropriate adjustments according to the needs of the function. According to researchers such as Owen (2013), Sitorus et al. (2017) and Ryan and Deci (2000), this is also a very common and effective gamification element. Not only that, giving detailed hints is in line with the ideas of Zapico et al. (2009), Bartiaux (2008) and Mankoff (2007) about changing people's behavior.

"When I first see this, it looks like a notice to tell me how much energy I would waste. I don't want to know that, it makes me feel guilty. But I am willing to know how much energy I can save if I buy this second-hand sofa. (R1)"

It can be seen that when applying hints and tips, more positive expressions should be used to generate positive feedback to users. If the prompt method or content is not positive enough, it may affect the enthusiasm of users. This is also in line with the view proposed by Zapico et al. (2009) that the sustainable behavior of users should be praised and encouraged to encourage users to become sustainable.

At the same time, what needs to be recognized is that the impact of hints and tips is very limited. All the interviewees' descriptions and cognitions are a medium for transmitting the information. Therefore, in order to achieve a better effect, they can be combined with other elements.

Rewards

Reward, as a gamification element that has been frequently mentioned by many researchers such as Owen (2013), is a game element that is most often talked about in interviews, and the scope of application of rewards is also very wide, such as rewards for exchanging items: *"Exchange some coupons, vouchers or something else, such as H&M's coupon or Netflix*

coupon. (R2)", rewards for ranking, *"…as long as you participate, you should get some encouragement. (R1)"*, rewards for encouragement, *"…it will also be better for the people who participate, at least it will make me more willing to participate… (R5)"*.

According to the interview results, the form of rewards should also be diversified, which can be virtual items or physical objects. But rewards must be attractive enough to users to attract them to participate. This is also consistent with the various types of reward methods proposed by Owen (2013) and Sitorus et al. (2017).

"If you want everyone to participate in the event, you still have to seduce everyone with attractive and affordable things, so a coupon is a good choice. (R2)"

But when setting rewards, it should be consistent with the purpose. In order to achieve sustainability-related purposes, rewards should also appropriately reflect sustainability, just like the hand-cranked flashlight mentioned by R1. If the reward of a sustainable activity is an extremely environmentally friendly product, it may deviate from the original intention of the activity and reward to some extent.

"I just give an example, which is more related to environmental protection, or a small achievement that can better reflect a sense of personal honor. If the item you provide is unsustainable, then this reward is meaningless. (R5)"

Competition (Leaderboard)

Competition and leaderboard are gamification elements to realize group community activities. It is also a common gamification element proposed by Owen (2013), Sitorus et al. (2017), and Reeves and Read (2009). In addition, two examples mentioned by Zapico et al. (2009) and UN Environment Program (2019) also use such gamification elements. According to R1, leaderboards are only meaningful when they exist in groups: *"…the leaderboard is meaningless if it exists independently of the group. (R1)"* The leaderboard is an important expression of the user's sense of participation in the game process, which can strengthen the communication and connection between users, *"I like the leaderboard very much, I think this is a very important part of playing games. (R2)"* Therefore, it can be inferred that the ranking can effectively improve the effect of group community activities.

Two factors need to be considered when adopting the rankings. The first one is the size of the rankings. *"Most of the game's rankings are strangers, and social media is full of people I know, and the rankings would make me feel weird. However, ranking all users together loses its meaning. Too small or too large is not good, so the scope of the ranking must make users feel comfortable. (R4)"* If the range of the leaderboard is too small, it would not be able to fully reflect the sense of accomplishment of a user's ranking in the group. In other words, if the range is too small, it would lead to a sense of disengagement from the group to a certain extent, thereby losing the meaning of the leaderboard. If the scope is too large, too many users would participate in the same group, which may cause many users to lose their sense of participation. Therefore, the size of the group should be fully considered in the specific application.

The second thing to consider is how to increase the enthusiasm for the participation of the people in the rankings. According to the results of the interview, it is effective to increase the sense of participation by rewarding and promoting changes in the rankings. *"It is not good*

that only the top-ranked group can get points. (R1)", "…if those people are always at the top of the ranking, it would discourage the enthusiasm of others. (R2)" If the users participating in the activity cannot get the rewards they want, or their ranking in the leaderboard hardly changes, it would be meaningless for the user to participate in the ranking activity. Moreover, these users would no longer want to participate in other activities in the future. In response to this situation, the interviewees mentioned two methods. First, all participants in the event should be rewarded, and at the same time, the top-ranked users can get more or unique rewards. In this way, everyone's sense of participation can be increased, and rewards that can rank first can also encourage users to actively participate in activities. The second method is to distribute rewards periodically and clear the leaderboard after the rewards are distributed. This can prevent some users from accumulating extremely high points so that users who are lower in the rankings do not have the opportunity to rise on the rankings, and thus lose interest. If the leaderboard is restarted regularly, all users can have a chance to rise.

Sharing and promotion

Sharing and promotion are also common gamification elements based on social functions, and their effects can be viewed from two perspectives. Most interviewers would browse the content shared with them based on their social relationships.

"…my friends threw the event information to me, usually I'll click on it to complete their task…(R4)"; "… it's equivalent to forwarding to my Facebook page to get 100 virtual gold coins when you play a game because you want him to promote it, right? That's what I usually do. Because it's usually shared by friends. (R5)"; "For example, if you send me a questionnaire and ask me to do it, or if you ask me to read an article, I would do it. (R3)"

It can be seen that sharing plays a certain role in promoting news. However, the impact of sharing with friends is limited. For example, R3 and R4 both stated that they seldom read the information shared by friends carefully. So, sharing for promotion does have a good effect, but it should be noted that it may not have much impact on users. Nevertheless, according to R4's point of view, it can be inferred that if there is sufficiently attractive content, it would still have an impact.

"I would not participate in any events my friends shared with me unless it is something I am very interested in. (R4)"

Therefore, the elements of sharing promotion can be adopted by social media platforms. As mentioned by Carr and Hayes (2015), most social media platforms have relatively powerful social networks, so the implementation of sharing functions is relatively supportive. It should be noted that high-quality content output would affect the effectiveness of sharing and promotion to a relatively large extent.

Details

Sufficient details and subdivision of categories help to enhance users' awareness of sustainable information and use of functions related to the sustainability of social media. This is also consistent with the conclusion of Deterding et al. (2011b) that many levels of gamification design should be taken into account. For example, R1 proposed a detailed description:

"I think we can tell users the impact of your behavior in a better way, rather than just a simple carbon emission figure. For example, tell the user that the number of emissions he saved is approximately equal to a tree. Such things should be reflected in more kinds of functions. (R1)"

Displaying the information to be expressed to users in an easy-to-understand display method, such as adding a more detailed display or introduction, can strengthen users' understanding of sustainability-related content and increase the possibility of user acceptance. R5 proposed that groups should be subdivided:

*"I think there should be a local group transaction or a different kind of group transaction, and they can be encouraged to participate in the corresponding group transaction, in which case I would like to participate more. For example, when I'm in ***, I want to trade in ***'s local group, so that ***'s group ranking would be high. Or, if I want to sell video games, I would join the video game group; if someone wants to sell pet supplies, go to a pet supplies-related group. I think the categorization of groups can actually speed up or facilitate transactions. (R5)"*

It can be inferred that detailed classification can help users clarify their goals and increase the likelihood of users staying in a team for a long time. Therefore, considering the details as much as possible can provide users with more and clearer information to help users make understanding and judgments, thereby increasing the possibility of users' participation in sustainability and the effect of being affected by sustainability.

5 Discussion

This chapter mainly shows the main contribution of this paper. Based on the discussion in the previous chapter, a framework that can guide social media to make users sustainable through gamification is concluded in this chapter. It consists of two models, which are shown in 5.1 and 5.1 respectively. 5.3 shows a brief summary of the contributions of this research and it is also an instruction on how to use the framework.

5.1 The model for designing gamified social media on sustainability

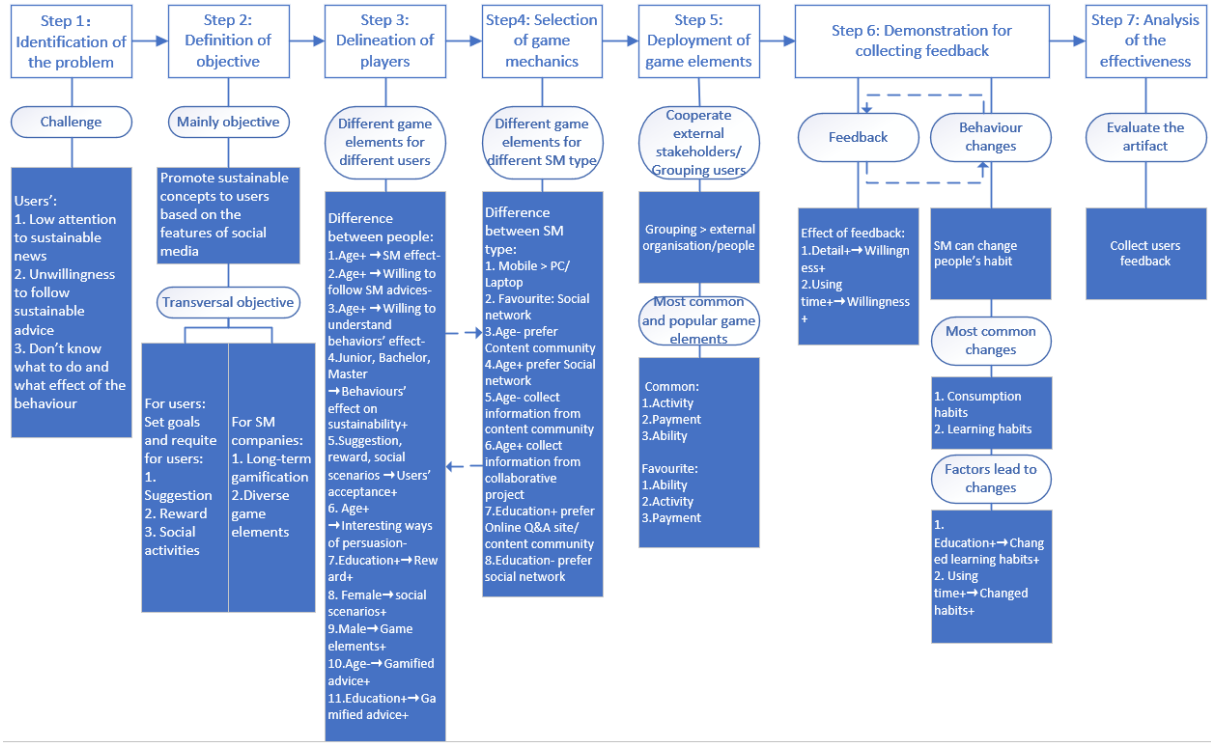


Figure 5.1: The model for designing gamified social media on sustainability

This design model is based on the initial framework obtained in Section 3.6 of this study and combined with the survey results, as shown in Figure 5.1. Specifically, the initial framework provides general and overall steps and design processes, and the survey results provide considerations and other details that can be filled in each step. The main purpose of this model is to provide step-by-step guidance when designing a new sustainability-related function or module for social media platforms using gamification, and to inform in detail which steps need to be paid attention to. This process mainly consists of six steps, and social media platforms can design and practice according to this process based on their actual conditions. It should be noted that the last step in this model is described further and in more detail in Section 5.2.

For the target audiences of this process, namely social media companies, their final aim of adopting this process is to affect social media user's behaviors and minds, to make them more sustainable. In order to achieve this aim, the first step for social media companies is to make clear what is the challenge for them at present. According to Table 4.3 in Section 4.1, there are three main challenges for social media platforms from the survey. Firstly, people do not care about sustainable information on social media. Secondly, people do not want to follow social media advice, thus, even if people read some sustainable articles on social media, they will not make changes. Thirdly, there are also some people who are willing to make changes but have to give up because they do not know how to make concrete actions. Different types of social media have different performances, thus challenges for them will not be exactly the same. Although there are various reasons why people refuse to change their behaviors, there is a willingness to understand the impact of their current behavior according to Figure 4.14. And according to Figure 4.16, with an understanding of the impact of their behavior, the willingness to make changes based on the impact of their behavior increases.

In the second step, each social media company should find the solutions based on the features of social media to meet the challenges to achieving the purpose. An effective way to increase motivation and willingness is to set goals and requite for users. According to Table 4.4 in the survey result, social media users mentioned what their most wanted things from social media are: suggestions, rewards, and social scenarios. And their most wanted things could be the solution to the challenges in step 1. Social media platforms can give some specific sustainable suggestions on what people should do to get involved in sustainability. Rewards are relevant to social media users' self-interest and give the users an incentive other than sustainability to follow social media advice. Since social media is the social tool that users use for social purposes, integrating sustainability into social scenarios is consistent with the users' purpose and is more likely to get users' interest. According to Section 3.4.3, gamification as a technology is an effective way to persuade people, thus social media companies should consider how to adopt more game elements and make them influential in the long term.

Step 3, social media platforms should consider how to choose game elements. The purpose of step 3 is to help social media platforms to choose different game elements for various groups of people. From the survey result shown in Figure 4.12 and Figure 4.15, young people are more likely to be influenced by social media and more open to social media advice than older people. Young people are also more concerned about the sustainable impact of their behaviors. Thus, if social media paid more attention to their influence on young people, it could get significant results. Suggestions, rewards, and social scenarios will increase the willingness to change behaviors for all kinds of users according to Table 4.4. According to Figures 4.20, 4.21, and 4.22, if a social media platform has mostly young age users, they should consider using an interesting way to persuade. Platforms with many highly educated users can give some rewards to users to persuade them to be sustainable. Also, social media that is dominated by women, can try to create more social scenarios to guide their users to be sustainable. Moreover, because the male community knows more about gamification elements shown in Figure 4.25, social media with men as its primary audience can try to incorporate more gamification elements. According to Figure 4.29, young people and highly educated groups are more receptive to gamified suggestions, so social media platforms that are dominated by these two groups can make interesting and fancy use of gamification elements.

The purpose of step 4 is to choose game elements for different types of social media. What social media platforms should do in this step is closely related to Step 3. This step identifies the types of users of the different social media, and in combination with the preferences of

different people for gamification as summarised in step 3, then the different types of social platforms can decide how to choose gamification elements. According to Figure 4.7, most people prefer to use social media on mobile devices, thus social media companies should prioritize designing features for mobile. In Figure 4.2, social networks are the most popular kind of social media among all kinds of people; thus, social networks should prepare some appropriate game elements to guide all groups of people. However, according to the survey result shown in Figure 4.3, content communities are the most popular type of social media for young people, the preference for social networks increases as people get older. Therefore, content communities can pay more attention to their impact on young people, and social networks can properly focus on the impact on older people. According to Figure 4.4, social networks, content communities and collaborative projects are the main platforms for people to access information, thus the owner of these platforms should understand the impact of their own platforms to better influence their users, especially in collaborative project-based design media. Collaborative projects are not a popular kind of social media; however, it is the most common way for older people to obtain information based on Figure 4.5. Figure 4.5 also shows that content communities are the most important type of social media platforms for young people to obtain information. Highly educated people like to get information from online Q&A sites and content communities shown in Figure 4.6, so the main audience for online Q&A sites is likely to be well-educated people.

In step 5, social media companies need to consider how to deploy game elements. There are four considerations for social media companies when deploying game elements, they are the association with external organizations, communities, the impact of sustainable attitudes of large companies on the platform, and the relevant benefit of users. According to the survey results shown in Figures 4.23 and 4.24, most people have limited interest in sustainable activities related to external organizations, but interest in sustainable activities in communities is high, especially among young people. Therefore, social media companies may first consider using community elements in their actual deployment.

In step 6, social media companies should consider the long-term impact of the product after the deployment phase. The Gameback framework described in Section 3.4.3, proposes long-term changes in thinking and behavior through a constant cycle of feedback and behavior. It could be found from the survey that most people are influenced by social media to change their habits, and that the more detailed the feedback given from social media, the more willing people are to change their behaviors. Therefore, social media platforms should provide immediate and detailed reports or feedback on user behaviors to help users further be sustainable.

In step 7, social media companies should evaluate the effectiveness of their artifact. The effectiveness can be shown in users' feedback. But in the survey stage, it was impossible to collect respondents' feedback on an artifact that did not exist. Thus, the effectiveness was evaluated in the interview.

5.2 The model for verifying gamified social media on sustainability

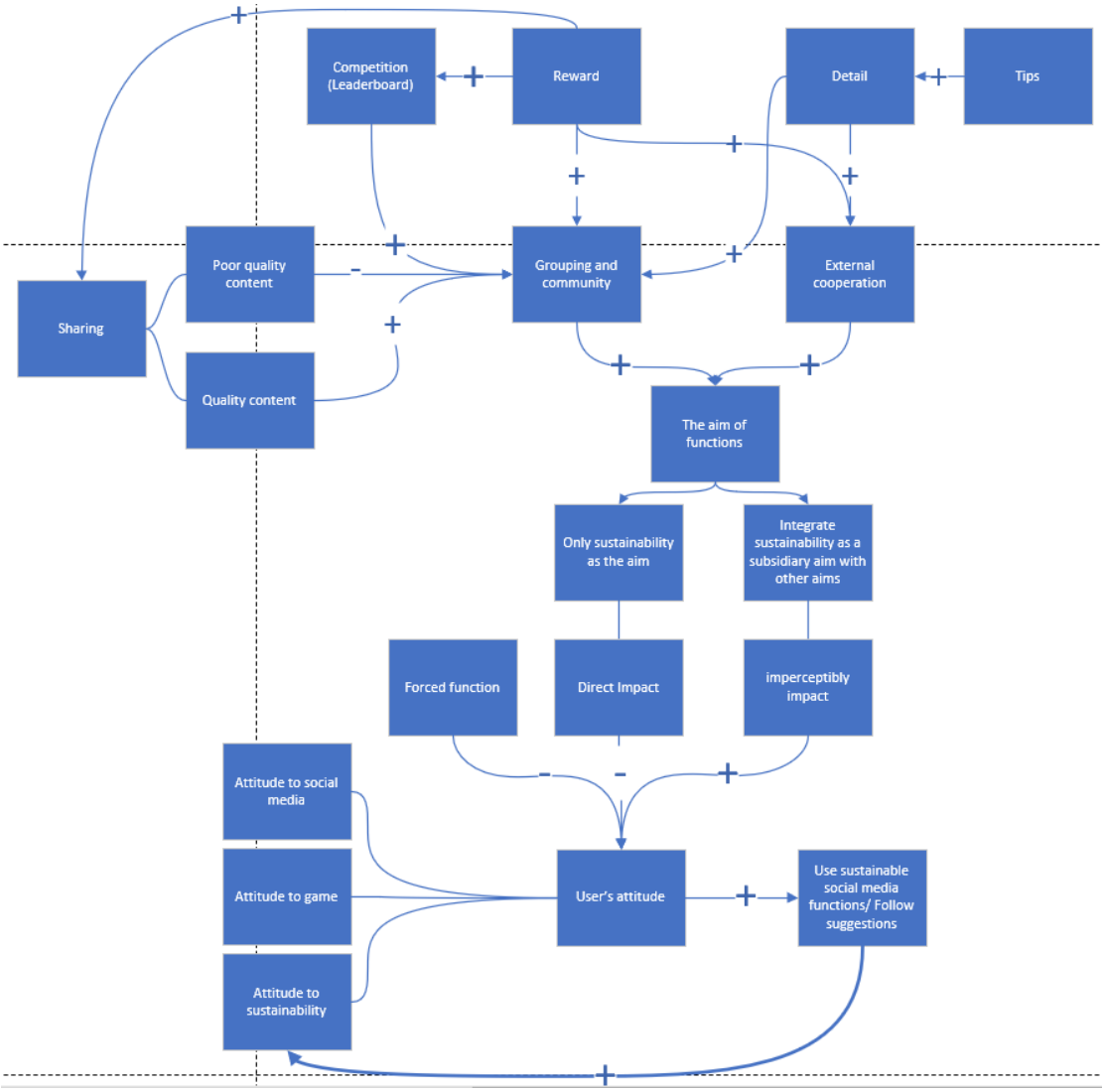


Figure 5.2: The model for verifying gamified social medial on sustainability

In order to fill up the blank of the Step 7 *Analysis of the effectiveness* in the design model, the verification model was formulated based on the results of interviews, that is devoted to verifying the effectiveness of existing work that has leveraged gamification into social media (shown in Figure 5.2). This model mainly aims to describe the impact of social media generated for users' sustainable behaviors and thoughts when applying game elements. Then the whole model can be divided into three parts.

