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Master's Thesis
Academic Year 2020

DAGONGREN: A Simulated Workplace Gamification Design of Online Python Learning Application

Keio University
Graduate School of Media Design

Xinyi Bai

A Master's Thesis
submitted to Keio University Graduate School of Media Design
in partial fulfillment of the requirements for the degree of
Master of Media Design

Xinyi Bai

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Abstract of Master's Thesis of Academic Year 2020

DAGONGREN: A Simulated Workplace Gamification Design of Online Python Learning Application

Category: Design

Summary

An increasing number of jobs require programming skills in recent years. Therefore, programming has become one of the popular courses in online education in China. Traditional online teaching is mainly in the form of video lectures with few interactive functions, which has brought many difficulties to self-learners.

This research aims to make programming learning more engaging through gamification for Chinese female learners aged 18 to 30. First of all, the author surveyed 352 respondents to understand the needs of target users. Then, a Python learning and social mobile application called DAGONGREN was designed based on "The 6 D's" Structure, the Ocatalysis Framework, and the Game Elements Pyramid. Finally, usability testing and a/b testing were adopted to evaluate the effectiveness of the design. The results indicated that users were highly motivated by the gamification design and interactive features, which improve their willingness to learn, learning efficiency and outcome.

Keywords:

gamification, online education, programming course, mobile application, female-oriented design

Keio University Graduate School of Media Design

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Acknowledgements

I first learned about the term “gamification” during the pipeline2 group project at KMD in 2019. At that time, Harry Krekoukiotis, Li Ximeng, Huang Shengwen, Elli Gadon and I were working on a project about encouraging millennials to donate second-hand items through gamification. Thanks to the intense discussions and memorable experiences with the team, I have learned a lot and developed a great interest in gamification.

When I exchanged to the National University of Singapore as a CEMS MIM student in 2020, I was fortunate to be a member of the gamification project of Empire Code, a local coding school in Singapore. Our team designed an online programming learning platform for Singapore teenagers. Because of this project, I began to systematically study the concept of gamification and its applications in depth. I would like to give my thanks to Manuel de Oliveira and Amine Msr, who provided the team with a lot of reading materials and insights about gamification, which inspired me a lot. Special thanks to our project supervisor Doreen Kum and Co-founder of Empire Code Jasmine Tang for meeting with us every week online during the special period and giving us a lot of constructive advice on our project.

Continuing the gamification project of Empire Code, I changed the background from Singapore to China, and the target users from teenagers to young females as the theme of my thesis. Because of the previous study, I am familiar with the concepts and frameworks so that I could spend more time on the design part. During the time, I was grateful that many friends helped me: Xue Jiaxin always listened to me sharing my latest inspirations and give me helpful feedback and encouragement; Zhou Yuting sponsored my questionnaire to help me collect more responses; Zhang Xinya, Yuan Xinmeng, Wang Yiqi, Zhou Wenjia, Zheng Wenjun, Wang Junying, Bao Wanqian, Chen Yuhui, Ye Xinning, Zhu Ying, Huang Xinyu, Sun Wenjun, Hentona Sho and Zhang Siyu spent time using my application and

give me suggestions from unexpected perspectives. Their positive feedback also contributed to my confidence in my design work. Also, I would like to thank Katerina Limpitsouni for her amazing illustrations. Last and most important, I would like to thank all the faculties of KMD, especially my supervisor Professor Hiro Kishi, sub-supervisor Professor Matthew Waldman, Senior Assistant Professor Chihiro Sato, Professor Akira Kato, and Professor Keiko Okawa for giving me useful suggestions and inspirations; and my family for their support all the time.

Chapter 1
Introduction

1.1. Background

1.1.1 Online Education in China

The widespread use of the Internet in China began in 1996, online education has been slowly taking off ever since. The year 2000 witnessed an important milestone in the history of online education in China. First of all, the emergence of the “three-part-separated screen”, displaying teaching videos, visual aids such as PowerPoint, as well as course outline on one screen, marks that online education has stepped into the multimedia era. Secondly, the Ministry of Education of China approved 68 educational institutions as the pilot schools of remote education in China, including Huang Gang Middle School and Beijing No. 4 High School, and allowed them to open online schools and issue online diplomas, the overall scale of which accounted for more than 90 percent of the total market of online education in China at that time. Thirdly, traditional offline training schools, such as New Oriental Education were entering the online education market. [1] However, the development of online education was relatively slow due to the low popularity of the Internet, technical limitations, unexplored appropriate profit model, and unformed user habits.

Until 2011, with the outbreak of mobile Internet and the entry of Internet companies, who pump vast flows of capital and technical support, the online education industry also entered into a rapid development period. In 2016, Live Streaming was born and accelerated the evolution thanks to its rich interactive features. In recent years, with the help of Artificial Intelligence, big data, cloud computing, and other cutting-edge technologies, online education in China is expecting a new round of rapid growth.

1.1.2 Future Trend

The outbreak of the COVID-19 in early 2020 reshaped the world to a great extent, including the way students attended classes. According to the speech made by Michael Yu, Founder and Chairman of New Oriental Education and Technology Group, on Business Panel of Harvard College China Forum 2020, the revolutionary transformation brought by the COVID-19 outbreak was that, no matter urban or rural, teachers or students, online education permeated, been acquainted with at full speed, which will consequently bring various profound influence on the field of education. For example, the convergence of technology and education will accelerate; traditional education will transform into OMO (Online - Merge - Offline) model; new business models will be generated; there will be more investments in capital.[1]

1.2. Opportunity

1.2.1 An Increasing Number of People are Paying for Online Knowledge

"Paying for knowledge" has become a popular concept these years in China. The nature of the concept is to package knowledge and information into products and services, which has developed from the early books, newspapers, and periodicals to Internet-based text, image, audio, and video that deliver valuable content, solving the desire and anxiety for knowledge of especially young people. The rise of online knowledge payment marks the transition of knowledge transfer from offline to online, as well as the enhancement of consumers' awareness of copyright.

Online education, as a form of paying for knowledge, has been growing rapidly since 2016 in China. According to the *China Online Education Market Data Report*[2] released by iResearch in June 2020, the scale of the online education market in 2019 reached 322.57 billion yuan, with a year-on-year growth of 28.1%. It is

1 Baidu Live. "Harvard College China Forum 2020: Business Panel". `http://mbd.baidu.com/webpage?type=live&action=liveshow&live_type=review&room_id=3598724627`

2 iResearch. `http://report.iresearch.cn/report/202006/3599.shtml`

expected that the growth rate will remain between 19% and 24% in the future (figure 1.1). The main reasons for the continuous growth include the popularization of mobile Internet, the rise of public acceptance of e-learning, the gradual cultivation of the awareness of paying for knowledge online, and the improvement of the quality, user experience, and learning effectiveness of the content. However, although the policy of "suspending classes without stopping learning" during the pandemic had a positive impact on K12 education, the overall market size of online education might slow down over the year due to the postponement or cancellation of various qualification examinations. Nevertheless, the market scale of online education will continue to grow in the next few years.

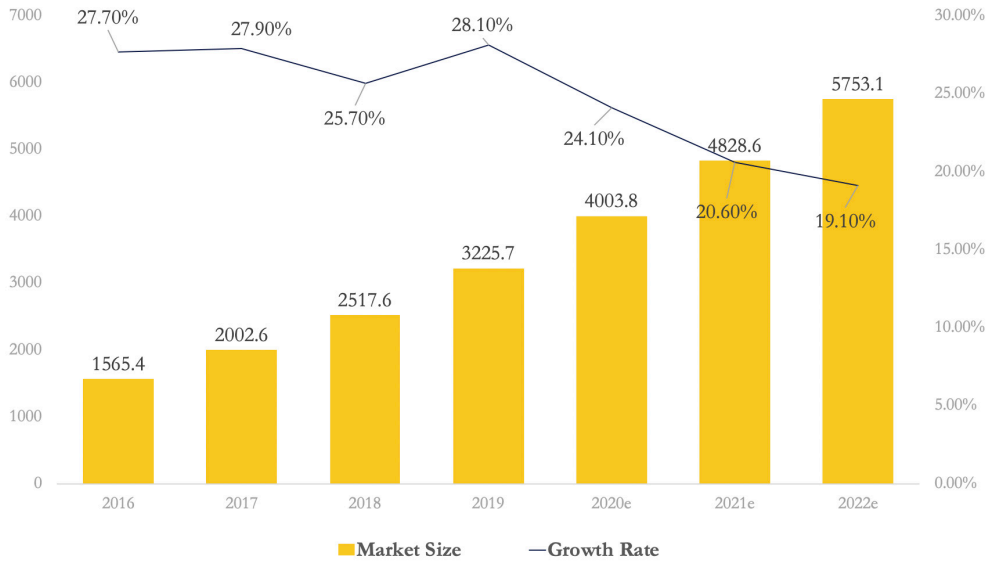

Figure 1.1 The Scale of China Online Education Market from 2016 to 2022e

1.2.2 Adult Education Market Remains Great Potential

Although the proportion of K12 online education is increasing year by year (figure 1.2)[3], the adult online education market is far from saturated, and the demand will further increase. On the one hand, from a demand standpoint, with China's economic growth and transition, and consequently the talent demand structure being adjusted, the number of the high-level technical qualified workforce is far from meeting the market demand; on the other hand, in terms of supply, the external environment laid a favorable foundation for fast progress of educational enterprises, such as the rapid advancement of education informatization, and the gradually deeper integration of technology and education.