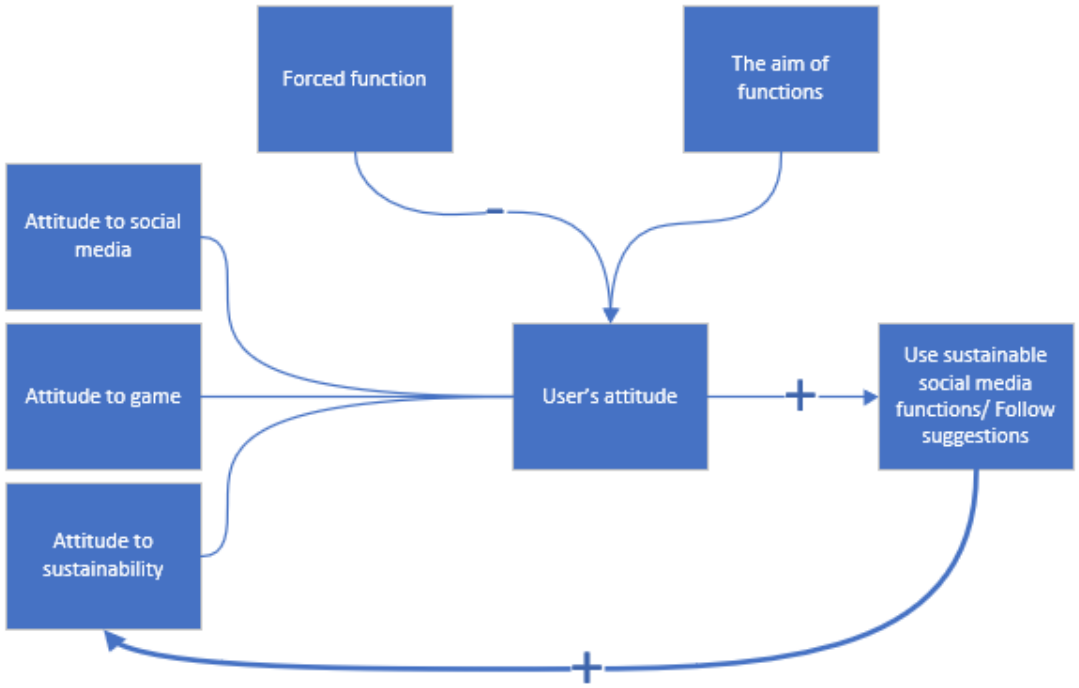


Figure 5.3: Factors influencing users' use of gamified sustainable social media

The first part is about the influencing factors when users follow sustainable information on social media (shown in Figure 5.3). According to the results of the interview in Section 4.4.1, users would be influenced by three aspects when social media integrates game elements to convey sustainable concepts, users' attitude, the aim of functions, and forcing functions, among them, whether the user uses sustainable functions with game elements on social media directly determined by users' attitude. From the perspective of users' attitudes, there are different types of social media, games, and sustainability for users. The interview Section 4.4.1.1 suggested the negative attitude to one of them would result in reducing the willingness of users to follow the gamified sustainable instructions on social media, while the positive attitudes to three of them would increase the willingness of users as well, therefore, the user's attitude is positively correlated with their willingness to follow. Then after the user utilizes sustainable functionalities on social media due to different reasons, the user's mindset would be influenced by his/her behaviors (Owen, 2013; Georgina et al., 2021). In particular, when the user participates in the sustainable activities, the user would reflect self-inflicted sustainable consequences, so that the attitude to sustainability would be changed. Therefore, when the user's behavior generates positive feedback, while the user's attitude would encourage the user to participate in more sustainable activities, which forms a positive feedback loop.

Then at the aspect of forced function, it would not directly change users' behaviors, but it would have an influence on users' attitude. Section 4.4.1.4 in the interview mentioned that not all users would be interested in new functionalities, and be willing to use them without intervals. In this way, forcing some users without interests to always adopt the sustainability-related components would result in the reluctant mood generated. Therefore, persuading all users to adopt sustainable widgets with gamification would have a negative influence on users' attitudes, which following would decrease the willingness of users to use sustainable functions on social media as well. Similarly, the aim of functions would influence users' attitude and willingness, but to be more complicated.

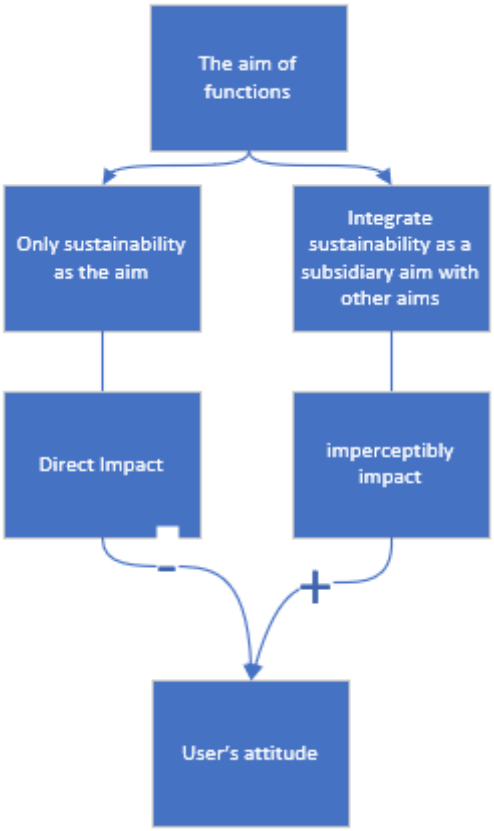


Figure 5.4: The impact of the function's aim on user attitudes

Actually, the aims of the functionality are always diverse (shown in Figure 5.4), but for the purpose of this research, the aim should be that gamified social media to convey sustainable mindsets for users, so that achieving sustainability should be at least the one of aims during the process of designing widgets with game elements. At the interview research, Section 4.4.1.4 displayed that forcibly and directly changing users' behaviors or thoughts to sustainable activities and arguments may arouse users' antipathy and resistance, so that when straight targeting to change users' instant behaviors to be sustainable would lead to reverse outcome on users' attitudes. On the other hand, users would not use the specific functionality, until they need to fulfill the specific and empirical requirements (Section 4.4.1.3 and Section 4.4.1.4), thus integrating sustainable related things into required needs would not arouse their resentment, and even attract users with certain sustainable interests to participate into applying, which can exert a subtle influence on users gradually and accumulatively, and at last influence users greatly. As a result, when designing the aims of functions, combining the concepts of sustainability into other practical requirements can reduce the resistant feelings and enhance the attitudes to sustainability.

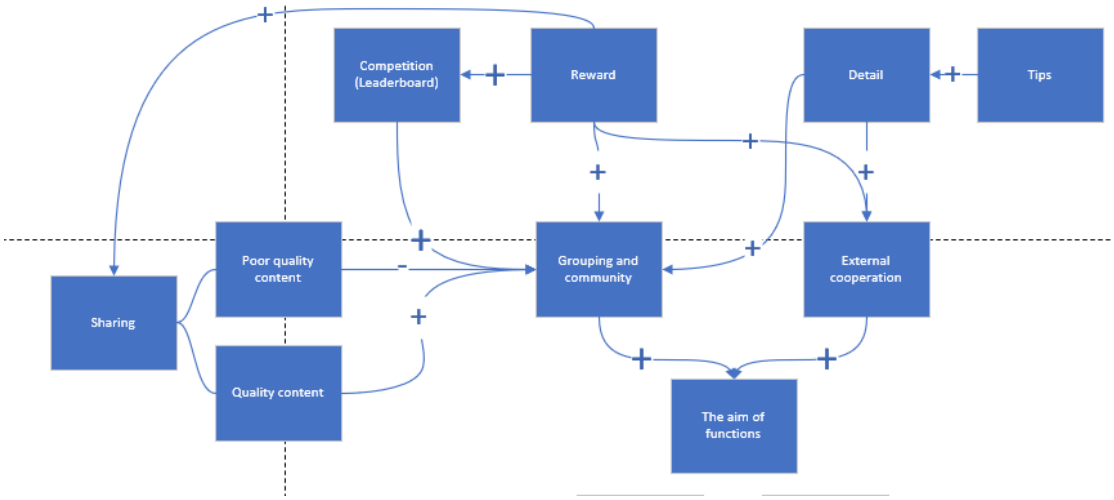


Figure 5.5: The impact of gamification elements on functionality

As for approaches to achieve the aim of functions, there are two primary ways, grouping and community, and external cooperation (Figure 5.4 and Section 4.4.2). In fact, these two methods intend to expand functions' purposes, in order to play a positive role on users' attitude when combining with the upper-level argument. Section 4.4.2.1 of the interview showed that grouping and community can help users meet social needs, and at the same time, digital sociality originally is the basic target of social media. On the other hand, the diversity of aim can draw support from external cooperated companies. In other words, different cooperative partners would generate various boosts for functionalities and purposes.

In the aspect of grouping and community, competition and sharing are two central game elements to meet users' social needs. On one hand, a leaderboard as a manifestation of competition at games can strengthen the communication and connection between users, hence, reasonable use of competitive game elements can help users form groups and communities for finishing common tasks about sustainability (Section 4.4.3.3). On the other hand, Section 4.4.3.4 illustrated that sharing can build connections between users by conveying information, but the ultimate consequence greatly depends on the content quality. In detail, sharing content with high quality would stimulate users' interest in reading and dissemination, thereby generating positive feedback to the game element of grouping and community, while low-quality sharing brings reverse feedback.

Then according to more than one interviewee's opinions, detail is another active game element during the process of achieving the sustainable aim. In Section 4.4.3.5 of the interview, sufficient details and classification could quicker help users grasp the essentials of the functionality and more easily find the interested in contents, and the information of groups and cooperative partners can be clearer received by users, which has a positive effect both on community groups and external cooperation. As a simple and flexible game element, hints can be used in various scenarios to deliver and display more details (Section 4.4.3.1). Especially, when it combines with details to present and replenish more contents, it can boost the significant aid to details, even though the effect of hints is limited due to its plain performance.

Ultimately, the reward is the most frequently mentioned gamification element and can be used in various scenarios. Section 4.4.3.2 suggested that rewards combining with corresponding purposes promote users to participate in various behaviors about sustainability, which claimed

that the results of applying rewards are always useful for the intention. In this research, rewards not only can be used directly to improve the users' engagement about sustainable activities in the approaches of grouping and community and external cooperation but also can encourage users for competition and sharing.

5.3 The summary of contributions

Overall, the main contribution of this study is a framework consisting of the design model in Section 5.1 and the validation model in Section 5.2. In response to the purpose of the study, this framework could be a guide for social media companies to design and improve their own gamified sustainable functions. As for design, if social media companies need to design a new function, they can follow the process in Section 5.1 step by step. In step 7, the social media companies need to send the artifact to some testers and collect the user experience as the model in Section 5.2. The interview is not the only method to collect user experience but can be a reference. According to the result of user experience, social media companies can improve their artifact from step 2. As for improvement, if a social media company has already owned a gamified sustainable artifact and wants to improve it. The social media company can directly start from step 7, follow the model in Section 5.2 to analyze the effectiveness of the artifact and go to step 2 to improve the artifact.

Specifically, the design model obtained by the survey can be used as a guide for the design of gamification functions on social media platforms, and the verification model obtained from the interview is mainly to make up for the lack of validation of the design model, thereby supplementing the framework. In the case of this study, the verification model has verified the effectiveness of the prototyping process from the perspective of the user, the design of functions, and the selection of gamification elements. These three aspects can also be supplemented to explain the second step in the design model, which is the purpose of determining the function, and the fourth and fifth steps, the selection and use of game elements. Therefore, as shown in Figure 5.5, after the results of the seventh step are collected, the product of the design can be iterated, that is to say, the function improvement could be started from the second step. The interview model can not only help improve the existing process of the design model, but also has some additional supplements to it, mainly the user's right to choose and the setting of functional goals. For example, as mentioned in Section 4.4.1.4 earlier, when social media releases new sustainability-related functions, users should not be forced to use the new functions to avoid disgusting users. In addition, when designing the goals, sustainability should be integrated into the daily needs of users, to provide users with more reasons and opportunities to use a sustainability-related function, and at the same time, it can also increase users' willingness to use it.

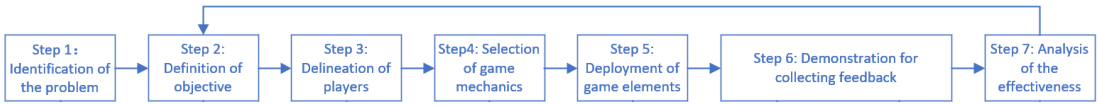


Figure 5.6: The process for designing gamified social media on sustainability

Moreover, some conclusions obtained in the interview can be used to verify the results of the survey. For example, the results of the interview verified some of the content contained in the sixth step of the design model, including "sufficient details help increase the user's

willingness to participate in a new function" and the effect of some gamification elements. However, it should be noted that the effectiveness of the game elements involved in the interview is only for the elements used in the prototype design of this research. This means that the effects of gamification elements not covered in the prototype have not been studied. In other words, according to different situations and different needs, social media platforms may choose different methods and gamification elements, and the effects may be different. Therefore, it is necessary to analyze the effectiveness of specific functions and iterate continuously to achieve the optimal state. Secondly, the survey results did not involve whether social media influences people should be behavior-based or thought-based. In the interview, the interviewees clearly stated that they are unwilling to be explicitly taught by social media. This kind of statement also confirms the view of Owen (2013) and Georgina et al. (2021) that the function design should be based on guiding the user's behavior, and the user begins to reflect through the change of behavior, and then promotes the change of thinking.

The verification model obtained from the interview not only supplements the survey results, but part of the content can also be combined with the survey results to draw further conclusions. For example, the results of the interview indicate that whether a user uses a feature depends on their attitudes toward the feature, in this study, includes attitudes toward social media, gamification, and sustainability. Therefore, in order to make more users willing to try the sustainability-related functions on social media initially, the function design should be aimed at users who hold a positive attitude towards these three aspects. This can be discussed in conjunction with the design model. According to the design model's step 3, different types of groups have different attitudes towards these three aspects. It can be inferred that gamification design for young people and highly educated people may be easier to attract users to use the sustainability-related functions of gamification on social media at the beginning.

5.4 Limitations

For the survey part in this research, most questions are not scaled questions, thus, the reliability and validity of the questionnaire results cannot be objectively analyzed by some data analysis software such as SPSS and SmartPLS. In view of this situation, when designing the survey, the researchers gave a detailed explanation before the questions of each part, so as to help the participants better understand some background knowledge and make a choice with higher reliability and validity. Also, due to the snowball method used to spread the survey in this study, the distribution of sample age and educational background was uneven. For groups with only a small number of participants, the results obtained from the survey may not be sufficiently representative of the relevant groups, such as those with Ph.D. qualifications and primary school qualifications. Another potential limitation is that only the average value was taken for analysis for all scaled questions which may affect the accuracy of the results to some extent.

For the limitation of the interview, only 5 respondents were interviewed in this study. The small number of interviews led to the fact that the views of the interviewees were all different. while it could affect the generalisability of the results (Kvale & Brinkmann, 2009). Finally, the prototype cannot be used as a completed application, it can only be presented to the

interviewees. The interview results obtained through presentation may not be as effective as the interview results obtained after a period of real use by interviewees. As R1 points out, he has not used or experienced the application, and it is difficult to say whether he would be interested in it. Moreover, due to the limitation of objective conditions, the prototype design in this study did not include all the 25 game elements mentioned by Sitorus et al. (2017), but only the more representative gamification elements in the six categories. This may also cause the limitation of the results of this study to some extent.

6 Conclusion

The research purpose of this thesis is to explore how to leverage gamification into social media to make users sustainable, which leads to the following research questions being raised:

> *What guidelines can social media follow when using gamification to influence users to become sustainable?*

In order to answer the research questions of this study, a literature review was conducted to systematically understand the relationship between social media, gamification, and sustainability, their current application status, and the existing theoretical framework. Then, an initial framework that can answer the research questions was derived mainly based on a literature review. At the same time, the results of the literature review also guided the data collection in the first phase of this study. The results of the quantitative research phase together with the previous initial framework guided the prototype design, and the prototype design was also the basis for the subsequent qualitative research. In the end, a framework to guide how social media can make users sustainable through gamification was derived, which mainly consisted of two models. The first model was to guide social media on how to use gamification step by step to carry out sustainable related design, and the other model was to help social media platforms evaluate and iterate on their gamified functions or other related artifacts on sustainability.

As a design science research, according to Gregor and Hevner (2013), the contribution of this research can be regarded as a preliminary and immature invention, that is, a new solution to a new problem. Specifically, the main contribution of this research is the above-mentioned framework that guides social media on how to leverage gamification to make users sustainable. The social media platform could develop a brand-new function or other kinds of artifacts or modules according to the design model of the framework, from “Identification of the problem” to “Analysis of the effectiveness”, then evaluate and iterate the functions according to the verification model of the framework. What is more, social media platforms could also use the verification model of the framework alone to verify and iterate an existing function or module to achieve a more ideal effect. By using this framework, social media platforms are expected to increase the richness and interest of the platform, thereby attracting more users and creating more profit opportunities. Not only that, based on the guidance of this framework, social media platforms can effectively implement the requirements of sustainable development to achieve CSR, thereby enhancing corporate image and brand recognition. Moreover, according to the guidance of this framework, social media platforms can promote cooperation with more external companies, and are expected to seek more cooperation opportunities with them in the future, so as to achieve a win-win situation while creating more business value.

As for future works, the researchers suggest that, on the one hand, a technical practice can be attempted on the basis of the framework derived from this study, which can also supplement the current framework to some extent. On the other hand, future works could be developed on the basis of the framework obtained in this research. Since the framework of this research is relatively general, which means there are many details that can be further studied and expanded. For example, future research could be more focused on the selection of gamification elements on the basis of this framework, that is, how to choose the most suitable

gamification elements under different situations and different requirements to achieve specific effects. All in all, this research provides a general framework, and more specific research results can be incorporated into this framework to make it complete and more enriched to further improve its usability in the future.

7 Appendix

○ Appendix 1: Survey questions

This survey is part of a research project by three master students in Information Systems at Lund University. The purpose of the study is to explore how social media platforms can influence users to be sustainable through gamification. All participants are anonymous in this survey and the results of the survey will be used for research papers only. The personal information and choices of the participants will be kept confidential. If you have any questions or concerns about this research or how the paper is being used, please contact the School of Economics and Management at Lund University by email (info@ehl.lu.se).

This survey contains four main sections: the first section is about personal background information; the second section is about different types of social media and the impact they have on users; the third section is about users' attitudes toward sustainability messages on social media and their willingness to change their behavior based on the messages, and the fourth section is about users' perceptions of gamification on social media and the attitudes of social media to convey sustainability through gamification.

This is a bilingual questionnaire. Please choose a language you are familiar with to answer.

本调查是隆德大学信息系统专业三名硕士生的研究项目的一部分。该研究的目的是探索社交媒体平台如何通过游戏化影响用户的可持续生活方式。此调查是匿名的，调查的结果仅供研究论文使用。参与者的个人信息和选择将被保密。如果您有任何问题或担忧关于此研究或论文被如何使用，请通过 info@ehl.lu.se 联系隆的大学经管学院。

本调查主要分为四个部分，第一部分是个人的背景信息，包括三个问题；第二部分是关于不同类型的社交媒体以及对用户造成的影响；第三部分是关于用户对于社交媒体上可持续发展消息的态度以及根据消息改变行为的意愿；第四部分是用户对于社交媒体上的游戏化元素的看法以及社交媒体通过游戏化传达可持续的态度。

这份问卷是双语的。请选择您熟悉的语言作答。

Category	Questions	Source	Purpose

Background information 背景信息	In this section you need to tell us some background information to help us better understand the basic situation of the participants of this survey. 在这部分您只需要如实填写一些您的背景信息来帮助我们更好的了解此调查的参与者的基本情况。		
	1. Your age 你的年龄 A. Under 14 14 岁及以下 B. 15-25 C. 25-35 D. 35-45 E. More than 45 14 岁及以上	Siddiqui and Singh, 2016; Wojdan, Wdowiak, Witas, Drogon and Brakowiechi, 2021	1. Collect basic information about the users to classify the users to choose different game elements for social media. 2. Verify which groups of people are more affected by social media
	2. Education background 教育背景 A. Elementary school 小学 B. Junior high school 初中 C. High school 高中 D. Vocational school 专科	Kulandairaj, 2014	

	E. Bachelor's degree 本科 F. Master's degree 硕士 G. Ph.D.-degree 博士		
	3. Gender 性别 A. Male 男性 B. Female 女性 C. Secret 不愿透露		
The different types of social media and their impact on users 不同类型的社交媒体以及对用户造成的影响	In this section, you need to answer some questions about your daily social media habits. We have given you one or two examples of different types of social media to help you better understand and make choices. Similarly, we have given you one or two examples of how social media has changed your habits to help you choose the best options for you. In addition, the number of hours spent on social media includes the sum of the hours spent on mobile devices and the hours spent on PC. 在这部分，您需要回答一些关于您日常使用社交媒体的习惯的问题。针对不同类型的社交媒体，我们都给出了一两个例子，来帮助您更好的理解和做出选择。类似地，对于社交媒体改变您的习惯，我们也给出了一两个例子来帮助您更好的选择最符合自己的选项。另外，社交媒体的使用时长包括在移动设备上的使用和在个人电脑上使用的时长总和。		

	4. Please rank the following social media types according to your preferences (ranking) 请对以下社交媒体种类按你的喜好排序(排序) A. Online Q&A Site: Quora 在线问答网站：例如，知乎 B. Social network sites: Facebook 社交网站：例如，微信 C. Virtual social worlds：Second Life 虚拟社交世界：例如：摩尔庄园，动森 D. Collaborative projects: Wikipedia 协作创建知识：例如，百度百科 E. Content communities: YouTube 内容社区：例如，哔哩哔哩，抖音，快手 F. Virtual game worlds: World of Warcraft 虚拟游戏世界：MMORPG 例如：魔兽世界，天刀，逆水寒	Kaplan and Haenlein, 2010	Verify which types of social media have significant effects on social media users

	5. Which of the above types of social media do you use most to get information (e.g., news, video, advice, posts, etc.)? 你最主要用以上哪个类型的媒体获取信息（例如新闻，视频，咨询，帖子等）？ A. Online Q&A Site: Quora 在线问答网站：例如，知乎 B. Social network sites: Facebook 社交网站：例如，微信 C. Virtual social worlds: Second Life 虚拟社交世界：例如：摩尔庄园，动森 D. Collaborative projects: Wikipedia 协作创建知识：例如，百度百科 E. Content communities: YouTube 内容社区：例如，哔哩哔哩，抖音，快手 F. Virtual game worlds: World of Warcraft 虚拟游戏世界：MMORPG 例如：魔兽世界，天刀，逆水寒		

	6. How many hours per day do you spend on your favorite social media? 你会在你最喜欢的社交媒体上每天花费多少小时？ A. Less than one hour 少于 1 小时 B. 1-3 hours 1-3 小时 C. 3-5 hours 3-5 小时 D. 5-8 hours 5-8 小时 E. More than 8 hours 多于 8 小时		Verify that there is a correlation between the impact of social media and the amount of time users spend on social media.
	7. Which kind of devices do you usually use on social media? 通常在哪个端使用社交媒体？ A. PC/Laptop 电脑/笔记本电脑 B. Mobile devices 移动设备	Chui et al., 2012; Kaplan, 2012	Identify which devices users usually use social media on.

	8. Has social media changed any of your habits for a long term? (multiple-choice) 社交媒体是否在长期上改变了你的某种习惯？（多选） A. Learning habits (online and offline course, learning place, learning time, learning duration, learning methods, etc.) 学习习惯（线上线下课程选择，学习场所，学习时段，学习时长，学习方法等） B. Travel habits (transportation choice, driving habits, etc.) 出行习惯（交通方式选择，驾驶习惯等） C. Eating habits (food choices, cooking methods, eating places, eating healthy, reducing food waste, etc.) 饮食习惯（食物选择，烹饪方法，饮食场所，饮食健康，减少食物浪费等） D. Consumption habits (payment methods, changes in shopping types, online and offline shopping, consumption level, etc.) 消费习惯（支付方式，购物种类倾向变化，线上线下购物，消费水平等） E. Social habits (social etiquette, etc.)	Gee, 2007; Schaffer, 2008; Dewey, 1916; Nordby et al., 2016; Aguilera, 2013; Zapico et al., 2009	Explore what kind of people's habits and thoughts can be influenced by social media

	社交习惯（社交礼仪等） F. Living habits (save water, save electricity, etc.) 生活习惯（节约用水，节约用电等） G. Not affected 没有被影响		

Users' attitudes towards sustainability messages on social media and their willingness to change their behavior based on the messages 用户对于社交媒体上可持续发展消息的态度以及根据消息改变行为的意愿	In this section, please imagine a scenario where you receive a sustainable message or suggestion while using social media, whether you are browsing for information or participating in an event. Choose what you would do in this situation and why you would do it, and just choose according to your real thoughts. 在这部分，请您设想一种场景：您使用社交媒体时，不论是浏览信息或是与参与活动的过程中，收到了一些可持续的信息或是建议。请选择您在这种情况下的做法以及这样做的原因，只需要按照您的真实想法填写即可。		
	9. To what extent do you follow the sustainability-related news shared on social media? 你在多大程度上会关注社交媒体上分享的与可持续发展相关的消息？ Not at all 0-1-2-3-4-5 Frequently 不关注 0-1-2-3-4-5 十分关注	Reilly and Hynan, 2014; Zuckerberg, 2017; Handelman and Arnold, 1999; Fraser, 2011; Wenzel, 2009	Verify the impact of sustainability-relevant information on social media (posted by people or companies).

	10. When you receive sustainable advice from social media, are you willing to follow? 当你接收到来自社交媒体的可持续的建议时，你是否愿意根据社交媒体的建议改变你的行为以实现可持续？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意	Gee, 2007; Schaffer, 2008; Dewey, 1916; Siddiqui and Singh, 2016; Power and Phillips Wren, 2011; Linich, 2013	Verify the impact of sustainable advice on social media
	11. Why don't you take action when you are guided by social media as for some sustainable issues (e.g., greenhouse effect, desertification)? (Multichoice) 当你受到一些来自社交媒体的可持续引导的时候（例如温室效应，荒漠化），为什么不采取行动呢？（多选） A. Has nothing to do with my life 与我的生活无关 B. Do not know what can be done to this problem 不知道对于了解到的问题能做什么力所能及的事情 C. Do not know how much impact your actions have	Owen, 2013	Clarify the reason why some people refuse to change their behaviors to reduce their impact on sustainability.

	不知道自己的行为能带来多大影响 D. It feels like my personal contribution can't improve the problem 感觉自己的个人贡献无法改善存在的问题 E. There's no tangible benefit to me 无法给我带来切实的利益		
	12. Would you like to know the specific impact of your actions on sustainability? 你是否愿意了解你的行为对可持续造成的具体影响？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意	Mankoff, Matthews, Fussell and Johnson, 2007; Sitorus et al., 2017	Verify what types of people are more receptive to social media feedback and advice by cross-tabulate with

	13. Would you like to change your behavior after you understand the sustainability impact of your behavior? 在你了解了你的可持续影响以后,你是否会改变你的行为习惯？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意		demographic information.
Users' perceptions of gamification elements on social media and social media's attitudes towards communicating sustainability through gamification 用户对于社交媒体上的游戏化元素的看法以及社交媒体通过游戏化传达可持续的态度	In this section, imagine a scenario where social media is trying to give sustainable messages and advice to you in a gamified way. If you find this difficult to understand, consider the following example: you are browsing Facebook and one of your favorite actors' posts an interactive post inviting you to participate in a virtual tree planting game, where you will be rewarded for completing the game. If you can complete the game, you will be rewarded. If you invite friends and relatives to participate, you can get extra rewards. You can complete the game multiple times to get a higher ranking among your friends. Also, if 10 people like you complete the game, the game initiator will plant a real tree on the earth and notify you with detailed feedback about your contributions. Now, you can try to answer the following questions based on your understanding of this example. 在这部分，请您设想一种场景：社交媒体以游戏化的方式试图传达给你一些可持续的消息和建议。若您觉得有些难以理解，可以参考以下的例子：您正在浏览脸书，此时一条您喜爱的演员发了一条互动帖子邀请您参加一个虚拟种树的小游戏，如果您可以完成此游戏，便可以获得一定奖励。若您邀请了亲戚朋友来参加，可以获得更多的奖励。您可以多次完成此游戏，以在好友圈中获得更高的排名。同时，若有像您一样的 10 人完成了此游戏，游戏发起人便会在现实中种一颗真树，并将详细的反馈通知给您。 现在，根据您对此例子的理解，可以试着回答以下问题。		

	14. Would you be more likely to engage in sustainable behavior if you were given more detailed feedback? 如果给你更详细的反馈，你会更愿意这样去做吗？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意	Mankoff, Matthews, Fussell and Johnson, 2007; Sitorus et al., 2017	Explore what situations or game elements make users more receptive to the ideas and suggestions that social

	15. Which of the following would make you more willing to accept the advice of social media? (Multi-choice) 以下哪些会让你更愿意接受社交媒体的建议？（多选） A. Social scenarios (e.g., news shared by friends and family, people around you using it, etc.) 社交场景（亲友分享的信息，周围人都在使用等） B. Examples (e.g., celebrity endorsements, advice, etc.) 榜样行为（明星代言或建议等） C. Rewards (e.g., monetary rewards, voucher rewards, virtual items rewards, physical rewards, honors, etc.) 奖励行为（金钱奖励，代金券奖励，虚拟物品奖励，实物奖励，荣誉等） D. Suggestions or opinions that are relevant to your current life (e.g., exam information for candidates, treatment information for patients, etc.) 与你目前生活紧密相关的建议或观点（考试信息对于考生，治疗信息对于病患等） E. Detailed feedback (e.g., immediate feedback on the impact of your actions)	Kaplan and Haenlein, 2010; Akbarov, 2020; Zapico et al., 2009; Handelman and Arnold, 1999; Mankoff et al., 2007; Sitorus et al., 2017; Williams et al. 2014; Du et al., 2016; Dangelico et al., 2013; Prokesch, 2010; Mount and Martinez, 2014	media conveys to users

	详细的反馈（及时反馈你的行为带来的影响） F. Interesting ways of persuasion (e.g., games, stories) 有趣的方式（游戏，故事） G. No acceptance whatsoever （无论怎样都不接受）		

	16. Do you follow or participate in sustainability-related activities that are posted on social media in conjunction with organizations (brands, celebrities, etc) that you are interested in? 你是否会关注或参与在社交媒体联合你感兴趣的机构组织（品牌，名人）上发布的相关的可持续相关活动？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意	Du et al., 2016; Dangelico et al., 2013; Prokesch, 2010; Mount and Martinez, 2014	
	17. Would you be more willing to participate in sustainable activities in groups between family or friends? 可持续活动放到家庭或朋友间的团体中你是否会更愿意参加？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意	Zapico et al., 2009	

	18. Do you know or use any of the following game elements? (Multichoice) 你是否知道或使用过以下游戏化元素 （多选） A. Feedback 反馈 B. Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family) 活动（目标；叙述/剧情；有挑战的任务；竞争；联盟/公会/社团；合作/家庭） C. Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion) 能力（策略/趣味性；约束/限时完成任务；细致/专注/投入） D. Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty) 奖励（积分；徽章；虚拟物品；关键功能/特殊条件解锁；实物奖励；惩罚） E. Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)	Sitorus, 2017	Clarify social media users' understanding and preference on game elements.

	状态（统计/使用时长/订阅数量；排行榜；虚拟形象；等级；完成度/任务完成度；历史反馈/根据历史人物完成度调整未来任务；社交图谱/共同好友） F. Sharing (Telling people; Charity) 共享（告诉他人；分享虚拟物品）		

	19. Which of the following five types of game elements are more common in social media? (ranking) 上述 5 类游戏化元素中哪些在社交媒体中更常见？(排序) A. Feedback 反馈 B. Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family) 活动（目标；叙述/剧情；有挑战的任务；竞争；联盟/公会/社团；合作/家庭） C. Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion) 能力（策略/趣味性；约束/限时完成任务；细致/专注/投入） D. Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty) 奖励（积分；徽章；虚拟物品；关键功能/特殊条件解锁；实物奖励；惩罚） E. Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)		

	状态（统计/使用时长/订阅数量；排行榜；虚拟形象；等级；完成度/任务完成度；历史反馈/根据历史人物完成度调整未来任务；社交图谱/共同好友） F. Sharing (Telling people; Charity) 共享（告诉他人；分享虚拟物品）		

	20. What gamification elements do you prefer in social media? (ranking) 在社交媒体中你更喜欢哪些游戏化元素的应用？（排序） A. Feedback 反馈 B. Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family) 活动（目标；叙述/剧情；有挑战的任务；竞争；联盟/公会/社团；合作/家庭） C. Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion) 能力（策略/趣味性；约束/限时完成任务；细致/专注/投入） D. Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty) 奖励（积分；徽章；虚拟物品；关键功能/特殊条件解锁；实物奖励；惩罚） E. Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)		

	状态（统计/使用时长/订阅数量；排行榜；虚拟形象；等级；完成度/任务完成度；历史反馈/根据历史人物完成度调整未来任务；社交图谱/共同好友） F. Sharing (Telling people; Charity) 共享（告诉他人；分享虚拟物品）		

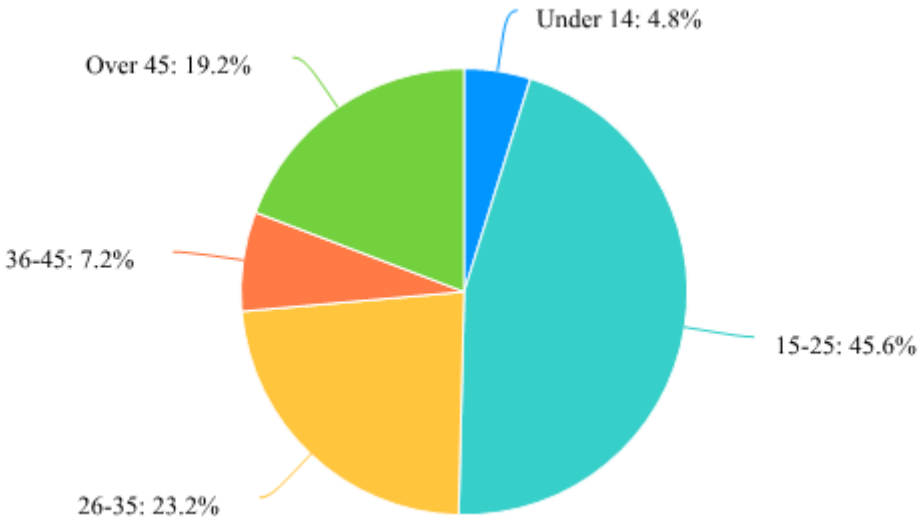
	21. If social media convey sustainable advice by your favourite game elements, would you be more willing to accept it? 如果社交媒体利用你喜欢的游戏化元素传递给你可持续性的建议，你是否会更愿意接受？ Definitely No 0-1-2-3-4-5 Definitely yes 非常不愿意 0-1-2-3-4-5 非常愿意		
Thank you for participating in this survey! 感谢参与！			