As for the target users, there are a large number of potential learners of adult online education. China's Ministry of Education released statistics that 13.325 million graduates entered the labor market in 2018, of whom 60.4 percent had college degrees or above. According to iResearch[4], China's vocational education market will reach 268.85 billion yuan in 2019, among which the online vocational education (including vocational qualification examinations and vocational skills) will reach 39.33 billion yuan in 2019. In the future, the growth rate will be maintained at around 20 percent.

It can be seen from figure 1.2 that higher education and vocational training (summarized as the term "adult education" in this paper) have always been the main players in the China online education market, accounting for about 80 percent of the total market size, with strong demands for furthering education, job hunting, obtaining qualifications or certificates and other scenarios. Compared with the target group of K12 education, adults have relatively stable vision, strong self-control and self-motivation, limited free time, and the ability and awareness to pay for online knowledge.

Generally, online education platforms for adults can be divided into three categories: general platforms, which connect content providers and content consumers; specific content, providing knowledge or training of a certain professional field; study tools, including dictionaries, language learning, qualification examination

3 iResearch. http://report.iresearch.cn/report_pdf.aspx?id=3336

4 iResearch. http://report.iresearch.cn/report_pdf.aspx?id=3336

practice and mocks, etc.

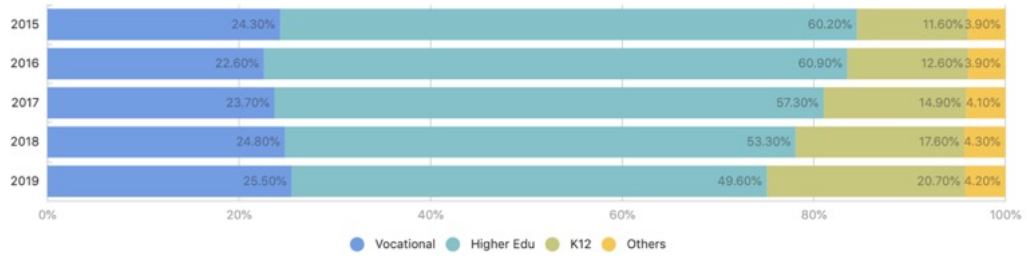

Figure 1.2 Online Education Market Segment from 2015 to 2019

1.2.3 The Demand for Programmers is Growing

In recent years, the proportion of graduates employed in information transmission, software, and information technology services has been rising. According to the Chinese 4-year College Graduates Employment Annual Report 2020[5] published by Mycos, the proportion of Graduates working in the information transmission, software and information technology service industry in 2019 (8.9%) ranked next to that in the education industry (15.9%). In terms of profession, the proportion of graduates engaged in Internet application development (6%) and computing and data processing (5.7%) is relatively high. In addition, not only technical but also non-technical positions have requirements for programming capabilities as a screening condition in the recruitment.

1.3. Problem

1.3.1 Online Courses for Adults are not Fun

Online courses aiming at adults are mainly in the form of free and paid live streaming or recorded videos. The way adults attend online classes is relatively dull, compared with various service approaches of K12 education, such as AI courses,

5 Mycos. `http://www.mycos.com.cn/index.php/Index/service_info/nav/2/i/4.html`

one-on-one tutoring, and double-teacher classes, with one teacher in charge of teaching and the other in charge of after-class service.

In response to the national policy of "opening artificial intelligence-related courses in primary and secondary schools and gradually promoting programming education", children's programming web and mobile applications aiming at exercising programming thinking and cultivating interests from an early age have sprung up since 2017. Kid programming courses are mostly gamified and based on visual programming tools, such as Scratch. Learning programming is designed as simple and fun as playing an appealing game. Kids can make animations, games, music pieces, and other mini-programs, as well as share their works in the online community.

Considering that kids' attention could be easily dispersed, courses designed for kids should be both engaging and effective enough to alleviate the disadvantages of e-learning. For example, the teacher cannot supervise students while giving a lecture remotely and get knowledge of each student's condition in time, so that the teaching efficiency is often not guaranteed. Therefore, courses designed for kids include various powerful tools: AI technology can provide more personalized teaching, generate real-time ability assessment and report learning curve; the emergence of an adviser, who is in charge of after-class service and connects teachers, students, and parents, helps teachers and parents better understand students' learning situation and strength through frequent communication. However, the technology cost, labor cost, and operation cost could be very high, and the high fixed cost and customer acquisition cost determine the high price of K12 online courses. K12 education needs to not only be engaging and motivating enough to attract kids but also professional and responsible enough to satisfy the parents who pay the bill.

But when it comes to adults, who pay for the knowledge for themselves, it is different. Compared with kids, adults' learning behavior is usually more voluntary and purposeful, either to obtain a qualification or learn a skill. As a result, courses designed for adults are mostly result-oriented, serious, and professional, with no fun. At the same time, IT is also one of the most popular categories on adult online education platforms. In contrast, adult programming courses are mainly recorded videos, which are relatively boring and less interactive. Although adults are more

disciplined and goal-oriented, they also need to be enlightened and motivated along the journey. Unfortunately, few institutions are paying attention to this issue, which are exhausting every creativity for school kids and teenagers rather than the job hunter and young professionals.

1.4. Proposal

The stereotype that "adults are more self-disciplined" and "adults don't need to be motivated by fun" limits the exploration of adult education and discourages innovative attempts. The author is aware of the lack of fun in adult education, therefore, determines to design a gamified programming learning application, investigating how to make learning as enjoyable as playing a game.

This project aims at the young generation who are more familiar with online education. They are also the group who are fascinated with gaming. According to data issued by iResearch, from 2016 to 2018, mobile game users under the age of 30 accounted for about 55% (figure 1.3) and the gender ratio of gamers is reaching 1:1 these years.[6] Also, it can be seen that, in terms of user age, mobile gamers are highly overlapped with online vocational education users, who are mostly college students and young professionals aged under 30 (figure 1.4)[7].

Furthermore, this research will focus on the female market. According to data from SlashData[8], in 2019, there are approximately 1.7 million female developers and 17 million male developers globally. In other words, the ratio of female developers to males is 1 to 10 worldwide. However, in recent years, programming is no longer dominated by men, while more and more women are devoted to the field. According to the *Big Data Report on the Workplace Power of Chinese Female Programmers*[9], from 2018 to 2020, the number of female programmers has increased by nearly 70% overall, which was a significant increase. The report

6 iResearch. `http://report.iresearch.cn/report/202011/3679.shtml`

7 Tencent Research Institute.`https://tisi.org/Public/Uploads/file/20190416/20190416162420_71843.pdf`

8 SlashData. "Gender War". `https://www.slashdata.co/blog/the-gender-wars`

9 Tencent. `https://edu.qq.com/a/20201024/019585.htm`

pointed out that the development of female programmers has shown two major trends: younger and more willing to invest in learning. On the one hand, the number of females born after 2000 studying IT courses accounted for the highest proportion of all ages, and the gender bias in programmers is expected to be further reduced in the future. On the other hand, females are more willing to spend money and time to invest in themselves. Female programmers have more enthusiasm for learning than males and take longer to learn: the average length of each class is about 20 minutes and their learning expenditure is 1.5 times that of males. It is worth noting that non-computer major females are also interested in coding, and the abundant resources on the Internet allow them to learn programming by themselves. Therefore, this application is designed for young females and the paper will study the characteristics of the female-oriented games and identify the problems that they often encounter when learning programming to design suitable solutions for this market segment.