○ Appendix 2: Survey results

Gamified social media and sustainability

1 Your age

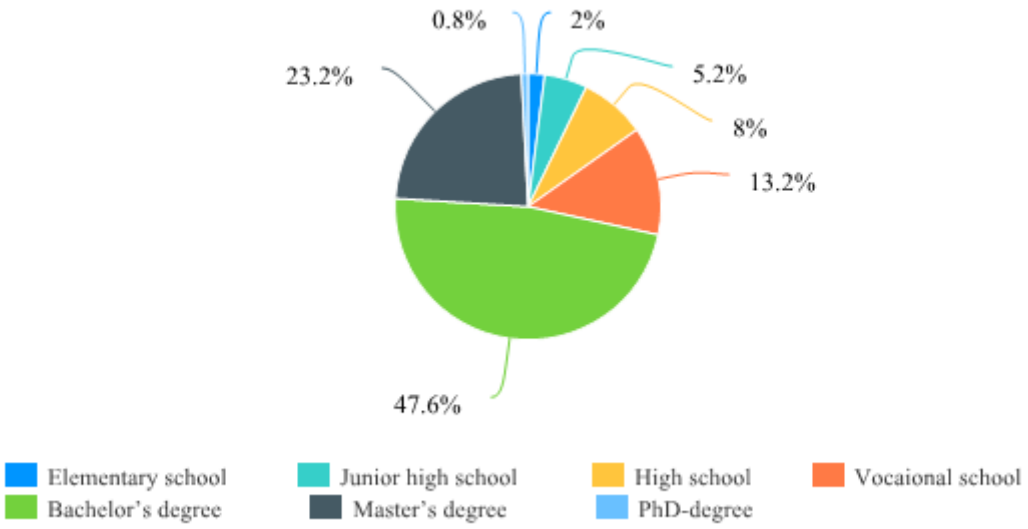
Options	Count	Percentage
Under 14	12	4.8%
15-25	114	45.6%
26-35	58	23.2%
36-45	18	7.2%
Over 45	48	19.2%
Number of Participants in this question	250	



2 Education background

Options	Count	Percentage

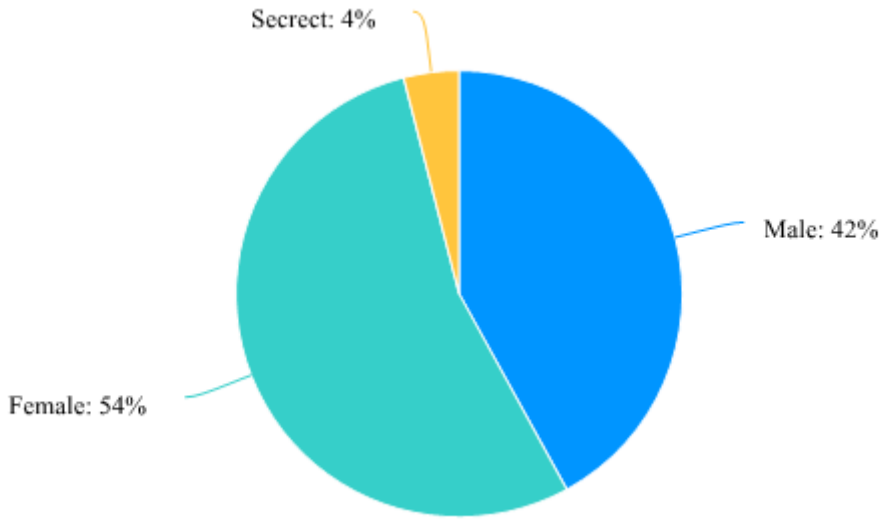
Elementary school	5	2%
Junior high school	13	5.2%
High school	20	8%
Vocational school	33	13.2%
Bachelor's degree	119	47.6%
Master's degree	58	23.2%
Ph.D.-degree	2	0.8%
Number of Participants in this question	250	



3 Gender

Options	Count	Percentage
Male	105	42%

Female	135	54%
Secret	10	4%
Number of Participants in this question	250	



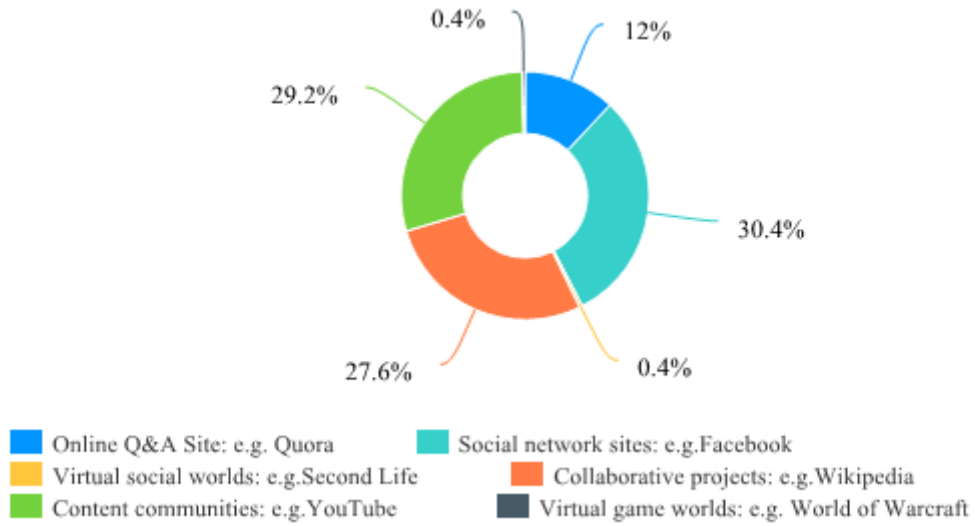
4 Please rank the following social media types according to your preferences

Options	Average score
Social network sites: e.g., Facebook	5.01
Content communities: e.g., YouTube	3.71
Collaborative projects: e.g., Wikipedia	2.88
Online Q&A site: e.g., Quora	2.76
Virtual social worlds: e.g., Second Life	1.64
Virtual game worlds: e.g., World of Warcraft	1.58

P.S.: Average score = (Σ frequency × weight)/the number of people filling in this question

5 Which of the above types of social media do you use most to get information (e.g., news, video, advice, posts, etc.)?

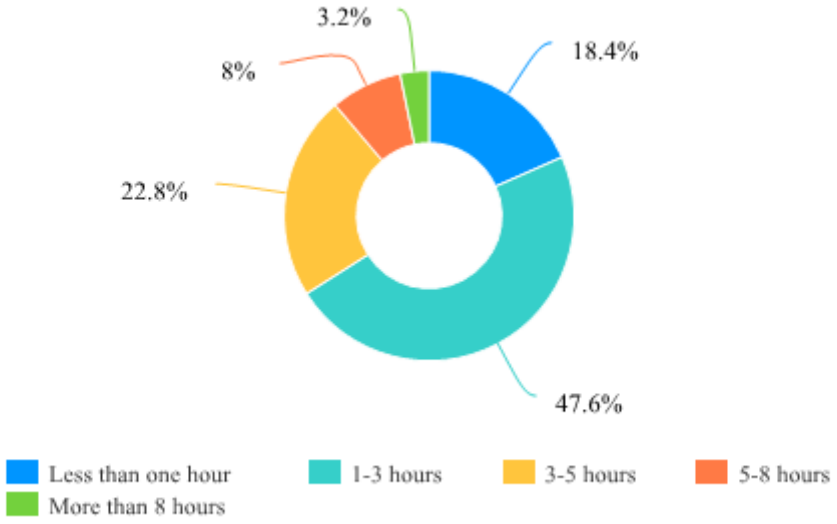
Options	Count	Percentage
Online Q&A Site: e.g., Quora	30	12%
Social network sites: e.g., Facebook	76	30.4%
Virtual social worlds: e.g., Second Life	1	0.4%
Collaborative projects: e.g., Wikipedia	69	27.6%
Content communities: e.g., YouTube	73	29.2%
Virtual game worlds: e.g., World of Warcraft	1	0.4%
Number of Participants in this question	250	



6 How many hours per day do you spend on your favorite social media?

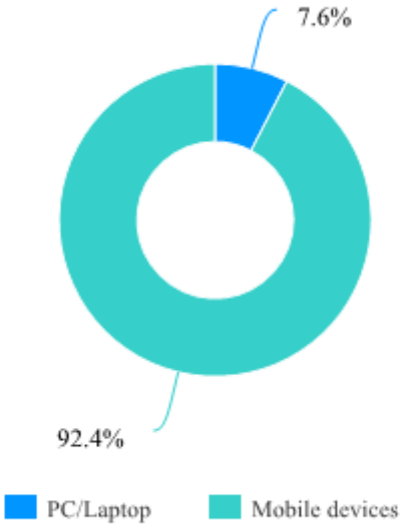
Options	Count	Percentage

Less than one hour	46	18.4%
1-3 hours	119	47.6%
3-5 hours	57	22.8%
5-8 hours	20	8%
More than 8 hours	8	3.2%
Number of Participants in this question	250	



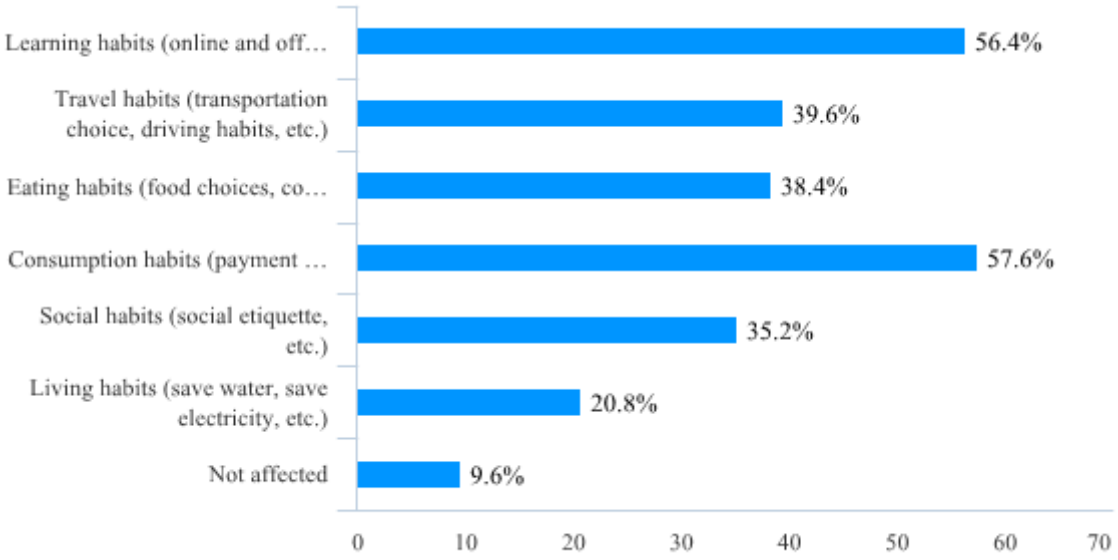
7 Which kind of devices do you usually use social media on?

Options	Count	Percentage
PC/Laptop	19	7.6%
Mobile devices	231	92.4%
Number of Participants in this question	250	



8 Has social media changed any of your habits for a long term? (multiple-choice)

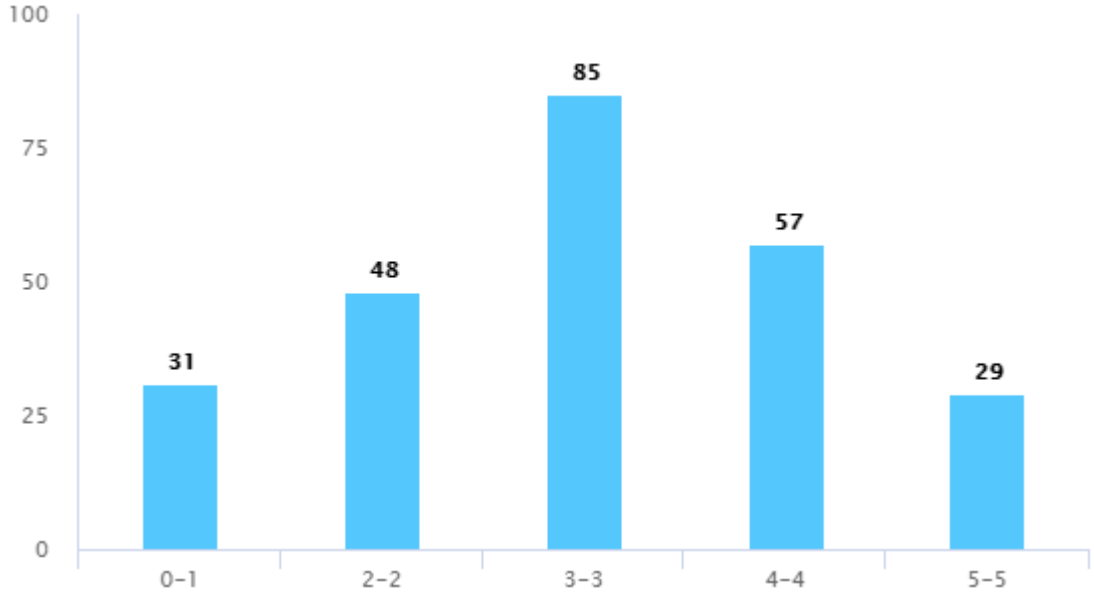
Options	Count	Percentage
Learning habits (online and offline course, learning place, learning time, learning duration, learning methods, etc.)	141	56.4%
Travel habits (transportation choice, driving habits, etc.)	99	39.6%
Eating habits (food choices, cooking methods, eating places, eating healthy, reducing food waste, etc.)	96	38.4%
Consumption habits (payment methods, changes in shopping types, online and offline shopping, consumption level, etc.)	144	57.6%
Social habits (social etiquette, etc.)	88	35.2%
Living habits (save water, save electricity, etc.)	52	20.8%
Not affected	24	9.6%
Number of Participants in this question	250	



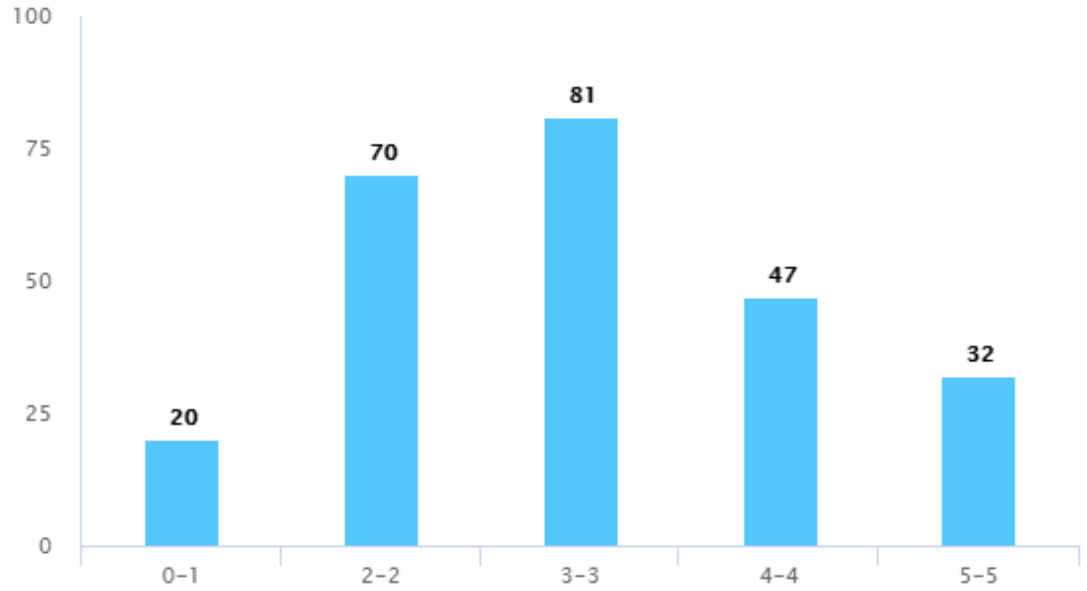
P.S.:

a) *Percentage of multiple choice options = number of times this option was selected ÷ number of valid answers;*
b) *It means the proportion of the number of people who choose this option in all the applicants.*

9 To what extent do you follow the sustainability-related news shared on social media?
The total score of the answer to this question: 748; Mean: 2.99

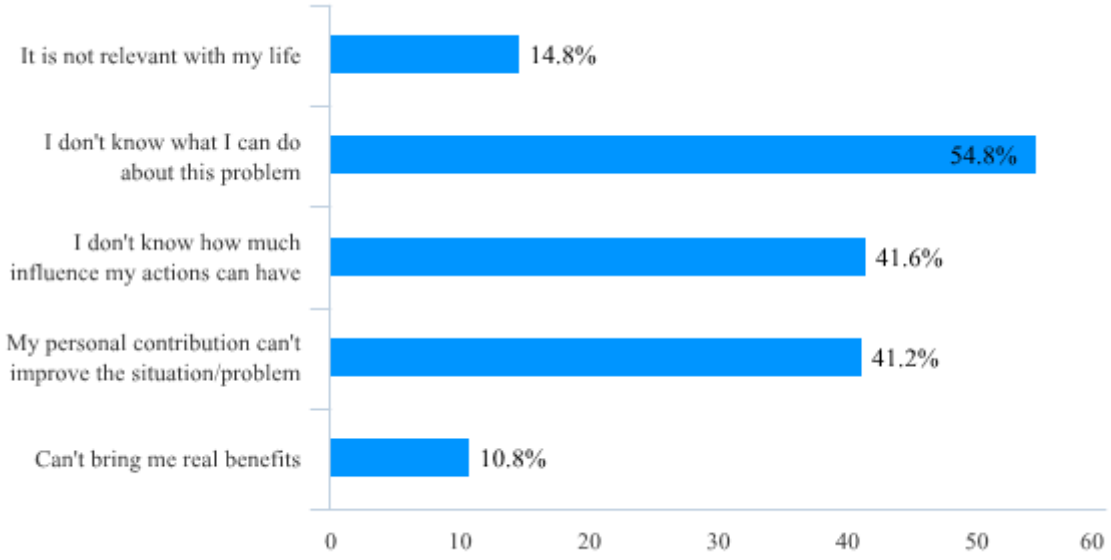


10 When you receive sustainable advice from social media, are you willing to follow?
The total score of the answer to this question: 749; Mean: 3



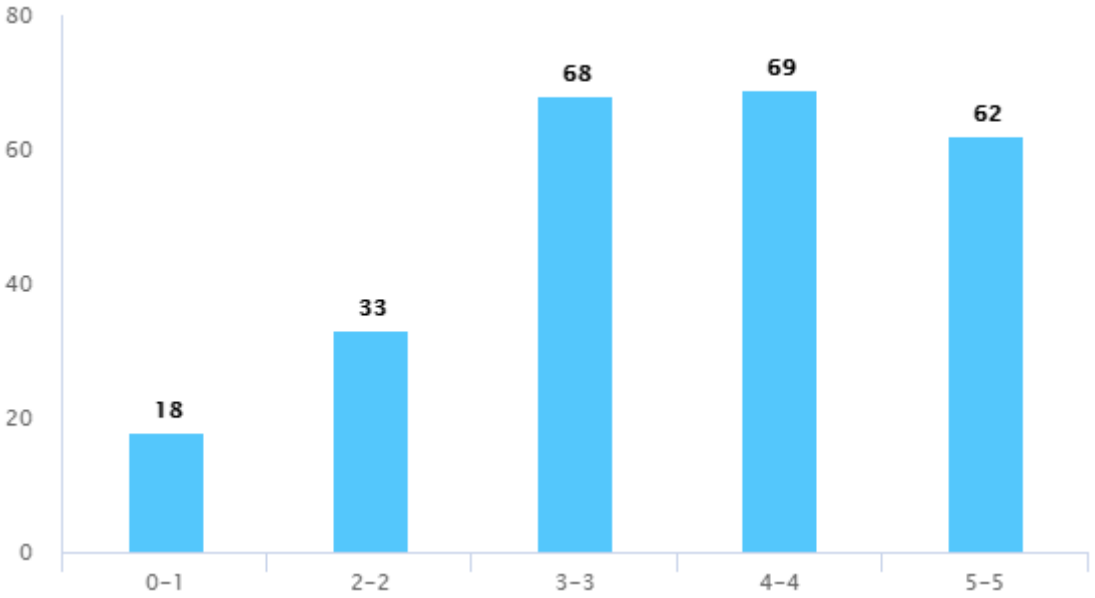
11 Why don’t you take action when you are guided by social media as for some sustainable issues (e.g., greenhouse effect, desertification)? (Multi-choice)

Options	Count	Percentage
It is not relevant with my life	37	14.8%
I don’t know what I can do about this problem	137	54.8%
I don’t know how much influence my actions can have	104	41.6%
My personal contribution can't improve the situation/problem	103	41.2%
Can’t bring me real benefits	27	10.8%
Number of Participants in this question	250	



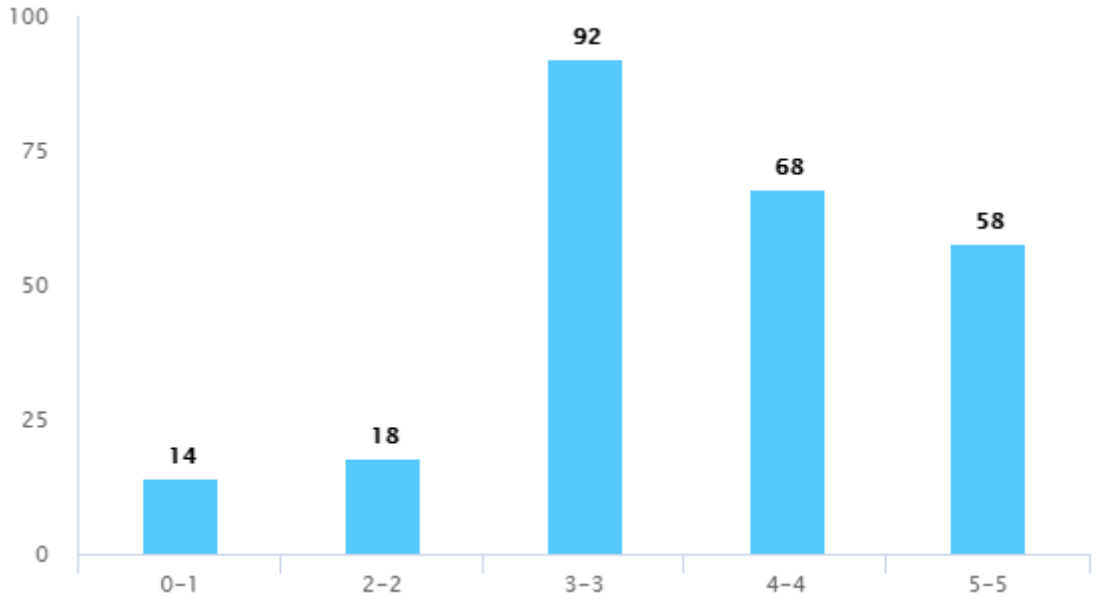
12 Would you like to know the specific impact of your actions on sustainability?

The total score of the answer to this question: 872; Mean: 3.49



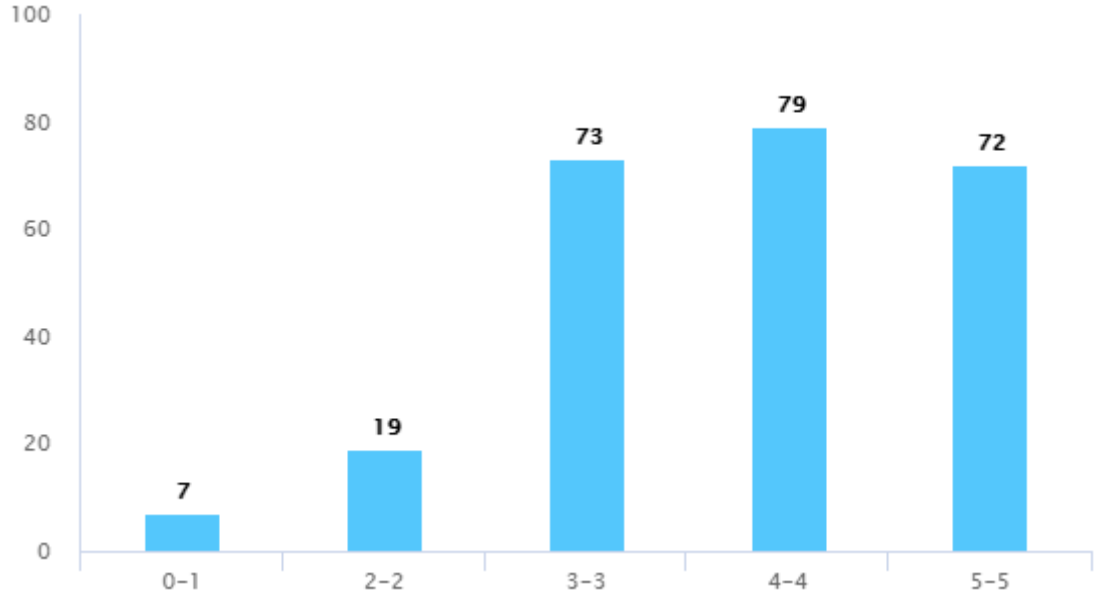
13 Would you like to change your behavior after you understand the sustainability impact of your behavior?

The total score of the answer to this question: 885; Mean: 3.54



14 Would you be more likely to engage in sustainable behavior if you were given more detailed feedback?

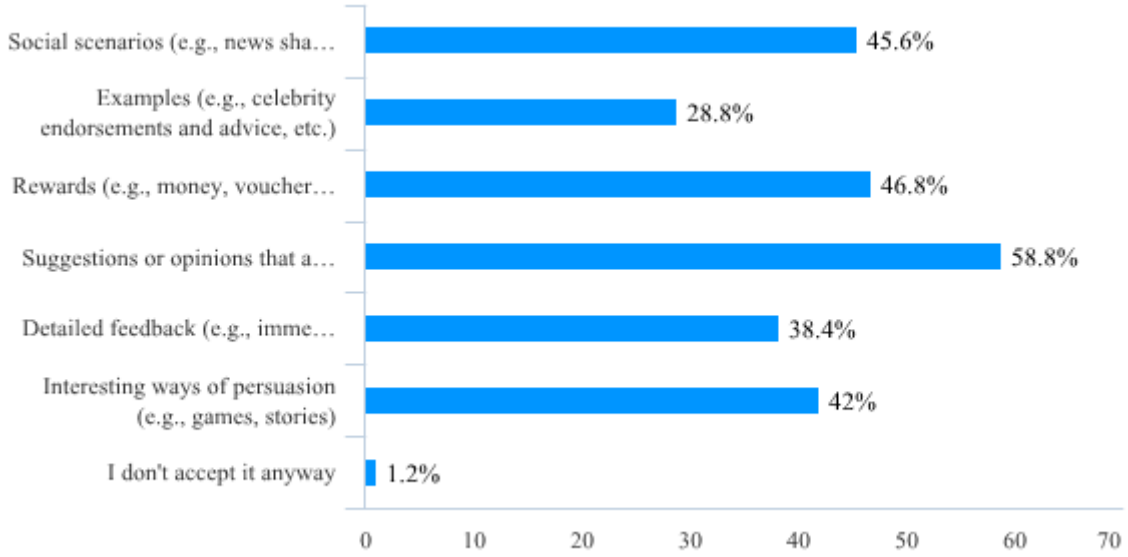
The total score of the answer to this question: 939; Mean: 3.76



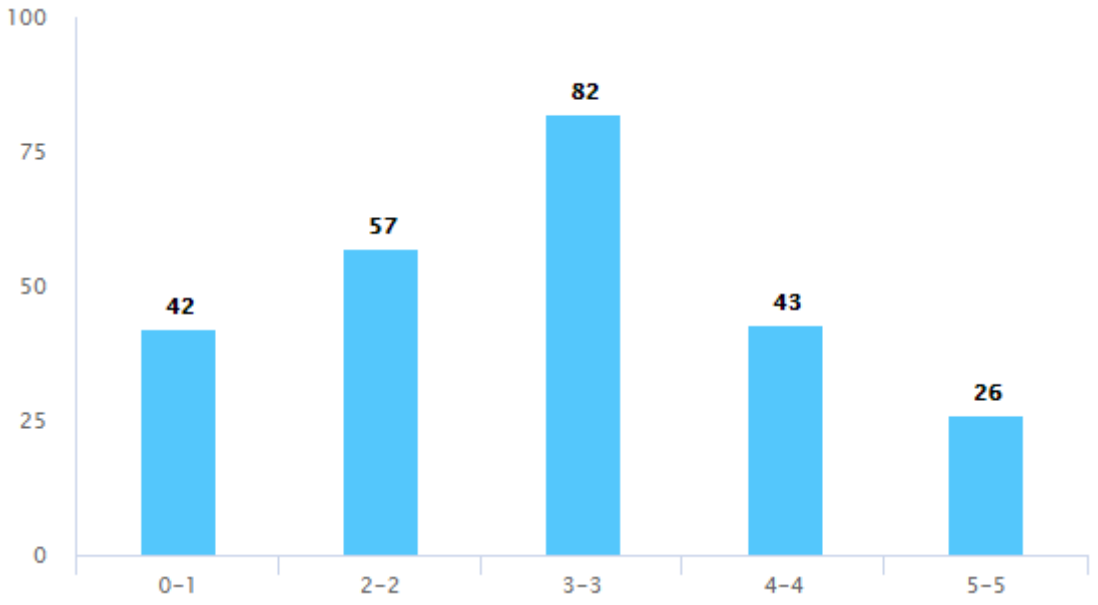
15 Which of the following would make you more willing to accept the advice of social media?

Options	Count	Percentage
Social scenarios (e.g., news shared by friends and family, people around you are using it, etc.)	114	45.6%

Examples (e.g., celebrity endorsements and advice, etc.)	72	28.8%
Rewards (e.g., money, voucher rewards, virtual items rewards, physical rewards, honors, etc.)	117	46.8%
Suggestions or opinions that are relevant to your current life (e.g., exam information for candidates, treatment information for patients, etc.)	147	58.8%
Detailed feedback (e.g., immediate feedback on the impact of your actions)	96	38.4%
Interesting ways of persuasion (e.g., games, stories)	105	42%
I don't accept it anyway	3	1.2%
Number of Participants in this question	250	

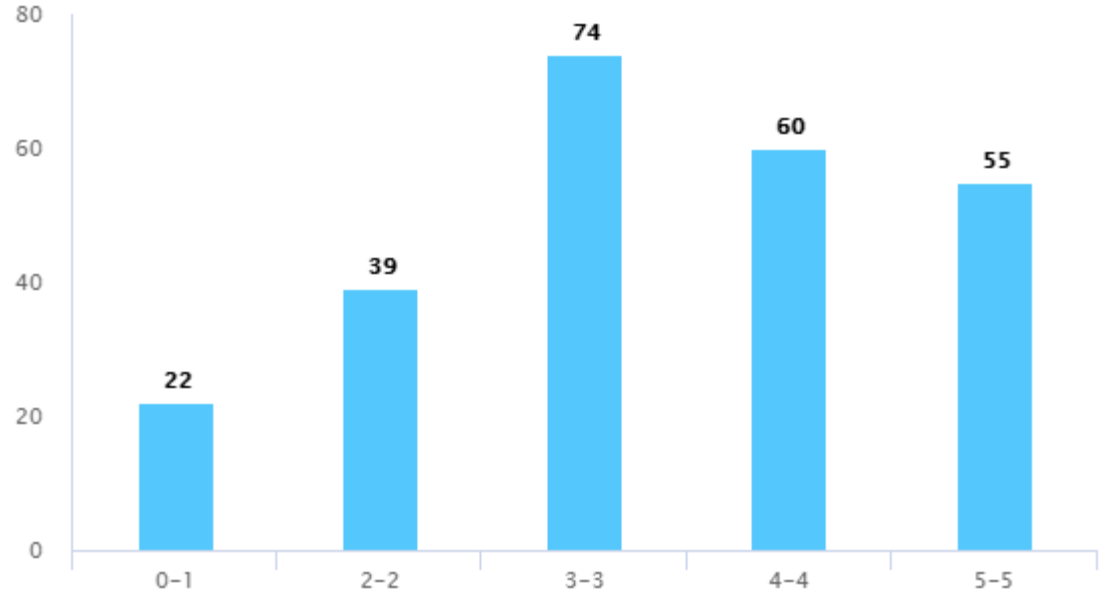


16 Do you follow or participate in sustainability-related activities that are posted on social media in conjunction with organizations (brands, celebrities, etc.) that you are interested in?
The total score of the answer to this question: 692; Mean: 2.77



17 Would you be more willing to participate in sustainable activities in groups between family or friends?

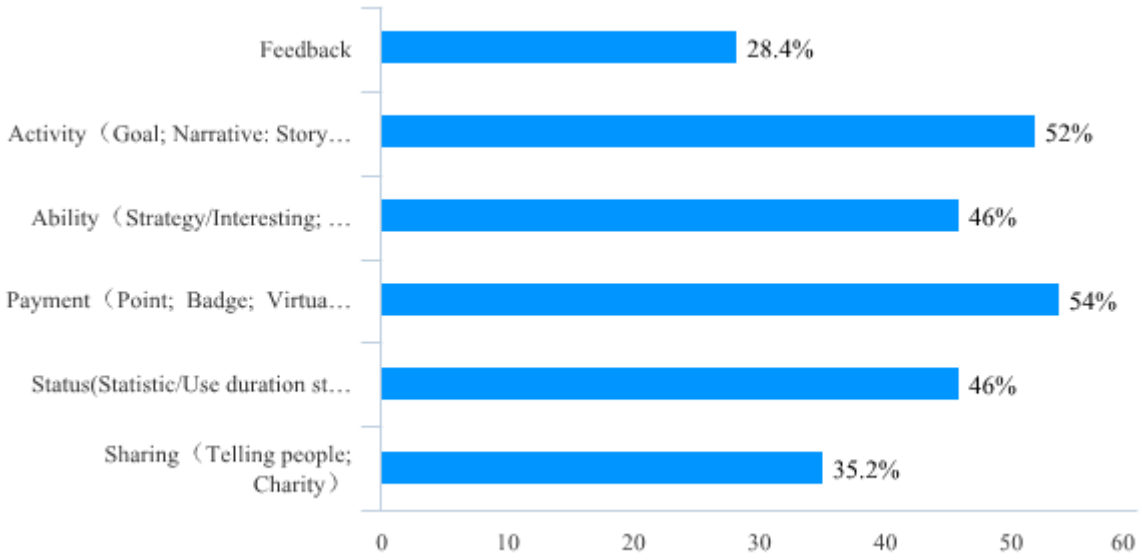
The total score of the answer to this question: 834; Mean: 3.34



18 Do you know or use any of the following game elements?

Options	Count	Percentage
Feedback	71	28.4%
Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task;	130	52%

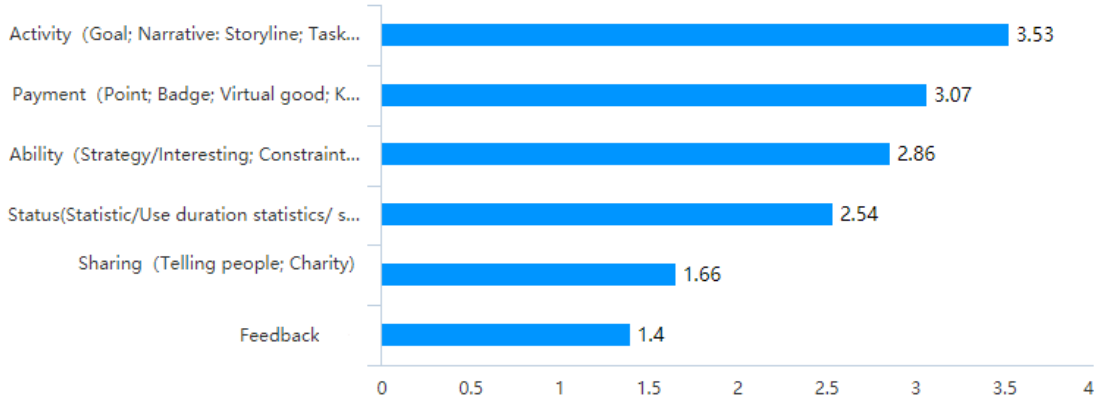
Competition; League/Association/Community; Co-operation/Family)		
Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion/)	115	46%
Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty)	135	54%
Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)	115	46%
Sharing (Telling people; Charity)	88	35.2%
Number of Participants in this question	250	



19 Which of the following five types of game elements are more common in social media? (ranking)

Options	Average score
Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition;	3.53

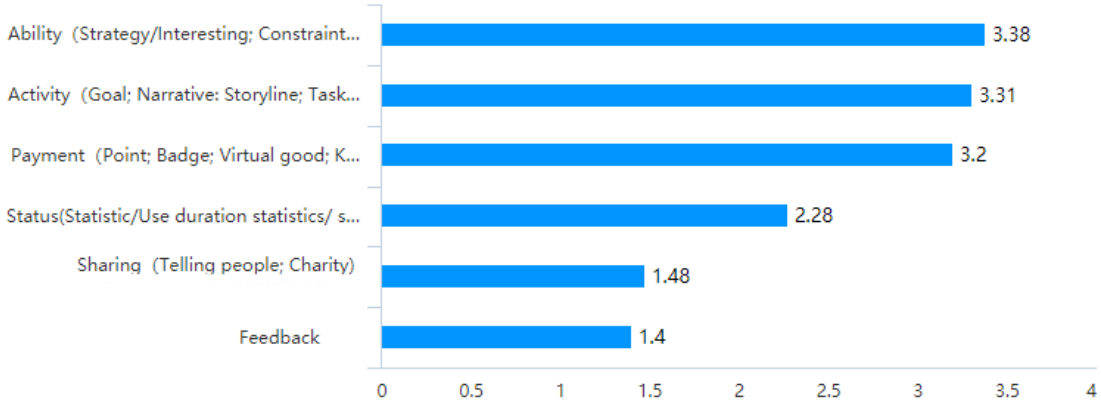
League/Association/Community; Co-operation/Family)	
Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty)	3.07
Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion/)	2.86
Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)	2.54
Sharing (Telling people; Charity)	1.66
Feedback	1.4