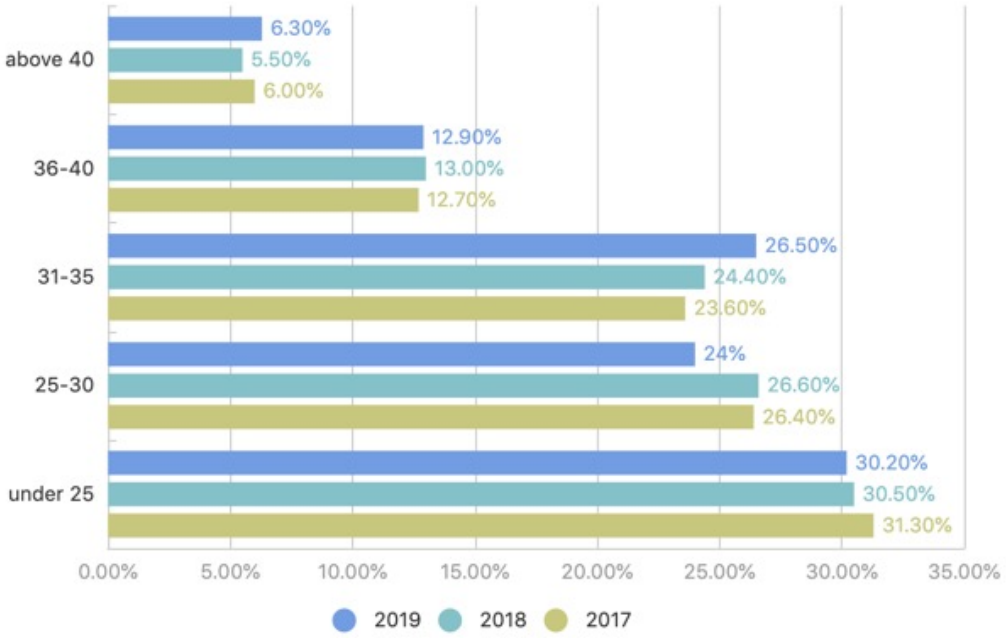

Figure 1.3 User Age Distribution of Online Game

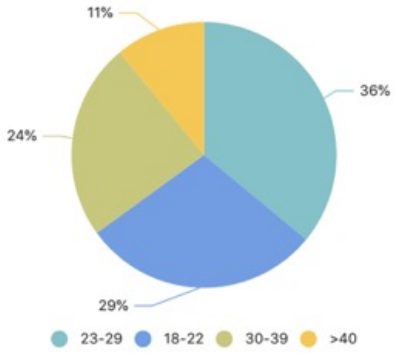

Figure 1.4 User Age Distribution of Online Vocational Education

1.5. Thesis Structure

The thesis is developed as follows:

- **Chapter 2:** Studies of female-oriented game, gamification theories, and gamificaiton cases;
- **Chapter 3:** Design process, based on a survey on the target users and gamification frameworks;
- **Chapter 4:** Evaluation through usability testing and a/b testing, and improvement of the design;
- **Chapter 5:** Conclusions, limitations and future work.

Chapter 2
Related Works

In this chapter, the author investigates the female-oriented game design, gamification concept, framework, and applications, in order to find the answer to the following questions:

- What attracts female gamers?
- What is gamification?
- How to develop a complete gamification project?
- What makes gamification successful?

2.1. Game Study

Gamification comes from games. Therefore, it is critical to understand how real games engage players in the first place. This study focuses on female-oriented games.

According to *Chinese Female Gamers Behavior Analysis Report 2018*[1], by February 2018, the number of female gamers in the Chinese game market has reached 367 million. They are mainly aged between 18 and 35, accounting for nearly 70%. For the most popular categories, board & card game and simulation game ranked as the top 1 and 2, with elimination game, one kind of puzzle game, ranked fourth. In terms of female game ranking in 2018, both the first and the third are elimination games, while the second and the fourth are the romance game Love & Producer and the Japanese game Tabikaeru: Travel Frog, both of

1 Gamekezhan. `https://mp.weixin.qq.com/s/GsyEXCePyriRVFBaclMLkg`

which became a hit at the time. In short, board & card games, simulation games, and elimination games are particularly popular with female players, which are more casual and less intensive.

Considering that the study explores the application of gamification in the field of online education, casual games with relatively easy and repetitive operations that bring instant gratification are suitable for being selected for the case study. As board & card games have their own unique rules, it is difficult to incorporate them into programming education. Thus, the over-the-years top 1 elimination game Kaixinxiaoxiaole (Happy Elimination) and one of the hottest games in 2018 Tabikaeru: Travel Frog are picked. Next, the author will analyze the selected games from the following three perspectives:

1. identify the core route of the game;
2. extract the core game elements;
3. game pace, that is, the short-term and long-term goal and, if any, the ultimate goal; to understand how the game captures the user psychology and creates motivation.

2.1.1 Elimination Game: Kaixinxiaoxiaole

According to *Mobile Elimination Game Data Analysis Report*[2] published in 2018 by Jiguang, the total number of players of elimination games reached 170 million, with 1.19 elimination games installed per capita. Female players account for 68.5% of the total, and more than half of them are between the age of 25 and 35, closely followed by the group under 24. Among the many elimination games, Kaixinxiaoxiaole has the most players.

Kaixinxiaoxiaole is a casual puzzle game developed by Happy Elements, officially launched as a web game in August 2013. The mobile version released in August 2014 and won the award of the player-favorite mobile single-player game. In December 2018, it has 17.1 million daily active users, ranked second on mobile game[3]. The game is set against the background of rescuing the chief of an

2 Jiguang. `https://mp.weixin.qq.com/s/PRZyExejtascuFq48EVnSw`

3 Jiguang. `https://www.jiguang.cn/reports/368`

animal village, and players need to climb along the soaring vine to reach the top through passing elimination games. The game has been constantly updated and has reached more than 3,000 levels. In each game, the players have to match three or more animal characters by switching their positions with limited shifts to complete a certain quest, such as to achieve a target score, to eliminate target items, or to collect a certain number of gold pods. There are seven animal characters and more than forty blockers, which add difficulties to pass. Below is the core route of the game:

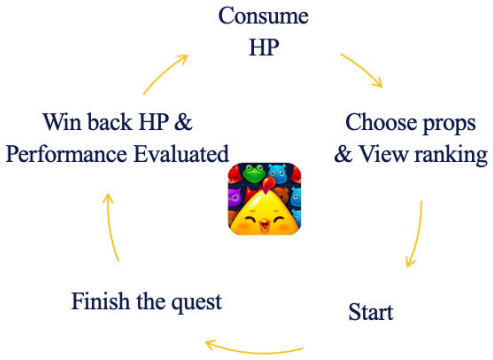

Figure 2.1 Core Game Loop of Kaixinxiaoxiaole

The game takes only a few minutes and make players keep moving forward, one stage after another, addictively. The following reasons explain what makes the game addictive:

1. Because of the shift limit, it won't take a player too long to finish a game, out of which a player would be more motivated;

2. The design of button that leads to the next level is striking, attracting players to click without awareness, therefore, a smooth operating experience is the key to retaining users;

3. The HP limit encourages players to exhaust them all at a stretch, resulting in developing a stronger desire to play after then, because the delayed gratification would increase their dependency on the game;

4. Although the game seems to be repetitive, the variety of objectives of each game adds more fun to the game while avoiding fatigue.

From the core route mentioned above, the core game elements and their functions can be summarized as follows:

- **Level:** There are normal levels along the vine and hidden levels on the branches, which can be unlocked by achieving 3-star of all previous normal levels. The hidden levels encourage players to repeat the normal ones and increase the sense of accomplishment after conquering them;
- **Rating System:** 3-star rating system is frequently used in casual games, which evaluates the user performance;
- **HP:** The HP limit causes delayed gratification that effectively increases user stickiness as well as control the pace of progress;
- **Props:** The boosters that can be activated before or during a game simplify the game and help to avoid frustrating players too much to continue when facing a quite difficult level;
- **Leaderboard:** Peer competition satisfies players' competitive and social needs, while increases gaming frequency.

2.1.2 Simulation Game: Tabikaeru: Travel Frog

Produced by Japanese game developer HIT-POINT, Tabikaeru: Travel Frog became a hit among Chinese mobile gamers in 2018, frog-related contents and posts being all over social media. This is a game without many operations, which makes it described as “Buddha-style gameplay”. The action of the protagonist frog is not controlled by the player. For example, what it does at home, when and where it goes traveling, and when it comes back are all random and unknown. Users don't have to spend too much time playing the game, but the frog has the charm for users to raise it as their pet. The core elements of the game can be grouped into three categories:

- **Currency:** The clovers automatically grow in the garden and can be used to buy props in the store;

- **Props:** Players can buy supplies, including food, shelters, and amulets with clovers, and the precious four-leaf clover can also be used as an amulet;
- **Lottery:** The souvenirs and photos sent back from frog can be seen as a more random form of Gacha game, with players being unable to decide the time and frequency to do it, leading to a stronger desire to collect.

Figure 2.2 Core Game Loop of Tabikaeru:Travel Frog

Tabikaeru: Travel Frog is a slow-paced game, with everything being random. Players are expected to be leisure and free, however, they can't help checking the game over and over again to see if there is anything new. Although the game gives less sense of control to the gamers, let alone competition and social elements, compared to traditional games, it successfully developed a closer bond with the users so that they joked themselves as raising sons.

Undoubtedly, the success factors of the game are increasing the emotional bond and creating a buzz on social media. Expect the adorable art design, surprises brought by the random system are also addictive. The collection map tells the player where they are and how many locked items they can expect for. It is because users have no idea of what and when they would get a new item, they will repeatedly login the game, increasing the frequency of use and time spent on the game; and it is because users cannot decide which item or photo to obtain the next time, they will continuously show off their progress and excitement to the world on social media. Different from a badge system that often gives clear objectives for users to achieve, the unknown system has a stronger power to hook

users, on the premise that their curiosity has been fully aroused. Besides, although there is a lack of competition or other social elements within the game, they get a full extension outside the game. Players enjoy sharing pictures of their frog, discussing the experiences with friends and will be motivated if they see a friend received a photo they don't have.

To sum up, the charm of a female-oriented game could derive from:

- admirable artistic design;
- progressive with short-term and long-term incentives;
- not too competitive and challenging;
- less time pressure;
- something worth sharing;
- surprising bonus.

2.2. Gamification

2.2.1 Defining Gamification

Games bring people fun by releasing dopamine in the brain. Regardless of gender, age, or cultural background, anyone can gain powerful mental strength from the game. Behind a successful game is the continuous accumulation of social experience and the sophisticated design combined with psychological research. In this case, can the game wisdom that immerses us in the virtual world be applied to other fields and help us improve performance?

Researchers are seeking answers to this question. The concept of "gamifying" can be traced back to 1980, proposed by Richard Bartle, a professor of the University of Essex and a pioneer of multiplayer online games, which means turning something that is not a game into a game. The first time the word "Gamification" appeared in this context was in 2003 and it has been widely used since 2010 [2]. Gamification research is receiving increasing attention in the past decade, and its applications cover a wide range of fields, such as education [3, 4], training [5], health [6], wellness [7, 8]and business innovation [9].

Originated in the business world, gamification is defined as applying game elements and game design techniques to non-game contexts [2]. Game elements frequently used in gamification include experience points, progress bars, badges, leaderboards, leveling up, gifting, content unlocking, teams, and storyline [10, 11]. It has been widely proved that, when intrinsic motivation is stimulated by game mechanisms [12], the entertainment provided by gamification is an effective tool to enhance motivation, attract participation, and increase engagement [13–16].

It is worth noting that in a non-game context, the ultimate goal of the player is not to gain achievements or win the game in a virtual world, but to deepen the understanding of products, experiencing services, making deals, improving performance, changing daily life habits, etc. in the real world. Therefore, in the case of online education, the goal is to create a platform for students to enjoy learning while challenging themselves. Specifically, the objective is to use game elements and design techniques to make students more interested and motivated in coding, help them experience the joy from learning progress, gain a sense of accomplishment that encourages them to push ahead.

Gamification is not about making a new game just for fun. Instead, it is about to create a new experience based on the current case and existing resources. A good design should accurately seize the user psychology, knowing what to achieve by elaborating the exact game elements or techniques. In other words, the game is designed to facilitate improving user experience and to provoke emotional attachments, rather than superficially decorate the original services with a hollow concept.

2.2.2 Types of Gamification

According to Hunter and Werbach [2], Gamification can be divided into internal, external, and behavior change gamification.

- **Internal Gamification** is also called enterprise gamification. It can be applied to the core business of the enterprise. Participants, who are part of the company, in general have common reference points, such as sharing a common corporate culture and common goals. The gamified incentive mechanism must be linked to the company's existing management and reward mechanism.

- **External Gamification** is related to existing and potential customers. The purpose is to obtain better marketing results, improve the relationship between the company and its customers, increase customer engagement and their identification with and loyalty to the product – ultimately increasing corporate profits.
- **Behavior Change Gamification** aims to help people form better habits and to create a positive social impact.

In the case of online education, behavior change gamification is the most relevant in that it is expected that the students' performance could improve after forming a positive learning habit. Given the goals of this project, gamification in education is studied more deeply in the following section.

2.2.3 Gamification in Education

It is widely proved that the application of gamification in education presents notable advantages, including increasing motivation, engagement, and capacity of the assessment activity, as well as continuity of the learning process beyond the school context [4,17,18]through competition and collaboration [19]. Courses with gamified pedagogy include higher media richness and interactive mechanisms, enabling immersion in learning more easily [20]– which results in higher behavioral intentions towards gamified learning systems [18]. A mapping study on gamification applications in education conducted by Dicheva et al. [10]summarized that the early adopters of gamification are mostly computer science/IT educators because the knowledge could be difficult to understand by the early users.

However, studies also show that, although the concept seems to be simple, gamification of education does not fully guarantee effectiveness. For example, Kocadere and Caglar [21]categorized players into killer, achiever, explorer, and socializer in learning environments and found out that different game elements and mechanisms will attract and influence users in different degrees and aspects. Therefore, when designing games, it is necessary to predict the possible reactions of different user personalities or preferences to certain elements or mechanisms and make corresponding adjustments in order to achieve higher effectiveness. D. Moore-Russo et al. [11]also pointed out the following possible pitfalls that should

be avoided in design: game elements not being closely related to learning goals; users' unfamiliarity and discomfort with gamified study environments; no real changes being implemented; diminished returns on time investment. Firstly, as mentioned in the previous section, gamification is not simply creating an independent game, but optimizing the user experience. Secondly, it is required that the gamification design should conform to the user cognition, and the designer should understand the behavior habits of the target users. The last two pitfalls remind designers to focus on actual effects and build long-term incentive mechanisms.

2.3. Gamification Framework

The framework adopted in this design project is based on "The 6 D's" [2] proposed by Kevin Werbach and Dan Hunter in the book *For the Win: How Game Thinking Can Revolutionize Your Business*, which lists six steps for developing a gamification project:

- Define business objectives;
- Delineate target behaviors;
- Describe your players;
- Devise activity cycles;
- Don't forget the fun;
- Develop the appropriate tools.

To begin with, the first three steps have been clarified in the introductory chapter and will be further developed in the next design chapter.

Secondly, the fourth and fifth steps will be comprehensively devised. With the project objectives and target behaviors being defined, the Octalysis Gamification Framework (figure 2.3)[4] put forward by Yu-Kai Chou summarizing 8 core drives that motivate users towards certain activities will be used to guide the activity

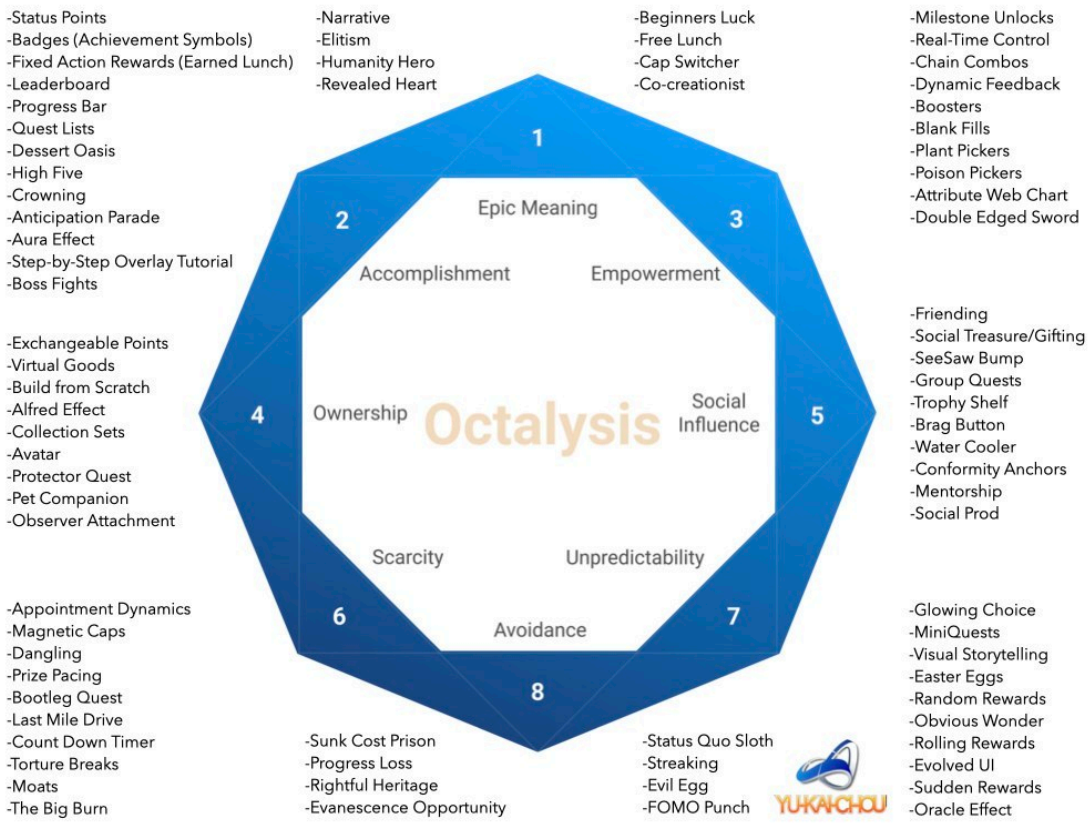

Figure 2.3 The Octalysis Gamification Framework

cycles and progression design.

Lastly, after completing the basic project framework, the author will employ appropriate tools with the help of the Gamification Elements Pyramid (figure 2.4) [2] to complete the gamification design.