20 What gamification elements do you prefer in social media? (ranking)

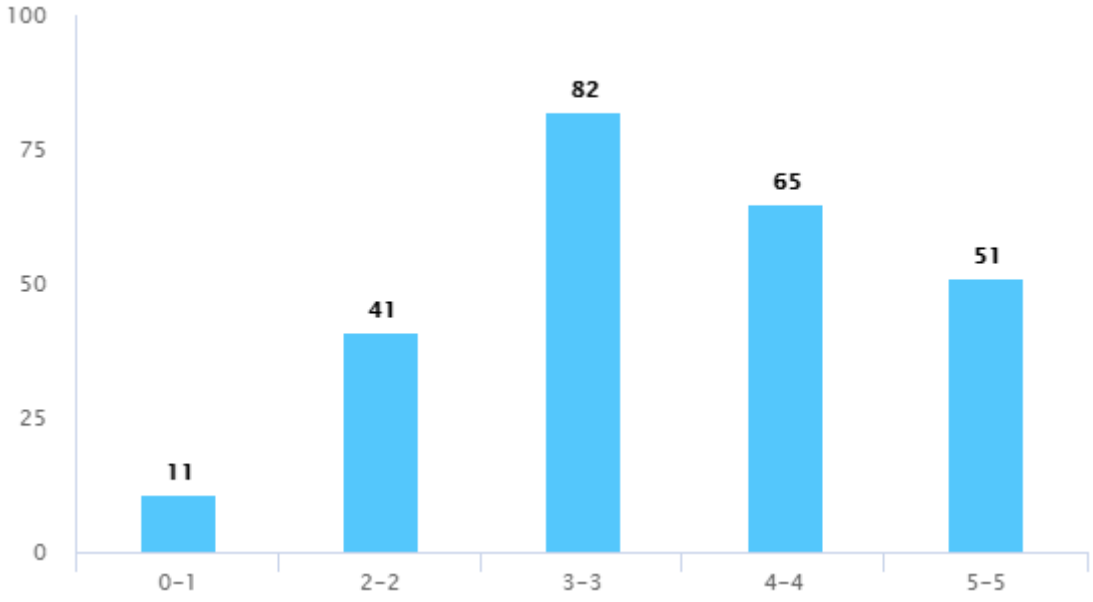
Options	Average score
Ability (Strategy/Interesting; Constraint/ Complete the task within a limited time; Carefulness Focus/Devotion/)	3.38
Activity (Goal; Narrative: Storyline; Task list/Challenge/Challenging Task; Competition; League/Association/Community; Co-operation/Family)	3.31

Payment (Point; Badge; Virtual good; Key feature/ Special Unlocking Condition; Real reward; Penalty)	3.2
Status (Statistic/Use duration statistics/ subscription number statistics; Leaderboard; Avatar; Level; Progress; History; Social graph)	2.28
Sharing (Telling people; Charity)	1.48
Feedback	1.4



21 If social media convey sustainable advice by your favourite game elements, would you be more willing to accept it?

The total score of the answer to this question: 853; Mean: 3.41



○ Appendix 3: R1 & R2 interview transcription

Part 1: Prototype introduction

Second Market
R1: Okay, when I first saw this second market page, I noticed you set the energy consumption or carbon emissions. It's a good idea, but I think you can use a more positive way to show it.
I: Can you go in more detail?
R1: When I first see this, it looks like a notice to tell me how much energy I will waste. I don't want to know that, it makes me feel guilty. But I am willing to know how much energy I can save if I buy this second hand sofa.
I: That make sense, anything else?
R1: For the payment, now you have cash and Facebook pay. Actually, I never used it before, but as a sustainable payment method recommended by the app, there should be more guidance for users to encourage people to use it. Now you have extra points for online payment, but you need to let users know it. Maybe you can set a popup window to suggest users to use Facebook pay and tell users what they can get if choosing this.
R2: I agree that you need to give more suggestions for users, but not the popup window. Adding one more step may affect user's willingness to buy second hand goods. A better way I think would be to add a reminder in small print below Facebook pay when choosing a payment method.
R1: That's true, I also want the experience to be as simple as possible.
R2: Yes. And if the aim is to implement paperless transactions, you should consider providing more online payment methods like Swish, PayPal. Some people may refuse to go paperless because they don't want to use Facebook pay. If there is a variety of online payment options, you don't even need cash anymore.
R1: I like the diversified online payments options, to be honest, I don't want to try Facebook pay. But cash should be kept as a part of diversified payment options. You can change its name to "Offline", now Facebook is using offline transactions.
R2: If it is based on Facebook's existing transaction method, offline can be kept.
I: That's right, we should consider more details about this. Do you have anything else you want to add for this page?
R1: Nothing special.
R2: One more thing, and we can talk about the publishing page together. I think it's necessary to distinguish points for different items. As you know, if I want to sell a sofa, it's difficult to move and transport it. After all that effort, if I can only get the same points as when I sold the book, I prefer to throw it in the rubbish room downstairs. So, I think you can consider adding some tags to the items at the public page, similar to "sofa" and "four seats", in this way, it is not only convenient to search, but also convenient and simple to distinguish the points of different kinds of things.
R1: Yes, everyone expects to get something in return for their efforts. And I think you can add a donate button at the publish page, because I only find a donate button after the publish. A direct donation button can simplify the donation process and increase people's willingness to donate. Because you said that donating can get double points, I guess you want to encourage people to do that.

I: You are right, as you know, there is no monetary gain from donating.
R2: But if you want to give users more points, how to verify their donation behavior becomes very important.
R1: They have mentioned before, the donated items will be received and disposed of by recycling companies or charities that the platform works with.
R2: All right, that's true, partner organizations can make sure donations are complete.
R1: What can these points do?
R2: Exchange some coupons, vouchers or something else, such as H&M's coupon or Netflix coupon.
R1: Netflix coupon, I like it.
R2: In order to keep the attractiveness of the points, you can add more types of goods, including some real goods, like the solar flashlight, just keep every goods eco.
I: Another thing is that if you accumulate enough points, you can also get achievement medals, these medals can be shown on the personal page and second market page.
R2: What are these medals for? Will the goods be sorted by points and medals?
I: We didn't have this, what do you think?
R2: Don't do that. If I want to buy second hand goods, I don't care how many sustainable things these guys did. What's important for me is the credit of the seller and how many products he sold. Medals are a good thing, but don't need too many functions.

Post
R1: Once again, I don't want to know how much emissions I am responsible for, I only want to know how much emissions I saved, people need more encouragement, don't make people feel you are judging them.
R2: I have a different opinion with you for this post. Maybe someone wants to know the impact of their behavior, for example me. So maybe we can use an interesting way to show the emission, such as carbon neutrality. If I do something environmentally unfriendly that causes additional carbon emissions, then what I do afterwards needs to be reduced to make up for the extra amount I emitted before.
R1: I don't think it's a good idea. Firstly, social media could record all the behavior of users. Secondly, it may make users feel like you want to teach them to do something. Maybe there are some people who hope social media tells them what to do every day. But I believe most people like me don't want to be taught by social media. I can accept some tips, but don't tell me what I did was wrong.
R2: That makes sense, carbon neutrality maybe is not such a good idea, but we can change a way to do that. For example, if I went to Stockholm yesterday, I can post something like "Traveling from Göteborg to Stockholm, great!" Then the social media could show me a tip: "Compared to taking a plane, you have already saved 200g of CO2 emissions." Only give users positive feedback.
R1: The user's rewards, points, and medals are controllable on social media, but the specific choices they make and the process of making choices are uncontrollable on social media. For example, he originally wanted to take a plane instead of a train. He may have changed his mind in life, but you have no way of knowing it on social media.
R2: I think showing the carbon emissions generated will make me very burdensome, I don't want to see it. Positive feedback is important, but users need to be told what impact their actions have caused. Our daily activities are generating carbon emissions, and social media should spread this knowledge to users by notifying the consequences.
R1: Yes, I also think popularization is very useful, but this is not something that social media can accomplish.

R2: I think I can accept the carbon footprint of my behavior. If I choose to add this when I publish it, it means that I am the one who wants to do this. People who don't pay attention to this thing will understand that this can generate so much carbon emissions after seeing the content I posted, and he may think more about this matter in the future.
R1: I don't use social media to get upset. Science popularization is important, but it shouldn't be here. You told me that I should do it like that. I'm very unhappy.
R2: Not everyone has to choose to display emission when posting activity. First of all, I want to choose to display my emission and then I add it, otherwise I can choose not to add it, which is pretty good.
R1: Can I choose to post eco activity and non-eco activity when I publish the event? If I go out by plane today, you would tell me how much carbon emissions I have caused. Then I never want to use this social media anymore.
R2: This starting point is strange. It should be posted by those who follow, and those who don't follow have not forced you to do so.
R1: Most people don't care about this thing. They don't really want to do it or are very disgusted. We should not push them to the disgusting side. It's not necessarily that people who want to do this will click in and post such things. Users should have the right to make their own choices.
R2: Positive feedback can also be retained, but users must first have the right to choose. There should be a place for users to open and display their carbon footprint, and it should not be blocked.
R1: That's right, but I think it can be as private as possible, but in the final analysis, I still think that this will cause most people to not want to use this, which will cause disgust. I really can't understand why people want to show others how much carbon I generate today. I don't understand.
I: Let's discuss this issue for a while, now let's continue to introduce the function.

Challenge
R1: It is not good that only the top ranked group can get points.
R2: I agree, not only can you get points in the first place.
R1: I have an idea. Regarding verification, how can we ensure that this matter is true and reliable? That is, is there any way to monitor that a participant does a certain activity?
R2: I think everyone exists in a community, and everyone supervises each other, which has played a role in verification.
R1: This is great.
I: Let's show all the functions first, and we can discuss the ranking and points in detail later.
R2: Okay. Is the activity posted by the participants under the event visible only to the participants or to everyone?
I: When creating an event, if the user selects group, it will only be visible to participants, and if public is selected, it will be visible to everyone
R2: Maybe you can give more rewards to people who create public tasks, after all, the more people see, the better
R2: Do you have any encouragement for me when I post? As long as I publish a post, I can get rewards? Or the more I write or the content contains pictures, I will get more rewards?
I: No, there is currently no such function.
R2: Okay, but I think people who write more content should get more rewards.
R2: Where can I see if my friends' scores have risen, or where are they in the team? That is to say the leaderboard. I like the leaderboard very much, I think this is a very important part of playing games.

Part 2: The formal interview

I: Let's talk about your current thoughts
R2: First of all, I suggest that the ranking should be added. This is very important for game participants.
R1: I think we can tell users the impact of your behavior in a better way, rather than just a simple carbon emission figure. For example, tell the user that the amount of emissions he saved is approximately equal to a tree. Such things should be reflected in more kinds of functions.
R2: Activity is a tweet, and event is a challenge activity, right? You should not spread the scope of your tweet too broadly
R1: Agree, the tweet is rather vague, because I can post any content here. When the eco notation is displayed, whether it is my own choice, it is very vague. It upsets me too much.
R2: The existence of activity's tweet function and the overall goal are getting farther and farther, and it feels like there is no meaning.
R1: Regarding whether to display the generated carbon emissions, I wonder whether it is possible to directly choose a different Facebook mode, and users can choose to turn on the sustainable mode. This is similar to some apps that have a youth model. In this way, it can target those who have a desire for sustainability itself, rather than unrelated people who don't know anything about it.
R2: I think it's a good idea, but there are some problems. When a user wants to use social media, if he wants to get more eco support, he can take the initiative to choose to turn on something. This is no problem, but it should not exist as an independent model.
R1: It doesn't have to be a pattern, maybe I might change the word more appropriately. For example, there is a button, "Do you want to learn more?", you can open it if you want to know, something like this.
R2: But I think this is a departure from our subject.
I: We can summarize these into a main point in the framework, for example, let the user autonomy principle instead of forcing him to accept it.
R2: Okay, I think it is very reasonable.
R1: It would be better if users can get rewards after turning on this sustainable mode. That is to say, a user can get stars after turning on this thing for the first time, and then they can use the stars to exchange for items.
R2: I think you can refer to the hot search on Weibo. After the hashtag is a topic, this topic can become a trend. After the trend goes up, more people can learn about this topic through the overall social network function. . This is more logical. If I, as a user, want to understand, I will take the initiative to click in. This feature is integrated into the overall social network. At this time, it does not matter whether you are facing users who are concerned about sustainability, because this situation is facing all users. I opened the hot search today and I was curious, so I clicked on a topic and then showed me the content. As long as I don't click, I will always have nothing to do with this topic, which will not affect the overall social network function implementation.
R1: Totally agree.
I: Let's discuss the issue of carbon emissions from user behavior that we mentioned when we introduced the prototype.
R2: My basic argument is that carbon footprints can exist.
R1: But I think it should not be annoying for users, so users should be allowed to choose whether to accept or not. The user can click a button to choose whether to display the carbon

footprint, and the button needs to be accompanied by instructions, for example, the following changes will be made after opening.
I: So when you tweeted, should it show how much you saved or how much you caused?
R2: I think it's difficult to calculate the amount of savings.
R1: You can just give a reminder, a common unit, for example, tell him how much carbon a 100-kilometer drive generates, and how much will be saved if you don't do this. Let him fill it out.
R2: This is fundamentally wrong, because Facebook is essentially a quick-sharing application. When you design the chain longer and more complex, users' willingness to use it will decrease. You should not require the users to fill in that much data.
R1: You have to tell him how much carbon he saves. The way to do it is to tell him one of the things, such as how much you will reduce emissions if you don't walk these 300 kilometers, and you don't need to involve specific calculations, or tell him how much emissions can be saved per kilometer. And show it to other users, that's it.
R2: Let me summarize. First of all, the consensus reached by everyone is that we want to show how much carbon emissions are saved. Next, everyone discussed how to implement the functions, and the most important thing is the level of hierarchy. In other words, if it is an analysis within a group, it doesn't matter if it is designed to be more complicated, but if I just want to share it daily, it will be very troublesome.
R1: To sum up, what we have reached a consensus is that we all want to tell him how much carbon you saved, but the focus of the discussion is how to tell him, right?
R2: Knowing "Why" is very important. If your ultimate goal is to let more people understand this knowledge and participate in this activity, it may not be necessary to be so complicated, because users have to input things.
R1: Maybe the user doesn't need to input anything. The system only needs to prompt a sentence. For example, if you travel by train, it is equivalent to saving something. This is enough.
R2: What you said I think there is a better way. For example, if the system recognizes that the user has entered the "travel" keyword, a tip will pop up below: you know what? Electric trains save 30% more emission than planes.
R1: I agree very much. It can be improved, and the hashtag topic can be added.
R2: I agree. We do not calculate the specific figures, this is not within the scope of the subject discussion.
I: If a user sees the tips and writes a lot of content and pictures, after the post is sent, should the way it be displayed to other users be distinguished from the general post? Because you have to show it to many people, they will react only when they see it.
R1: Instead of identifying its content, let him add topics or tags to distinguish it from other content.
I: Let's talk about the points that the first place in the leaderboard can get.
R2: I recommend that all participants have it, it's just a matter of how many
R1: I don't think everyone has it. But I agree to expand the range of users who can earn points.
R2: For example, I originally participated in this thing for fun, but I am not an active practitioner, and I didn't get anything in the end. Then I won't participate next time even if you kill me.
R1: Yes, as long as you participate, you should get some encouragement.
R2: What kind of rewards a group with higher points can get is a very important thing.

R1: If you have already been in the group, there is already an emergent property. For those who want eco, the influence has been shown. They already know that they want to participate in the activities of this group.
R2: I'm not talking about this. Perhaps what I want to know is whether *** University is the most eco-friendly school compared to all the school groups in *** Province.
R1: However, the leaderboard is meaningless if it exists independently of the group.
R2: I'm talking about rankings that are not related to events. I want to watch this ranking.
R1: I'm talking about an inherent group. If it is not related to any event, the points of this group are meaningless.
R2: Why?
R1: So what's the meaning of it?
R2: I may just want to see how many places I rank among my friends. After seeing this, I still want to see how many places I rank in *** university
R1: In this case, users are already doing things in a sustainable way. In this way, for those who don't pay much attention, the points are meaningless. For example, I want to go to the pub to have a drink on the weekend. The points are meaningless to me, doesn't it?
I: If a user doesn't care, he may be at the bottom of this ranking. But this does not prevent him from participating in it, nor does it prevent other active participants from participating in the activity.
R1: This brings me back to the point I just said. It is an emergent property. Once you have this idea, you will want to find a group. This is not the nature of the individual, but the nature of the group, which is why I have to distinguish between personal and community.
R2: Even if the user does not participate in the event, I usually want to see the most environmentally friendly person in my circle of friends.
R1: So, can the person ranked first get rewards?
R2: This is hard to say. Just like the qualifying of the game, it may be settled after a certain period of time is completed. The highest ranked player will give positive feedback.
R1: But if the user does not exist in the event, this credit is of no use to me. This feedback is an influence. When he is related to the event next time, he is willing to come here. This is a positive feedback, no need to give other positive feedback.
R2: Agree. But if those people are always at the top of the ranking, it would discourage the enthusiasm of others.
R1: This problem can be easily solved. It can be calculated without resetting, but it can tell you that you are the strongest person this quarter. The reward does not necessarily give users points, but can be badges, honor, or other things.
R2: I think it's good.
I: Okay, we can discuss the next feature. As we said earlier, stars can be exchanged for items, so what do you want as users?
R2: coupon, YouTube member.
I: Is there anything that can be directly related to Facebook or even sustainability?
R2: The physical rewards provided by advertisers are fine. How does it have a relationship with sustainability? Oh, maybe you can choose to donate one dollar to an organization.
R1: You can also have a hand-cranked flashlight.
R2: If you want everyone to participate in the event, you still have to seduce everyone with attractive and affordable things, so a coupon is a good choice.
I: What are your thoughts on the physical aspect?
R1: Renewable material products, such as clothes made of renewable materials. Or, for example, H&M's vouchers, H&M's clothes can be recycled, which indirectly helps sustainability.