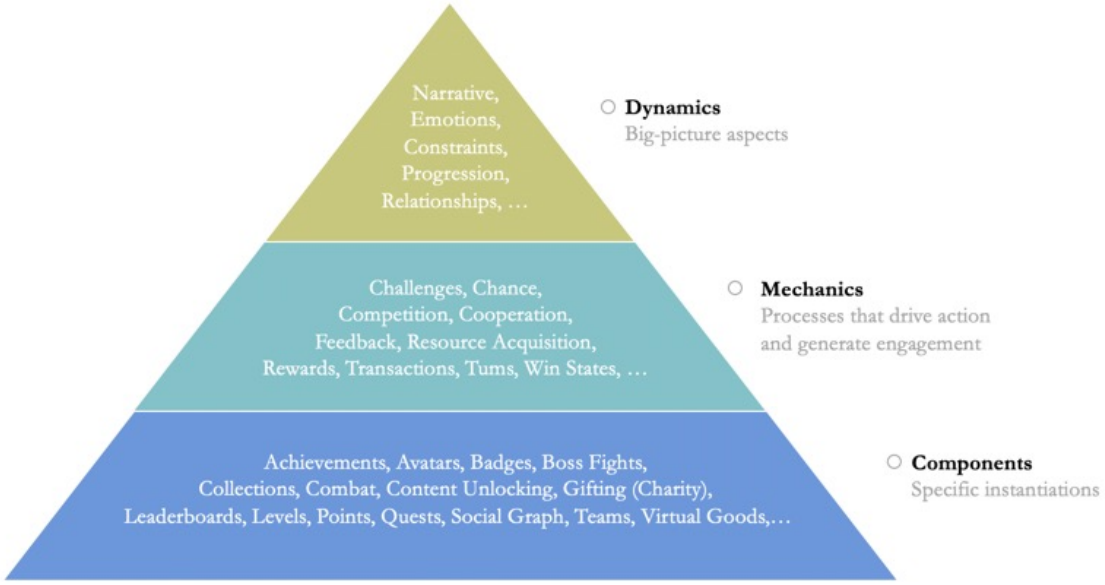

Figure 2.4 Gamification Elements Pyramid

2.4. Gamification Case Study

In this section, the Octalysis Framework is used to explain why gamification works with two successful cases, one is of e-commerce and the other of education.

2.4.1 Gamification of E-commerce: Ant Forest

Ant Forest is a public welfare service within Alipay, which aims to encourage users to live a low-carbon green life. In Ant Forest, users can collect “green energy”

4 The Octalysis Framework for Gamification Behavioral Design. `https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/`

to plant virtual trees when they walk or use Alipay to pay for various living expenses, and the company will plant a real tree when they reached the target amount. Alipay released the latest data[5] of Ant Forest that about 40 percent of Chinese people have planted trees with their mobile phones, with 550 million participants having reduced carbon emission of 11 million tons. So far, 122 million real trees have been planted, covering 1120 square kilometers of land.

User journey of the service goes as follows:

1. Users pay for 5 specified categories of services with Alipay: green traveling, including walking, riding shared bikes, taking buses and subways; paying living expenses online, such as purchasing tickets, making a hospital appointment, shopping, banking, etc.; reducing paper and plastic, such as ordering take-out, using express services, scanning QR code to pay bills, etc.; and energy-efficiency recycling;

2. After 24 hours, the system will produce a certain amount of "green energy" according to the scientific algorithm, and the user needs to log in and collect them, otherwise they will disappear in three days;

3. Users can accumulate "green energy" by collecting their own or stealing in friends' forest, and they can also give out "green energy";

4. When reaching a certain amount, users can choose to plant a real tree or protect a preserve and a certificate will be issued.

There are 5 game elements used in Ant Forest:

- **Points:** "Green energy" serves as point in the developing game;
- **Progress:** The appearance of the tree will gradually change in stages as "green energy" accumulates;
- **Achievement:** There are varieties of trees and preserves originally greyed out in Achievements for users to unlock;

5 iiMedia. `https://www.iimedia.cn/c1020/69846.html`

Figure 2.5 User Journey of Ant Forest

- **Leaderboard:** Users compete with friends on weekly and main ranking according to the amount of “green energy”;
- **Visit:** Users can steal, gift or help to collect “green energy” in friend's forests, as well as give props, recall friends or leave messages.

Figure 2.6 Long-term and Short-term Game Loop of Ant Forest

It is obvious that it takes months to plant a real tree. To prevent users from losing patience for waiting too long, the system set up several approaches to increase the times of instant gratification along the way. First of all, it allows users to take friends' energy, which both increases the fun and to some extent shortens the time it takes to reach the goal. Users can see how much energy they took from each other on friends' forest pages, shown as Weekly Energy Battle

(figure 2.7). In turn, users can also give energy away to friends. No matter giving or receiving, users can have fun socializing with each other.

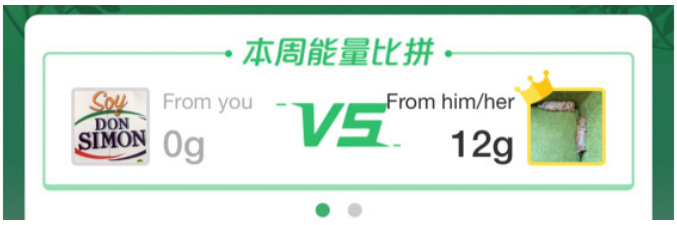

Figure 2.7 Weekly Green Energy Battle

In addition, when users competing with friends for weekly ranking (figure 2.8), they unconsciously accelerated the pace of accumulation. Motivated by short-term satisfaction, users may find it less arduous to move toward long-term goals. In summary, Ant Forest elaborately utilizes game elements that bridge Alipay with the public welfare. Although Alipay covers all aspects of the daily life payment scenario, not all services are frequently used or even known by its users, some of which facing the threat of competitors. The solution to this issue is to package all services in a system with the low-carbon concept, so as to educate and encourage users to use these neglected functions, and to cultivate their habit of using online payment in any possible scenario. It takes advantage of people's sense of social responsibility. For example, if one wants to buy a ticket to a scenic area, he or she would be more willing to purchase with Alipay in order to collect "green energy" than buy a paper ticket at the place.

It is reported[6] that the Ant Forest has created a platform that everyone can participate in the green action, making low-carbon life within reach: every four Chinese people use their mobile phones to pay bills; 350 million people choose low-carbon travel every day; more than 100 million people buy "green goods" online, and second-hand goods recycling has become a trend.

The gamification structure of Ant Forest relies on six of the eight core drives:

6 Policy Research Center for Environment and Economy. Ministry of Ecology and Environment of the People's Republic of China. `http://www.prcee.org/yjcg/yjbg/201909/t20190909_733041.html`

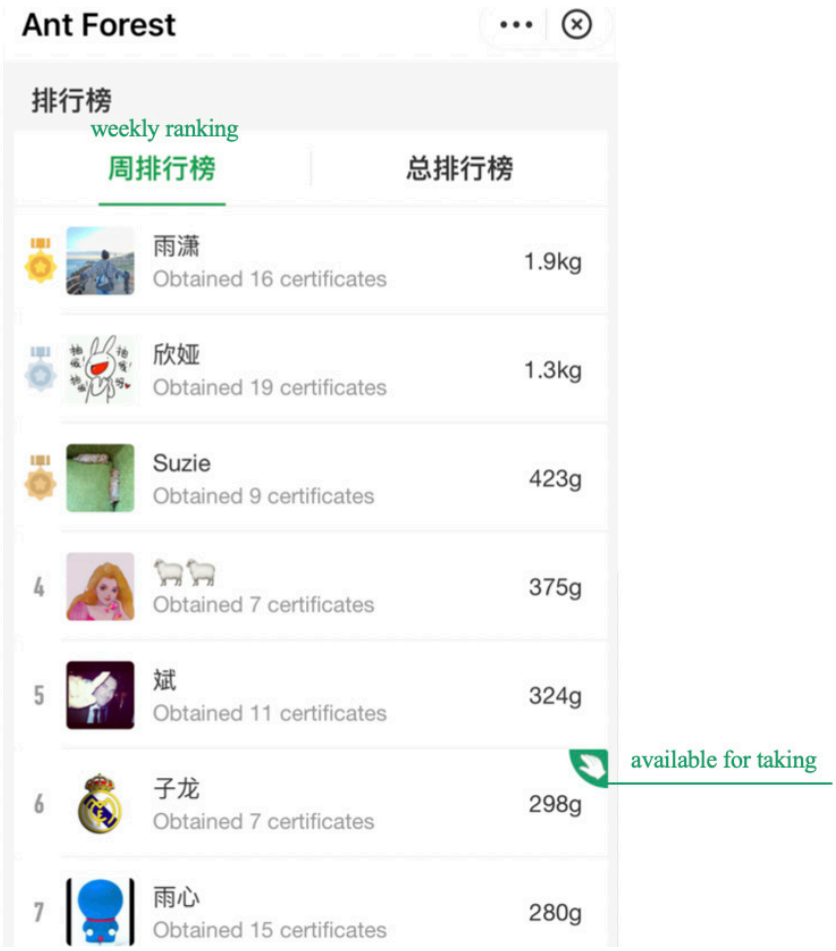

Figure 2.8 Weekly Ranking of Green Energy

- **Epic Meaning & Calling:** Users actively take part in promoting public welfare;
- **Development & Accomplishment:** Users witness their trees gradually grow with “green energy” accumulating;
- **Ownership & Possession:** Users take full control of their “green energy” that can be used to exchange a real tree or give out to friends;
- **Social Influence & Relatedness:** Users can compete with, visit and leave messages to friends, take others “green energy” or take care of others' trees, and the game also reminds users of a ten-year-ago popular simulation game Happy Farm;
- **Scarcity & Impatience:** It often takes months or even more than a year to reach the required amount to plant a tree;
- **Loss & Avoidance:** “Green energy” is generated the next day and will disappear after three days or be took by friends if users forget to collect them in time.