I: Do you have any opinions about donation, for example, do you want to donate to your designated organization? Or it doesn't matter?
R2: Sometimes the user may just want to get rid of his second-hand items, and you still let him choose where to donate and get feedback, which is too heavy for him. For example, are African kids having fun sitting on the sofa you donated? No need. However, it is of course good to have feedback, and I can't deny this.
R1: Based on the current function, it can be donated to the recycle company and charity. At present, there can be a list of charity, and you may be able to choose a charity. Then the rest is left to charity itself, some charity may have projects, some may not, this is charity's business. Then charity can only give user feedback.
R2: Will my donation go to an organization that may not need this item? This needs to be considered.
R2: What I want to say is that there are two situations for donation. One situation is that I just want to dispose of this thing as soon as possible, so that someone will take it away for me. In this case, the recycling company will help me take these things away. For me, this has been completed, and I don't care about the fate of this thing. In this case, maybe you just need to prompt me "thank you for saving so much carbon emissions". It will become very complicated if charity is involved. It is difficult for them to deal with things after they receive it. It's very difficult to give specific feedback to users in detail where this thing has gone.
R1: My thoughts on charity are like this. In order to avoid the problem that charity accepts things that are difficult to handle, it can be handled like this. A certain charity stated that what I accept now is a fabric sofa. If the thing the user will donate happens to be this thing, then show him that he can donate to this charity, otherwise just display the recycle company.
R2: It is very complicated and unrealistic to implement such a detailed classification. At most, leaving only the option of charity is enough. No need to refine.
R2: Generally speaking, it is good to have feedback, but there is no need to provide detailed and specific feedback to make things very complicated. Because if the user just wants someone to help take away my unwanted things, but you provide him with detailed feedback, it is not necessarily a good thing for him.
R1: Detailed feedback is very good. If the user chooses to donate to charity, then charity can give feedback to the user, such as filling in the email address and then personally contacting it. There is no need to provide feedback through Facebook. In this case, if a user wants to know specific feedback, he can choose to leave his own mailbox, and then Charity will notify the user after it has processed it.
R2: If this feedback is to be achieved in reality, the platform should stand up and help charity to achieve this. For example, Tencent has a "Jiujiu Public Welfare" platform. In fact, its work flow is that charity sends a rough draft to the platform, and then Tencent staff edit it to make something that can be sent to users. The Tencent Foundation is doing this as a platform.
R1: I still think it should be directly provided to the user feedback
R2: To be reasonable, it is necessary, but one thing is, if a charity cooperates with a social media platform, and then does not send a feedback to the user, this is dishonest to the platform and the user, so I think it is still necessary that the platform provides support.
I: Please tell us the most interesting, useful or most attractive point for you.
R1: There are many places that remind me that I can be sustainable. Almost every action or function can remind me that I can make related sustainable operations. The usage is also very simple and does not require me to do any additional operations.
R2: For me, events are more attractive to me, after all, they are based on social functions. After all, I opened Facebook to casually see if there is anything interesting today, not to look

at second-hand transactions with a strong purpose. Event allows me to get extra things while being entertained and participating in social interactions.
R1: Maybe I don't usually participate in activities and events on Facebook, so I'm not very interested in this and I don't know much about it.
I: After experiencing this prototype, do you feel that you have improved your attention to sustainable news?
R1: I have been involved in (this prototype design), and it is difficult to answer from the user's point of view.
R2: I will want to see what my friends are doing, which will arouse my interest in the process. But since I haven't used it specifically, it's hard to say how I feel. But I think it mainly depends on what my friends have posted, or whether the activity is of interest to me, it is not how your design itself is designed, but what users are doing based on this design.
R1: As a person who is not very interested in sustainability, I have not tried this application. Now I just took a look at it. It is difficult to say whether I will be interested in it.
R2: My focus is still whether it is fun, as long as it is fun, I will participate in it.

○ Appendix 4: R3 interview transcription

The dialogue in the prototype section is omitted.

I: Do you find this mechanism (the prototype shown earlier) interesting?
R3: No, sorry. Because I don't take the initiative to understand these things, I only know these kinds of things when others tell me. If no one tells me, I don't know they have done it, these things mean to me just a little game.
I: Does this little game inspire you to live more sustainably?
R3: No, because I think I am doing what I am willing to do. If I am a sustainable person, I will live sustainably no matter what, so I don't need other things to motivate me to become more sustainable.
I: Do you think there will be certain situations or other things that will motivate you to become more sustainable?
R3: Actually, I think it is education. In other words, the family or school tells you through education that the current society or environment requires us all to protect some social resources. In this way, this person will fundamentally establish a sustainable concept from an early age.
I: Do you think social media can also be part of education?
R3: I think it mainly depends on how much a person is dependent on social media.
I: Do you mean that some information recommended by social media may subtly affect users' awareness?
R3: Yes, it is possible, but I feel that school or family education should have similar effects.
I: Do you think that some means of social media can make up for the lack of school and family education?
R3: In that case, this kind of social media approach needs to be interesting.
I: Do you think this prototype is not interesting enough?
R3: Looks boring so far.
I: So where do you think it is not interesting enough?
R3: It's very complicated. Maybe I am a person who likes simple things. For example, I don't use Facebook to share things like where I flew today.
I: If this prototype is based on other social media, would you have a different view?
R3: No, because I am a person who can't even display my geographic location. I don't like to point where I am now, and then my location will be displayed next to me. I don't do this kind of thing.
I: Can it be understood that you are a person who is not very dependent on social media?
R3: Yes. I don't particularly care about these things (social media), but if you, as my friend, send it to me, I will read it.I usually watch some news media, if it tweets about something happening in India or sustainable reports or something, I usually go to it.
I: So you look at it from the official media, not from the social media like Facebook that people usually use?
R3: Yes.
I: Do you think social media is a way to get sustainable news?
R3: No, because I don't like to play these things in depth, such as Facebook.

I: When you see sustainable things on social media, would you be willing to accept or follow them?
R3: Yes, but not all. For example, For the donation function, just like Facebook now has a function, when a friend's birthday, you can launch some activities to raise some money to elementary schools and so on. I will not participate in this kind of activity.
I: So what will you participate in?
R3: I think I can do as much as I usually do.
I: Will you go because of community reasons, for example, some of your friends invite you to an event?
R3: No. If there is an event where you ask me to bring eco-bags every time I go to the supermarket, I can say that I actually do this every time. But I don't necessarily remember to check in on Facebook every time, which is very troublesome. I don't play these messy features on social media very much, but it doesn't mean that others will not play. I believe there are still many people who should be willing to participate.
I: So are you someone who has low reliance on games and social media?
R3: For me, facebook is only used when you need to socialize.
I: Does this mean that you use the Facebook messenger function more often?
R3: Yes. Another part is that I follow something that I find interesting. Because some youtubers will update synchronously on facebook. Then I usually use facebook to watch the content of my favorite youtubers and follow some news media. This is the case in most cases, and I have almost never used other Facebook functions.
I: Can you talk more about what you think this prototype is not enough to attract you?
R3: Because it is really too complicated for me. For example, I have to create an event first and then realize it.
I: You can also just go to other people's activities.
R3: But I may not find these sustainable activities. If it does not specify that I must do it, I may not receive this information.
I: What you mean is that if your friends don't invite you, you don't have a channel to obtain information about these activities, do you?
R3: Yes, it's almost like that. Because you can hardly find these things. Only when your friends notice these things, you will see them occasionally. Because I don't play facebook so frequently that I will see it as soon as it is updated, especially the facebook homepage will push a lot of things, and I am too lazy to keep paying attention to the latest news. Only by specifying that I have to do it, can I do it. For example, if you send me a questionnaire and ask me to do it, or if you ask me to read an article, I will do it. There is also a situation. Some activities like going to the beach to pick up trash or do volunteer work. If I have time, I might participate. But it's a bit difficult for me to share on Facebook while doing things, because I find it a little annoying.
I: If the activity is in the form of competition and has a little competitiveness, would you feel more enjoyable?
R3: But how does the activity of picking up rubbish carry out the competition? Who picks up more trash? It seems that children will like things, but adults shouldn't like this. Moreover, it takes a lot of time to count the results in the end. The time it takes for a person to clear the quantity is also a cost. For example, if we spend the time today to do this, we will actually spend our own human costs, so I feel that the carbon emissions that he performs the clearing and evaluation are actually very large. Maybe that person spent an hour or two liquidating, and everyone was waiting in place. Finally, there is an award presentation, I think it is not interesting. So I think the act of liquidation itself also increases emissions, and then the

organizers need to buy small gifts or something. I think it's actually a bit simpler. For example, everyone who comes to participate will receive a small gift. I think this is enough.
I: Do you think the game elements of competition will inspire you?
R3: I think adults don't care that much. If you use this type of thing on children, I think it's ok. The score-based game allows children to perform better. For example, children may enter some competitions for rewards. For example, kindergarten teachers and primary school teachers will hold some contests such as getting red flowers and scores so that children can perform better. But adults don't need it, because if an adult is willing to participate in a certain activity, it means that he or she is actually interested in participating in sustainability-related activities.
I: Yes, but there are actually many children who are users of social media.
R3: I think it is a matter of attracting different user groups, depending on who this event is held for.
I: Do you think there will be some influence on young people?
R3: Yes, it's probably between fifteen and twenty-five years old. I'm not sure whether this is the case for 10-year-old children, because 10-year-old children may still play with their parents and are more affected by their parents.
I: What kind of groups do you think gamification will affect to actively participate in sustainability-related activities?
R3: I feel that there are two main types of people, one is those who are willing to participate, and the other is people who are unwilling to participate. For this kind of people, they will never care about sustainability-related activities. Among them, there are two types of participation. Some people may be forced by others. For example, because his friends all participated and then he participated, his initiative is not high. The other is the group of people who are highly motivated. He himself wants to participate. I think this group of people may be more likely to be motivated.
I: What if we want to inspire all the types of users you mentioned?
R3: That's difficult to do.
I: Will you be attracted by the prizes and then do some sustainability-related things by the way?
R3: No, because I think it can be achieved, I usually do it. I already have the concept of sustainability, and I don't need these things to motivate me anymore. I think promotion should be done on those people who are not aware of sustainability. On the contrary, I feel that this kind of incentive is a waste of my time and even electricity bills. It may be a kind of secondary carbon emission and waste. For example, for people who specialize in sustainability-related industries in society, this gamification method is definitely a secondary waste for him, such as waste of energy, time, and mobile phone power, which he accounts for.
I: Do you think social media can influence people who are not aware of the importance of sustainability to make changes?
R3: That's possible. Because social media pushes that kind of news, for example, there are plastic bottles in undiscovered places in the Amazon jungle. Even if he doesn't click into it, the title may be remembered or surprised, which is equivalent to conveying to the user that unknown changes are taking place in the world. For example, if you push more, African children can't get enough food and no water to drink. This can tell the residents of more developed places to learn to cherish, which is probably the meaning of this matter.
I: Do you think that social media can benefit from promoting this sustainability-related news?
R3: News all have sponsors, and they have benefits. From the sponsor's point of view, a large company must establish a brand image, and he must promote this concept of sustainable development in different media. This attitude will affect users. He will tell the public that all

the things I use are environmentally friendly, so you have to come and buy them. For example, like H&M, they always put some advertisements, telling everyone that the clothes you don't want can be exchanged in the store for coupons. In fact, there is a corresponding incentive mechanism. In fact, the government influences organizations, organizations influence companies, and companies influence individuals. It is such a chain relationship. This is because the government, for example, provides environmental tax rebates to organizations, organizations do something to companies, and companies do something so-called to give back to customers. In fact, it is a chain, and all profitable relationships are involved in it.
I: What role can social media play in this chain?
R3: I think it is actually the role of the company, which is a chain between the company and the consumer, or the organization and the consumer. For example, some organizations directly face consumers, or some governments directly face consumers. For example, in the case of COVID-19, many countries' own governments have conducted some surveys through official web pages, and users can also see relevant pushes on Facebook. It should be regarded as government agencies directly facing consumer groups.
I: Do you think the recommendation algorithm for sustainability-related information in social media is useful for you?
R3: I think the sustainability-related news sent to me by social media that I am interested in is interesting. For example, some environmentalists may demand that they travel without carbon, and he may be very interested in such pushes, but these are all personal actions. If someone is not interested in things like sustainability, it doesn't make much sense to push these things. There are some sustainability-related behaviors that the teacher did not tell you, but you are unwilling to do so. Of course, it is not ruled out that there may be something that the teacher did not tell you.
I: So for you, can social media be a channel to provide some sustainability-related information?
R3: Of course, it can. But the problem is that if the person doesn't care about this thing, he will never click in to see it, so you have no way to control it in this respect.
I: What does social media mean to you?
R3: Just contact my friend, or use it to get some needed information. I will pay attention to the message reminder, there are some small videos, but I will not spend too much time on these videos. I think the Facebook homepage has too much information, too complicated, and updated too frequently, and the information is not very useful.
I: Do you think the form of text is not as powerful as video?
R3: I think very few people post text on Facebook, they post more videos. Because I feel that Facebook is a place where you post more videos than text, that is, people often share a video and add one or two words at most, or just add their feelings. It itself is not a place where you will read the text seriously, there is nothing connotative, so I think it is very boring now, in most cases it has become a place for me to watch youtuber. But not all social media are like this. Some social media still have some content that is worth reading carefully.
I: What are the ways that you can quickly get useful information from the messy information pushed to you?
R3: Classification. Because I'm the kind of person who likes to classify the things I want so that I can find them easily. For the things I am interested in, I collect them and classify them.

○ Appendix 5: R4 interview transcription

Part 1: Prototype introduction

In the prototype introduction section, the interviewee proposed the following ideas:
(Reward) The attractiveness of rewards is just okay. Virtual items should be quite attractive. Renewable small things are not very attractive. Unless they are people who really love sustainability, they might like that kind of stuff.
(Second-hand market) There is a situation where all the products sold by users are non-renewable products, but the things are particularly good, and the sales are particularly large, so the points are particularly large. This behavior itself is increasing carbon emissions, but he is getting rewards, so this mechanism is useless.
(Posting) The key is that some people are particularly addicted to post activities. If they see that their carbon emissions are very high, higher than other people, then they may be unhappy, or in a bad mood. Even deleted the post and reposted it.
(Leaderboard)For example, everyone is playing this carbon emission ranking. Then, there is a social butterfly, the things he does every time are not sustainable, so what should he do? He doesn't want to change his behavior, and he doesn't want to turn it off. This is too forced. He may not be a low-carbon expert, he may be a fake low-carbon expert, he may be a gourmet expert, he may be specialized in barbecue, that is, the kind of barbecue with high carbon emissions, and he may be the kind of person who hates vegetarianism.
(Leaderboard) Maybe make two rankings, one for low carbon emissions and the other for high carbon emissions. Because some people may think that it is better for him to be the first. Being in the first place is not the same as being in the last. For example, why do some people like to drive monster trucks, the kind of high-carbon emission wheel that is higher than yourself, just wanting to get a special feeling. Especially Americans. Many Americans like all kinds of weird high-carbon emission activities. Is there a kind of person who doesn't like to do those low-carbon things, such as changing monster trucks to electric ones? People just want to burn gasoline, the feeling of burning black smoke, you don't have that feeling when you are doing pure electric.
(Create an event) I feel that the incentives you give me are not enough. The rewards are too small. You can reward more coupons or something. And I hate this kind of activity very much, it is very troublesome, you have to help him order this, order that. I particularly hate this kind of invitation mechanism, it is this kind of need to invite others to participate. Everyone is now a social island. Everyone talks across the sea on the island. It is very difficult for you to really bring your friends to communicate with you. Of course, it's just me personally, maybe most people are not like this.

Part 2: The formal interview

I: From the user's point of view, do these mechanisms inspire you?
R4: No, I don't like sustainability-related things.
I: Do you find these game elements interesting?
R4: It's kind of interesting.
I: Then why don't you want to participate?
R4: Because I don't like sustainability, and I don't like helping others.

I: Can it (this prototype) make you aware of the impact of unsustainability?
R4: After I realized it, I just continued to do it with guilt. I am this kind of person. When I was young, I went to the vegetarian shop and read their vegetarian brochure. They said that eating meat is not good, and killing animals is not good. Oh, I was so uncomfortable, and then I continued to eat meat the next day. I was very happy. I think about it occasionally, and then I feel so sad, but I still want to eat meat.
I: Do you think this prototype will make you more aware of sustainability?
R4: What do you want to be sustainable? How much can you waste in your entire life alone? Someone drove a tank for one day, then all the efforts you have done were gone! How many people's energy savings are equivalent to the carbon emissions produced by the eleven US aircraft carriers going out in one day? Sustainability is just a trick to make money. No matter how good it is, it's just to make Facebook earn hundreds of millions more. Do you know what greenwashing is? Big companies use sustainability as a gimmick, and then cover up their un-sustainable activities. I think you are also greenwashing, sorry. Sustainability is a systemic issue. It does not mean that the minority needs to be awakened, or how to awaken the minority. And social media does not cover enough. For example, your country has 1.4 billion people, but only half of the Internet users, right? What about half of it?
I: Do you think it is useless if consumers reduce the use of unsustainable things to save energy and reduce emissions?
R4: If you reduce the purchase of products produced by the factory, the output will drop. What about the waste caused during the production reduction process? To be more extreme, the factory has been eliminated and all employees of the factory have been laid off. Why bother? Of course I am not saying that this (prototype) idea is wrong, this idea is very good. What I mean is that sustainable development is a systemic problem, and it's not enough to wake up users' initiative. Commercial operation is to sell things, and things can only be thrown away if they cannot be sold, which in itself causes a lot of waste. The products produced match exactly with people's needs, and it is impossible to avoid waste.
I: What role do you think social media has played in the sustainability process?
R4: Help the internet company make money. Of course, it also has the effect of popularizing knowledge, but I feel that it has the counter-effects often, especially when social media mentions environmental protection and animal protection, and then some people start to have a stress response and start to scold others.
I: Do you think gamification of social media can increase your awareness?
R4: I think it should be very helpful to ordinary people. You can't tell someone who doesn't want to do this kind of thing. But for most people, if you tell them these things, they will definitely be willing.
I: What is your attitude towards social media, gaming, and sustainability?
R4: I'm very dependent on social media. I don't really like games. I'm not interested in sustainability at all, but I'm interested in protecting animals.
I: Will you live a sustainable life for the ecology of animals? For example, animals will eat plastic because of environmental issues
R4: Animals are already eating, we humans are all eating. There is no way to change it, unless the garbage disposal factories are blown up. Because too many things are produced and then thrown away casually, the natural environment cannot be metabolized at all, but they are still being produced now. If all plastic bag factories are forced to switch to cloth bags, one is the legal aspect, it is impossible for anyone to enforce this kind of law, because the profits brought by plastic manufacturers are inherently huge, and private property is inviolable. It is impossible for someone to demolish the factories, and it is impossible for the government to demolish these factories.