Motivated by the sophisticated design, some planters even set an alarm clock at 7 a.m. everyday morning to remind them of collecting “green energy”. This gamification mode has been increasingly applied in various e-commerce platforms. For example, Taobao, Pinduoduo, and Meituan encourage users to plant virtual fruit trees (figure 2.9) by completing tasks assigned within the platform, such as window shopping, purchasing, sharing with friends, etc., and finally, they will receive a box of real fruit. On the one hand, it increases use frequency and duration, and consequently improves user retention and order rate; on the other hand, it helps farmers to solve the problem of slow sales. In addition to making use of the logic of simulation games to activate and retain users, some e-commerce platforms also introduce casual puzzle games such as elimination games and quiz games. Through linking game props and rewards to consumption, games effectively promote customer purchases.

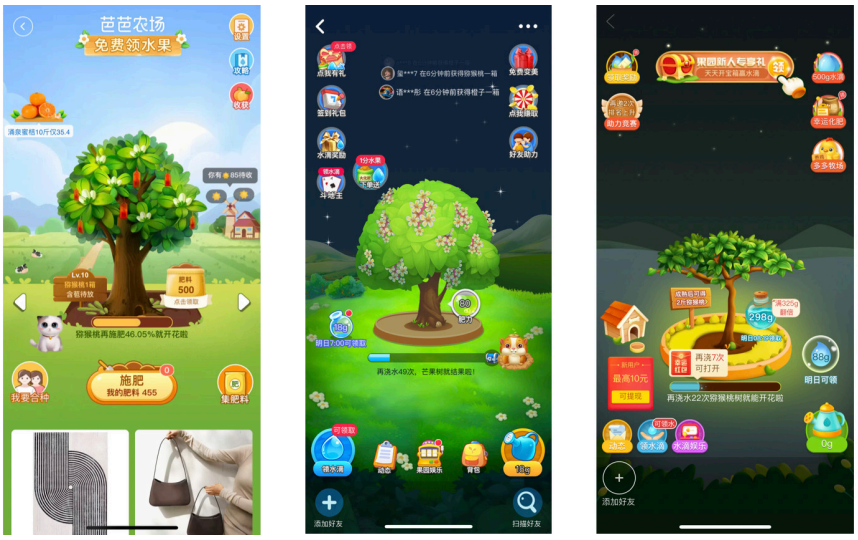

Figure 2.9 Virtual Trees of Different Platforms

2.4.2 Gamification of Programming Education: SoloLearn

SoloLearn is a free programming learning platform and community with nearly 40 million users globally from the United States. This product initiates a student-centric open crowd-learning mode, aiming at creating a fast, effective, and fun learning experience anytime and anywhere for coding learners all over the world, given that " *in today's world, learning a new skill can be time-consuming, expensive, and not fun or easy* " [7].

Sololearn is a fragmented learning platform, allowing learners to begin and pause anytime they want. Therefore, there exists no concept as a round of game within the platform. However, SoloLearn contains many game elements, which link all features together with game logic. As described on its official website, this is a platform not only for study but also a community for coding enthusiasts to interact with each other (figure 2.10). Thus, this paper will look into its course features and community features respectively.

Different from traditional video classes, Sololearn teaches with texts, like quests

7 Facebook for Developers. " SoloLearn " .`https://developers.facebook.com/success-stories/sololearn/`

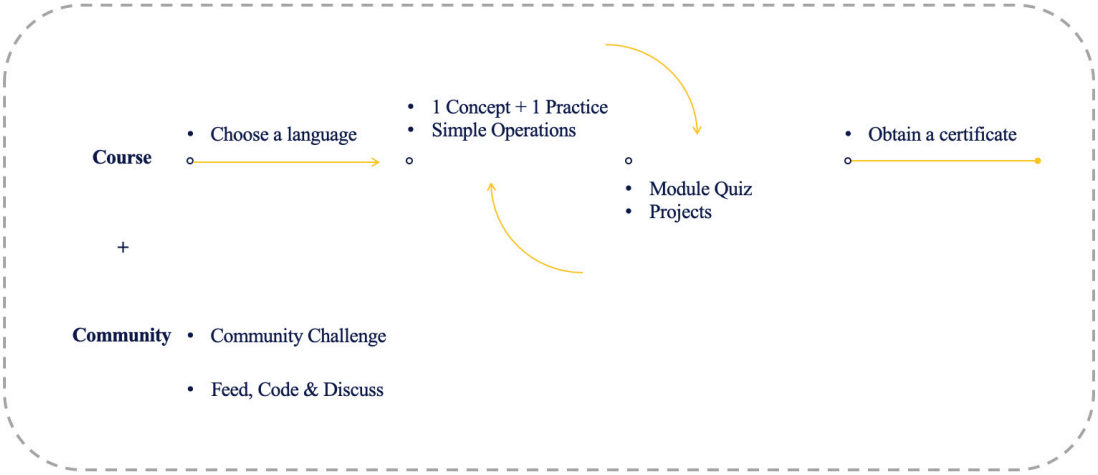

Figure 2.10 Structure of SoloLearn

in a game. It explains one concept at a time and attaches a practice right behind the concept for learners to check if they understand the knowledge by actually coding on their own. Such a minimum learning unit, learning-and-practicing, helps users to not only consolidate what they have just learned, enhance their understanding, but also gives freedom to learners to flexibly adjust their study time. During the learning journey, users can view their learning route after selecting one language and unlocked each level in sequence. A simple lock button can magically arouse users' curiosity and the desire to conquer the level. In addition, practical projects and module quizzes are set in the middle of the courses, which are more practical and challenging than the general questions, helping students examine their learning outcomes in an all-round way while creating a proper learning pace. After completion, the platform will issue a digital certificate, serving as the ultimate goal in a game, which encourages users to continue finishing the course rather than give up halfway. The progress bar works the same, appearing on the top of the course main page. At the same time, the PBL system also plays a role in facilitating learning. Users earn different amounts of Points by learning courses and completing quizzes and projects, and then Points determine Level and rank on Leaderboard. Points can also be used to exchange tips of practices, similar to game props. Badge helps in guiding users to make full use of platform functions and complete the courses in a more purposeful and planned approach. The design

logic of a point-based Leaderboard is to encourage users to complete more lessons and exercises, which not only contributes to a better result but also enhance use frequency and duration.

Compare to other platforms, which focus on either learning or forum, SoloLearn offers a comprehensive user-centric platform. Apart from attending classes, users can also experience competition, cooperation, share and discussion within one platform. Noted that SoloLearn is basically a free programming learning platform, therefore, it should win users' time as much as possible. It can be seen from the main menu of its mobile application that four-fifths of features are related to social functions, highlighting the role of community. Such positive internal ecology comprehensively solves users' demand of making friends, sharing personal works, and discussing questions, which creates a complete loop that deeply combines knowledge input with output.

- **Community Challenge:** 1v1 time -limit quiz;
- **Feed:** A social media for users to share study notes or anything they would like to;
- **Code:** Users share projects they create for others to play and learn with them;
- **Discuss:** A forum for asking and answering questions.

In all these forums, whether posts or comments are ordered by Vote, the same as like and unlike. The more a piece of content is liked by users, it will receive more exposure. Better than reverse chronological order, high-quality content will be displayed on the first page, creating a positive competition atmosphere. Moreover, users can leave a comment after each quiz to specifically discuss a certain question with each other. The platform also allows users to follow and chat privately with others to make new friends.

Sololearn makes use of three of the eight core drives developed by Yu-kai Chou, among which the growth mechanism is worthy of reference.

- **Development & Accomplishment:** Progress bar, level up, XP, badges, leaderboard, boss fight, etc. stimulate learners' internal drive of making

progress, developing skills, and eventually overcome the final challenge to obtain the certificate;

- **Empowerment of Creativity & Feedback:** Code playground offers a place for users to share their original works, receive feedback and respond in turn;
- **Social Influence & Relatedness:** Users can initiate a battle in community challenges, interact on forums or privately chat with other users, and the design of the feed looks similar to Facebook.

So far, it has been apparent that gamification could be a useful tool to stimulate a certain internal desire, which leads to certain activities. This is how gamification engages people. Inspired by the game and gamification cases, the author will embed some of the game elements and techniques into the application design with the help of the three gamification frameworks in the next Chapter.

Chapter 3
Design

In this chapter, a survey on target users is firstly conducted to gain an in-depth understanding of user demands and to verify whether the issues raised by the author are concerned by the group.

Based on the survey results, the author summarizes the common frustrations and expectations towards online programming courses and develops the application called DAGONGREN[1] according to “ The 6 D's ” structure. Besides, the Ocatalysis Framework and the Game Elements Pyramid are referred to design intrinsic motivation and materialize the framework respectively. Finally, Mocking Bot, a prototyping tool, is used to create user interfaces of the application.