I: What if social media can encourage users to reduce their demand for unsustainable products, such as plastic bags?
R4: What should I do if the tens of hundreds of millions of plastic bags produced before the factory cannot be sold? The backlog of goods will cause companies to lose money, which can only be thrown away. The factory definitely wants to stop the loss in time, so after stopping the factory, it will switch to other things, which causes all the original equipment to be scrapped. Discarded machines, along with the hundreds of millions of plastic bags mentioned above, have become new pollution. This should be a work that all human beings do together, not just to mobilize those consumers, but to control the source businesses. When you bring up this topic, I feel that I have lost hope for the entire society. I was the kind of person who lives like a walking dead every day, a very happy person, every day I don't think about anything, just eat, drink, sleep and watch TV, and now you let me think about this thing, I feel sad.
I: Do you think you should do something sustainable in your daily life that you can do?
R4: Yes.
I: So, does gamification inspire you?
R4: Generally speaking, I don't like to participate in these things very much. I myself don't like to participate in this kind of activity. Basically, my friends threw the event information to me, usually I'll click on it to complete their task. I will not participate in any events my friends shared to me unless it is something I am very interested in.
I: Do you think gamification has made you more interested in sustainability?
R4: I think gamification is a feasible way, but I have a big "bias" on sustainability itself, which is very troublesome, and the essence is a way for merchants to arbitrage money, so I absolutely won't go.
I: Gamification of social media makes it fun for you to do environmental-related things, and you can get some benefits by the way, so why don't you go?
R4: But these are not necessary for me, I don't need to take advantage of these small advantages. I go to social media to see some things I like, watch some airplanes, tanks, and animals, and then post some ideas of my own, and give my friends a thumbs-up --- like a ruthless thumbs-up machine. The only way I can participate is when my friends post new posts, and then I go to "like" them. It is impossible for me to follow this thing all the way, no matter what the theme is. It's just social media for me. I only use what I need. I'm like this. I don't know how other people are. First of all, ranking is what I don't like; then I don't like to post it second-hand, and contact people offline; I don't like to participate in created activities. Of course, if there are friends around who are interested and go to participate together, I will have fun. I am not interested in this matter itself, what I am interested in is just hanging out with friends.
I: Do you have any thoughts on using gamification elements on social media to live a sustainable life?
R4: I have no opinion on this idea at all. I think this idea is very good. I am just not interested in sustainability.
I: Do you think gamification will affect you?
R4: No, because I don't believe in this, no matter how fun it is, I just play it. I usually play games just to kill time, not to mention this kind of gamification is not fun. Most of the time, the game is just for me to kill time because I don't want to do business. And my level of playing games is not high, so the appeal of games to me is not long-term. I think gamification is to integrate sustainability-related concepts into the game, such as a sustainable mini game on social media, such as environmental protection Lianliankan, to help users identify which is combustible waste and which is non-combustible waste; Or which is environmentally friendly materials, which is not environmentally friendly materials, etc. At that time, there was a king

of minds, and it was also a small game similar to the one I mentioned earlier, which was very popular at that time. The feature of this game is that even if you are not interested, you will remember it in your mind. I think this is very important. For me, the most important thing about the game is to have visible growth, this (prototype) is not enough in this regard.
R4: Actually, people are not playing games all the time. We need to distinguish when it is real and when it is a game. Most of the game's rankings are strangers, and social media is full of people I know, and the rankings will make me feel weird. However, ranking all users together loses its meaning. Too small or too large is not good, so it is important that the scope of the ranking makes users feel comfortable.
I: What do you think is the difference between gaming and social media gamification?
R4: The purpose of the game is very simple, allowing players to pay for some virtual things, but the benefit of this (prototype) is to make people feel fulfilled through this interaction, so as to learn more sustainability-related knowledge. You can't make money without taking advantage of the weaknesses of human nature. For games, you can delete your account if you don't want to play at the end of the game, which means that the game account can be discarded at any time, but social media has a certain degree of user dependence, and the impact of specific behaviors in the social circle must be considered. The strategy of many online games is to stimulate players to spend money to enjoy the pleasure in time, and induce users to recharge and make profits. But this conflicts with the concept of gamification of social media for sustainable development. There are many daily tasks in mobile games, and they are constantly updated and constantly have new exciting points. Although there is a set of feasible gameplay methods, it is difficult to achieve sustainability. The scale of the launch of mobile games is very large, with different new mobile games coming out every year, but most of them may be over after a year or two. Most of the excitement of mobile games is short-term, and the game itself is basically unsustainable. After the player has played to the end and practiced to the top-level account, he will feel bored and start to quit; if it is a sustainable-related game, The user will feel that it is done, and there is no need to continue. I think that if you just use the elements of the game, the effect of the game will not be achieved, but the game will make the sustainable effect become very short-term.
I: For you, what is the main role of social media?
R4: I just look at it. I don't usually share my own affairs. What I share is mainly about the food I eat and my dog. Although social media is used a lot, most of the time is as a message receiver. In fact, in this case, the users of social media are not necessarily individuals. It can be organizations, shops, sustainable groups, and iInternet celebrities. They can use the function of "creating events" better. Ordinary users and fans as readers can just check these messages. For example, there may be certain rewards for you giving a "like" or "forwards". In this way, you can actually add more sustainable activities for the interaction between internet celebrities and their fans, and add more interactive things. For example, Internet celebrities publish an environmental protection task for fans to complete, such as competitions that turn waste into treasure, and vegetarian food festivals and so on, and then fans who complete the task can take photos or autograph photos with internet celebrities, and take advantage of the influence of KOL (key opinion leader).

○ Appendix 6: R5 interview transcription

Part 1: Prototype introduction

I: The main purpose of our paper is to integrate game elements into social media, and then make everyone's lifestyle more sustainable. We summarized a framework based on the results of previous literature review and survey, and then designed an interactive thing called prototype based on this framework. I will present it and please tell me how you feel about it. This is based on Facebook, and then we add some gamification elements to promote sustainability.
R5: Okay.
I: We started the first function, selling second-hand. Have you used the second-hand function on Facebook?
R5: I know it. This (camera) was bought on Facebook's marketplace, and it just arrived.
I: Okay great. There are some of today's pushes on this, you can see some product information. The following section is the sponsor section. There are many sponsor advertisements. We hope that Facebook can place those sustainability-related rankings higher so that users can see them more easily.
R5: OK.
I: In this section, you can see some information related to environmental protection or teach you how to be more environmentally friendly.
R5: Okay.
I: You can see that there are points on every product. It takes a certain amount of carbon emissions to produce something new, so buying used is equivalent to saving this much, so buying used can earn this many points.
R5: Yes, that's right.
I: There are two buttons for sending messages and payments to sellers. We want to encourage Facebook pay. It seems that nearly no one uses Facebook pay, right?
R5: Well, I have never heard of Facebook pay. For example, when I trade this thing (camera), it asks me to use Swish.
I: Cash can also be used, but the cash here includes swish and online payment on other platforms, but it is classified as cash here, but we still encourage you to use online paperless transactions.
R5: Yes, I agree.
I: If you use Facebook pay, you can get points.
R5: I can only get points in this way, and I can't get points in other payment methods. Right?
I: No. If you buy this thing, you can get points.
R5: Good, understood.
I: On this page, you can also see some information about the seller, and the points will be automatically redeemed for some medals.
R5: Well, points are equivalent to the achievement system. Does it have no substantial effect?
I: Yes, it has. We'll talk about it later. This (medals) is an achievement and an honor. You can see the seller's goods when you buy things, and you can also sell things.
R5: Can both the buyer and the seller earn points?
I: Yes. Both of them can earn achievements, but different achievements.

R5: OK.
I: This is the seller's page, you need to fill in some product information. You can choose to put the goods in public or groups.
R5: Yes.
I: It also includes location. If the seller and the buyer are from the same city, it can reduce some transportation consumption. There is also a donate option. If you feel that your item is unsellable or you change your mind, you can choose to donate it to a recycling company to recycle the item, or donate it to a charity. After the third party confirms the product, you can get double points. If you sell things to another person, you can only get normal points. Points can be exchanged for some physical or virtual items. For physical goods, they are usually related to sustainability. It may be a product made of some renewable and biodegradable materials, or something that encourages sustainable living, such as a hand-cranked flashlight.
R5: Yes.
I: Virtual items are coupons. Or those members of video sites. These are the two types of rewards that the points system can redeem. You can click the mark as sold and get points immediately.
R5: During the camera deal, I got the impression that the buyers were friendly. I said, anyway, how much money, I will give you first, and then you are free to send, he said no. He said that he would go to the post office to weigh it, submit the order in the post office system and tell me the order number, and then I would pay him. He marked the goods as sold as soon as he received the money. So, he's kind of a friendly guy.
I: That's nice. And then, you can display your items in a public place or in one or some specific second-hand group. If the transaction is successful in the second-hand group, the points will be accumulated in the group. So, this group will have total points, and then there will be a group points ranking.
R5: I think there should be a local group transaction or a different kind of group transaction, and they can be encouraged to participate in the corresponding group transaction, in which case I would like to participate more. For example, when I'm in ***, I want to trade in ***'s local group, so that ***'s group ranking will be high. Or, if I want to sell video games, I would join the video game group; If someone wants to sell pet supplies, go to a pet supplies-related group. I think the categorization of groups can actually speed up or facilitate transactions. Of course, it would be better if the same item can be put in two or more groups. For example, if I sell video games in ***'s group, I can put them in ***'s group and also the video game group. Both groups receive points if the transaction is successful.
I: Go ahead, please.
R5: It should be the group within which the transaction is successful, which group will be awarded points. That said, there should be a way to tell which group something is being sold from. I think the rule should be, for example, if you want to sell a pet collar or something like that, you can put it in the *** Pet Group, the *** Student Group, the Skane Pet Group, and if a buyer contacts you from a group and the sale is successful, it should count towards the achievement of that group.
I: Well, then the function of this second-hand transaction is over. There are currently two versions of this feature, we may choose the second version, and then I will tell you that the first version is our most original idea. When you publish a post, you can select the activity, and it will mark how much carbon emissions you are doing that will consume it, and it will be displayed to other users after publishing. What do you think of this?
R5: Is there any reward mechanism? Is it that the fewer activities you have to do, the better? Or is there no reward mechanism?

I: The original intention was that the user didn't know what impact the specific behavior would have.
R5: When users choose some activities, they will take a look at how much the so-called carbon emissions are, just like the calories on food. Some people who care about them will look at them. Those who don't care forget it. It is equivalent to a reminder, reminding the user to go to drink coffee today, or to go out today, it may consume 500.
I: That's what it means. There's an alternative that doesn't put too much pressure on users, because if you have to count your carbon emissions for everything you do, you might get so anxious you don't want to use social media. So, the alternative is that the system will intelligently detect what you're typing and suggest relevant, sustainable tags and topics. Tagged posts appear under the corresponding topic. At the same time, if it detects where the user has traveled or where they have clocked in, the carbon footprint will be suggested, but the user can choose whether to show it to other users or not.
R5: Very good, I think it is to make environmentalists more environmentally friendly. It doesn't mean to prevent you from doing it; it makes people who don't want to be environmentally friendly be kinder. Birds of a feather flock together; those who care about it can compare with each other.
I: This function is just like an online step counter, that is, there is a leaderboard that tells you how much energy you saved this week.
R5: It sounds great, very interesting. But I'd rather you tell me how much I save than how much I consume.
I: Yes, and the system might also tell you, for example, that your savings are equivalent to the total amount of air cleared by a tree in a year.
R5: It's pretty good. The user needs to be encouraged to do this, which means that the user needs to be given a reward, similar to the reward for selling used items. For example, if you are the biggest saver in your area, your reward will be large. For example, if you buy and sell more used goods, you get more points, and then you want to trade more used goods. The equivalent of carbon emissions of gold coins, or credibility. As soon as I see how much carbon he has saved, how much gold he has, and how good his reputation is, I am more willing to trade with him.
I: Yes, great. Then the last function is to create events on Facebook. Users can publish events, including name, description, start time, end time, and scope. Other users can participate or invite friends to team up to participate in this challenge. In the end, it will be settled by a group. Which group saves the most energy will be rewarded, and only the first group will be rewarded.
R5: And then I thought, this reward should not only be for the first one, but it will also be better for the people who participate, at least it will make me more willing to participate. Because it's not a competitive game. Of course, the first prize will be a little more than the others, and that's fine. If it's a competitive competition, where only one or two winners are rewarded, it's going to be bloody. And some people think, well, if I can't win first place, then I won't come. For another example, ****(a friend of the interviewee) is holding an Open House these days, which is to trade second-hand goods, and everyone is willing to go, and it is environmentally friendly, and there is no threshold.
I: Ok, if you post something about the progress of the challenge, such as how much you saved today, you didn't use plastic bags but cloth bags, or something, you would also get points.
R5: Well, it's equivalent to forwarding to my Facebook page to get 100 virtual gold coins when you play a game, because you want him to promote it, right? That's what I usually do. Because it's usually shared by friends.

I: Yes, that's what I mean, if he is your friend, and these posts will also be displayed on your homepage.
R5: Sounds great, I think I'd like to create an event now, ha-ha. There are many kinds of activities of this kind. This type of activity can be many and varied. For example, I don't use plastic bags, and I record it on Facebook every day for how many days in a row, and then I get some rewards. For example, it's a common garage sale in the United States, where a seller opens up a garage to display a large collection of items, attracting people to come to see or buy something.
I: That's it, all functions were displayed.

Part 2: The formal interview
R5: I think according to my personal understanding, it cannot be said to be gamification. This idea has existed 20 years ago and it is called communitization. It is equivalent to an electronic community, in which you manage your avatar and digitally display your personal personality. In fact, it is not similar to playing games, but just the virtual image you cultivate in the community, or use the community to carry out some interactive functions. All activities are to accumulate your points, establish your image, or broaden your social circle in it.
I: And one more thing, our entire system can be shut down. You can choose to turn it off, which means these points will not be displayed.
R5: All of these can be opened or closed. It is definitely necessary, should not be mandatory. But I don't think this is like a game.
I: It is not a game, it just puts some game elements into it, such as avatars, leaderboards, points, and competition. What do you think these elements will influence you? Would you be willing to use social media for buying and selling second-hand items because you can accumulate points?
R5: Yes, I trade a lot of second-hand items, and I pay much attention to environmental protection. For example, I usually use public transportation and I like to buy things without additional packaging.
I: Do you think this approach will increase your sustainable awareness?
R5: Yes, of course. If the achievement were a little more compelling, or more demonstrative of what I'm doing in terms of sustainability, that might be appealing to me.
I: Do you think our achievements are not sufficient?
R5: The current achievements are not very detailed. For example, if you achieve 1,000 points, you will give a virtual achievement, title, or medal; for example, if you reach 10,000 points, maybe the points are difficult, and you will get some physical rewards, such as this The special eco-bag for the event (how many are you the first person to reach 10,000 points) or you have a special mouse pad. In this way, you will watch it all the time, and you will be very happy when you use it.
I: Do you think the reward items should be more relevant in terms of sustainability?
R5: Yes, but it doesn't necessarily mean this kind of thing is compulsory. I just give an example, which is more related to environmental protection, or a small achievement that can better reflect a sense of personal honor. If the item you provide is unsustainable, then this reward is meaningless. In other words, you want to promote local transactions more, but remote transactions can also be encouraged, such as Postnord vouchers. Or you can get discounts on shipping costs when you trade second-hand items, which encourages trading.
I: Is it a coupon related to the transaction?
R5: Yes.
I: Then do you think social media will play a role in overall environmental protection?

R5: At present, the propaganda force of the self-media is quite extensive. It does not necessarily mean trading second-hand items, posting photos, uploading videos like YouTube, and you can get corresponding points as much as you read. The vlog function is also good. I think YouTube is just to stimulate everyone to create new things. The rewards they give are very generous, so many people are willing to go.
I: Do you think we are rewarded well?
R5: Don't you have those sponsors? You have to make it according to them. It is what services they will provide, for example, we have accumulated a lot of bottles and cans, they may provide, for example, you reduce to a certain point, in exchange for a service that will provide door-to-door recycling. In addition, providing these depends on what your sponsor will do. Some rewards are provided by them. This is a cyclical process. Then advertise on social media to expand the community.
R5: As for the marketplace, I don't use it much, but I used to buy this camera. This camera has been in production for ten years. The second-hand one is quite expensive. I looked around and found it on Facebook by accident. The seller was in Gothenburg. He sent it over for 180kr, and the price was two thousand five. I think it's quite appropriate, and the appearance is okay.
I: Why did you buy second-hand? Is the first-hand price expensive?
R5: It can't be found in the market because it is too old and I can't find a new one anymore, but it is the most economical and cost-effective product that can meet my requirements. But most of the time I trade second-hand stuff mainly because it is cheap. For me, sustainability may only account for 20 to 30%.
I: For example, will our mechanism make you think that your buying and selling second-hand is an environmentally friendly thing or sustainable behavior?
R5: Yes, I quite like this. Everyone encourages reusing and recycling. For me, as long as this thing is not broken, I will not replace it with a new one. So even if it is second-hand, as long as it can be used, I will continue to use it.
I: What kind of existence is second-hand for you in your life?
R5: Well, I also sell second-hand items. I think it's a waste to have something sitting around and not using it. I'd rather give it to someone who needs it, but I'll sell it cheap.
I: Do you think this gamification can make social media interesting, or more attractive?
R5: Absolutely yes. But to be honest, I don't think he is more like a game, just borrowing certain mechanisms. If this platform is made cuter, or if the first time you use this function, there is a cartoon image pair to guide the operation, it may be more approachable. For example, if you have a sustainability representative who can do some work for you, you can set it as a reminder. If the item you want appears in the second-hand market, it will remind you; or help you to check the tracking number or something.
I: Do you think it would be better to have a virtual assistant?
R5: Yeah, I like this platform better if it has an image. It's not so good if you're just attached to a feature of the marketplace, because social media is a complex, not just marketplace. The marketplace is just one part of the points system, but there are many others, including events, short videos. Sustainability-related plugins can be made for different functions.
I: What do you think of this strength?
R5: I think it's okay. The Ant Forest is very interesting, I think it's not bad.
I: Does this gamification effect continue to keep you doing this?
R5: Yes, since I use this function, for example, the first successful transaction will get some titles and rewards, and then prompt others to achieve the next one.
I: Because sustainability is a long-term issue in itself, we also hope to improve the awareness of users in this way, and then the next step is to change their lifestyles.

R5: Well, this kind of change should be imperceptible, and users shouldn't be forced to do so immediately. The way to do this may be better, and I will choose to do it when possible. For example, some food delivery apps allow you to make some options. You can choose whether to use disposable tableware or not. I think if I order food at home, I will choose not to use it; but when I eat at the company, I have to. Providing some options can make the subtle influence better. I just want to complain to Starbucks, why they use paper straws and I can't bite them. In the optional case, I still prefer to use plastic straws, although I know it is not environmentally friendly.
I: From the user's point of view, how do you feel dissatisfied when you see this prototype now?
R5: There is nothing to be dissatisfied with, I think this idea is quite good. Try not to have that kind of stiffness in the process of use, just like forcibly adding something, it is good for users to feel natural and reasonable, even, I think it is indeed a bit regretful that it does not have this function now. For example, just like the function of the marketplace, you can also invite a second-hand store to open an office-certified account.
I: Would it be annoying to suggest sustainability-related suggestions on social media?
R5: It won't be annoying. A user who has the concept of sustainability, will certainly not feel annoyed, he will think that it is a small tool to help him be more sustainable. But if you are disgusted with this feature, you can just turn it off, it won't disrupt anyone's life.
I: Do you think social media has any limitations in doing this?
R5: No, social media is not limited, or it spreads widely. It's a good thing for your case.

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