3.1. Pre-study: A Survey on Target Users

The author surveyed 352 Chinese females aged from 18 to 30 by an online questionnaire.

According to the result, 47.7% of the respondents have learned at least one programming language, with 28.4 % have a command of two languages and above. Among programming languages, Python is the most popular, with 34% of respondents having learned it, followed by C with 16%, R, Java, and C++. As for those who can't program, 58.7% indicated that they have the willingness to learn, with Python topping the list of the most want-to-learn programming language with an overwhelming 57.7%. In terms of the learning objectives, 7.4% of the respondents learn programming for the reason that their current job requires programming capability, and 88.9% are preparing for the future. From the data above, female

1 A 2020 buzz word in China that literally means Employee who strives for money everyday.

programming education seems to be a potential market, and Python is not only popular with learners, but also a favorable choice for beginners.

The learning behaviors and difficulties of respondents were also investigated. For those who have learned to program, online education is the most frequently used method of learning, followed by school education. Relatively few respondents study through reading paper or digital books. (figure 3.1)

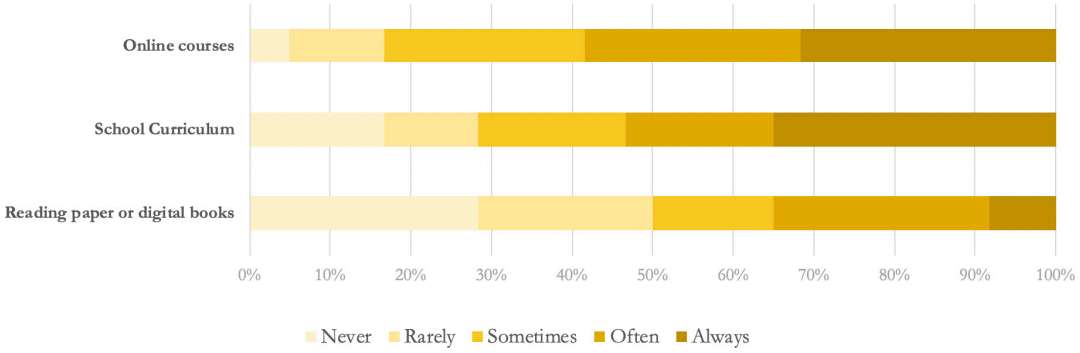

Figure 3.1 Q6: How do you usually learn programming?

Regarding the problems with learning to program online, "hard to truly understand" is the most frequently encountered situation, that is the users thought they understand but still have difficulty coding independently. In this case, it is natural for them to ask professionals for help, however, there exists no solution providing such service. Most online learners think that online courses are not interactive. Being unable to communicate directly with teachers or other users makes them unable to solve problems in a timely and effective manner. Moreover, many users are expecting the improvement in knowledge practicality, for programming as a tool, it is critical to put the theory into practice. How long it takes to finish a lesson also received concern more or less. (figure 3.2)

41.3% of the respondents who can not program has attempted to learn but failed. As shown in the chart below, first of all, 73.7% of learners stop learning due to lack of supervision. If there is no urgent work demand, the freedom of learning will result in making no plan and giving up halfway. Although adults are stronger in self-control than kids, they could be distracted by other work or personal issues based on their priorities. The case that paying thousands of yuan but hardly

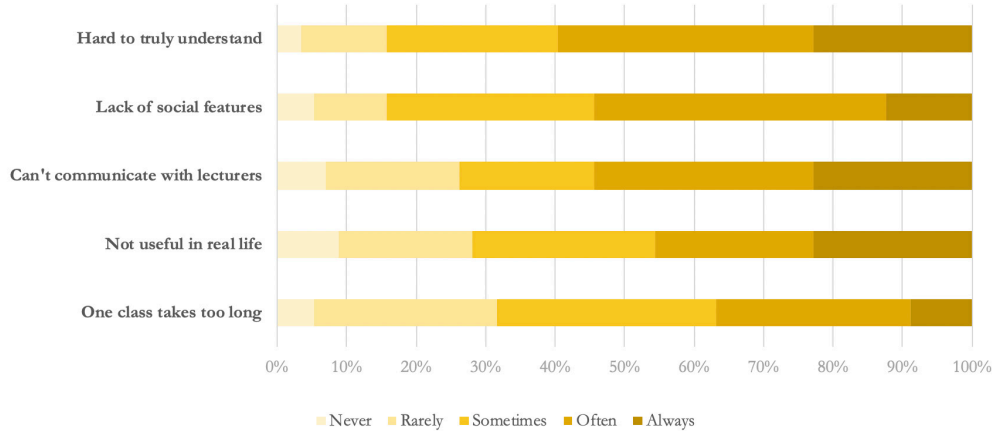

Figure 3.2 Q7: What difficulties have you encountered while learning to program online?

attending classes is not an exception. Secondly, as the course gradually progress to be more abstruse, 57.9% of the respondents were repulsed by difficulties. It is understandable that when self-study, if learners are unable to interact or discuss with lecturers and other classmates, they are more likely to get stuck, making it hard to push themselves ahead. Particularly when concepts are linked from one to another in one lesson, users will encounter bugs if they misunderstood or overlooked a small point, and they have to review the video several times until they identify where the problem lies, which could be time-consuming. Additionally, inadequate practice and social features are also discouraging reported by nearly a third of the respondents. More than a quarter claimed that they don't have time, or the content was too boring. (figure 3.3)

Finally, regarding the online programming learning product, the author has carried on a preliminary investigation to the demand of target users. The result indicates that more than half of the respondents think that "practice", "supervision" and "progression" will motivate them to keep learning, in accordance with the problems encountered in learning reported above that should be addressed. Nearly 40% of respondents also expect the platform to offer competitive elements to increase interaction between students. Therefore, this research will take these attributes into consideration in design to create a motivating and engaging programming platform. (figure 3.4)

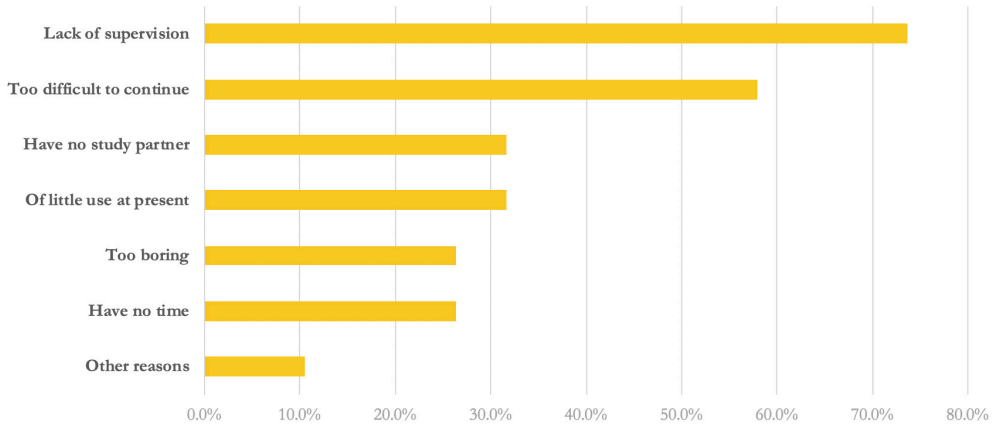

Figure 3.3 Q5: Why did you give up programming?

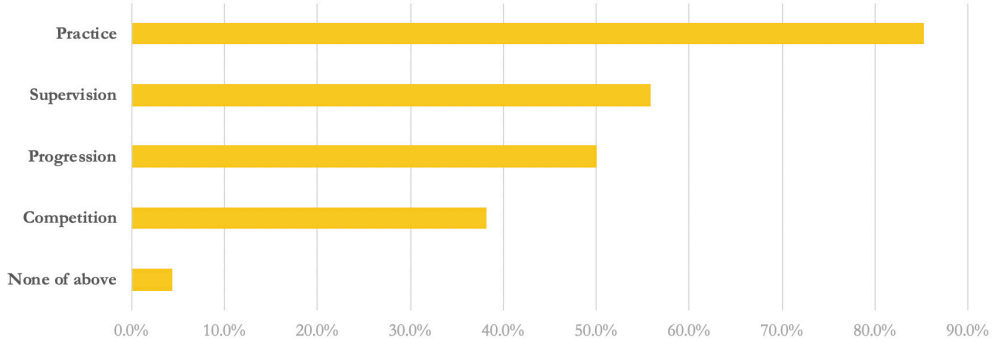

Figure 3.4 Q8: What features will motivate you to keep learning?

To sum up, according to the results of the questionnaire, four challenges will be solved as follows:

1. **Inadequate practice:** More practical projects will be added in the middle of the learning journey to inspire users by real-life applications, making what they learn useful;

2. **Lack of supervision:** Self and peer supervision mechanism will be developed;

3. **No incentive to continue:** A developing system will be designed to continuously provide users with a sense of accomplishment as well as build an emotional connection to the platform;

4. **Lack of interaction:** Users will be able to experience various ways of interaction such as competition, cooperation, team, etc. within the community.

In the next section, the author will develop the platform based on "The 6 D's" structure, the Octalysis framework, and the Game Elements Pyramid.

3.2. Design Process

The results of the pre-study convey the message that there is a demand for learning Python in a more practical approach among the target users of this research. At the same time, this particular group has a preference for simulation games, which often contains elements such as development, collection, and a progressing storyline according to the previous study on the Chinese game market. Therefore, an office simulation Python learning and social platform with the background story of career advancement is designed in this section.

3.2.1 Define project objective

The objective of this study is to help young females, who have difficulties with program learning at an early stage, to overcome the hardship through gamification by stimulating their internal motivation with engaging game design.

From many alternatives, Python is selected as the target language to learn, since, firstly, it is widely used in various working scenarios, including Web development, finance, data analysis, image processing, etc.; secondly, Python is relatively simple, easy to read and highly efficient, which make it a suitable programming language for those who have no technical backgrounds to get started; and lastly, it is mostly picked as the most want-to-learn programming language by respondents in the pre-survey.

3.2.2 Delineate target behaviors

The main expected user behaviors are summarized in the user life cycle below (figure 3.5). Generally, users may leave the platform during the transition from the first stage to the second or sometimes from the second to the third when they found themselves have trouble continuing the learning. This project aims to help users to stimulate their interests in Python and to ensure the continuity of the learning process until they finish all classes and finally feel a sense of belonging in the community. Once becoming active users, they would take the initiative to recommend to friends, which creates a positive user life cycle.

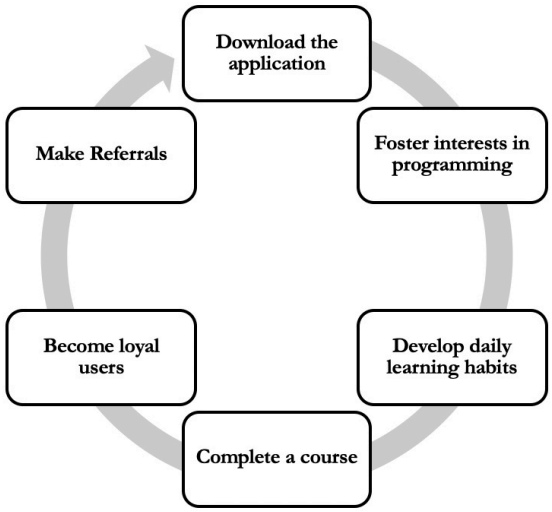

Figure 3.5 Ideal User Life Cycle

3.2.3 Describe your players

The target users of the study are female college students and young professionals aged from 18 to 30, who have personal or professional needs, such as data processing, office automation, etc., but have trouble with crossing the threshold or continuing the advanced level due to certain reasons. They have the tendency to learn but can't find an engaging course for them to learn with fun.

3.2.4 Devise activity cycles & Don't forget the fun

The Background Story

In order to be more practical, the platform simulates a real workplace environment, allowing users to experience a challenging development of growing from an inexperienced trainee to the CTO of the company eventually. The story begins with the user entering a company as a trainee, and progress then gets promoted along the career path by passing through each level. The whole course is divided into 30 levels as shown below:

Figure 3.6 Promotion Path

All users are employees in a virtual company, experiencing a series of workplace routines and events, the same as working in a real company. Before starting, a recruitment test is required to assess the programming level of each user, then the system will customize their course. Employees' performance is evaluated by KPI, which can be earned by daily punch-in (log-in every day), working (learning and practicing), contributing to projects (forming a group and developing projects with other users), competing for tasks assigned by the leader (participating in 1v1 time-limit quiz battle), etc. KPI will decide the weekly and annual employee ranking regionally and globally, and outstanding employees will receive awards as

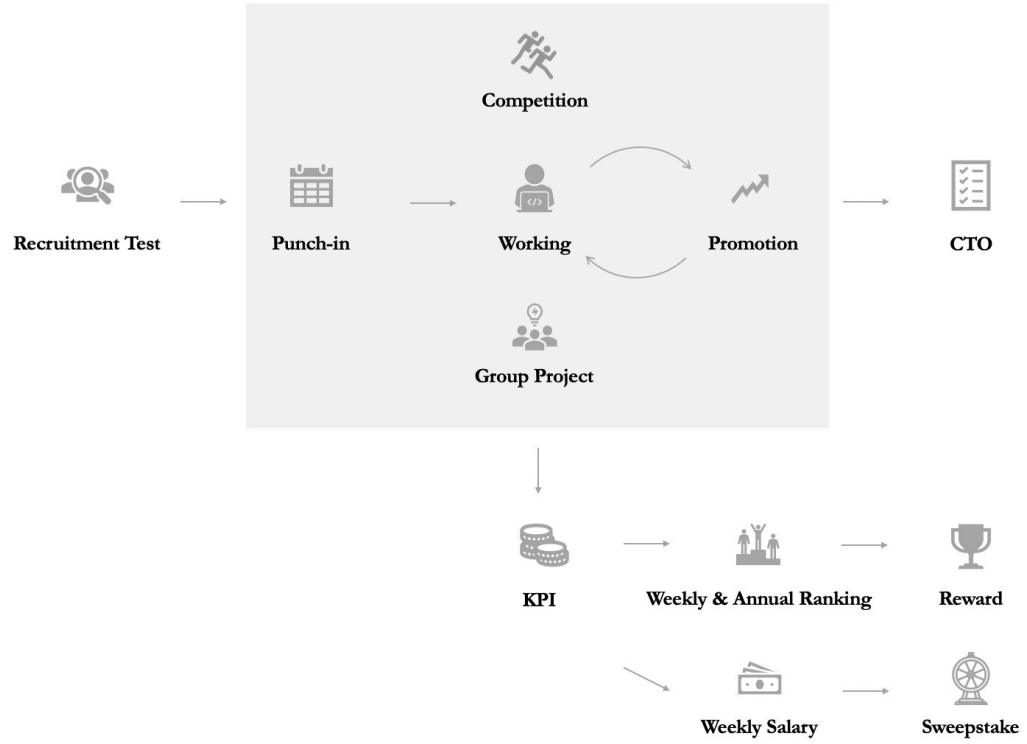

Figure 3.7 User Journey

well as physical rewards. In addition, users can use salary, distributed based on weekly performance, for sweepstakes to gain office items collections. (figure 3.7)

Quests will be given in a conversation mode. There is no video but texts in any scenarios, including learning, practicing, competing, collaborating, etc. For example, in the study module, there will be a virtual mentor teach users in the form of conversation and assign working tasks after then.

Internal Motivation - based on the Octalysis Framework

1) Epic Meaning & Calling

- Thanks to the storyline design, learners continuously complete various tasks on the platform not only for learning purposes but also for career advancement;
- Users can team up with colleagues to create original projects and share on internal BBS, which will be ranked based on the votes they received, and will strive for team glory by actively initiating and participating in building projects, interacting with team members, and thus further improving skills;
- Users will be divided into different branches according to their register region, and the performance of each branch will be evaluated by summing up the KPIs of all employees in the branch, in which case, independent users are no longer fighting for themselves but their branches.

2) Development & Accomplishment

- Points is presented as KPI which users accumulate based on the performance of designated Quest and Challenges, increasing the online frequency and duration;
- Employee Badges will be granted when users completing a certain number of Quests, encouraging users to repeat certain tasks;
- KPI decides rankings on Leaderboard;
- Users Level Up along the Progress Bar, which is presented in the form of promotion path, which greatly pushes users ahead;

- Promotion assessment is the Boss Fight that users encounter at the end of each transition stage, playing a role in controlling the progress pace.

3) Empowerment of Creativity & Feedback

- Users can create original programs solo or with a team and upload to the internal BBS;
- On the BBS, users share works and receive instant feedback, asking & answering questions.

4) Ownership & Possession

- KPI can be used to exchange hints when users have trouble with practice questions;
- Users will be paid weekly with Salary according to the KPI they accumulate within seven days that can be used to take part in sweepstakes for office items;
- Users' private space can be decorated with office items and certificates of awards.

5) Social Influence & Relatedness

- Users can message, hold audio and video meetings with colleagues;
- The platform allows users to collaborate with colleagues in conducting group project, enabling real-time co-editing on one program.

6) Unpredictability & Curiosity

- Courses are locked in order to stimulate users' curiosity;
- In a sweepstake, users don't know which office item they can get, and the unpredictability makes users get addicted.

7) Scarcity & Impatience

- In the learning module, users are allowed to make five mistakes in practice questions at most. The HP limit can control the pace of learning as well as improve user concentration;

- Users have to exchange KPI for salary to participate in sweepstakes, therefore, it takes some time to obtain one chance.

8) Loss & Avoidance

- After setting a weekly goal, users should punch in every day for a week, otherwise, their KPI will be reduced.

3.2.5 Develop the appropriate tools

Dynamics – Narrative & Progression

Both of these keep users engaged and motivated to participate in the working activities. At the same time, the narrative makes learning feel more like real-life experience, whereas progression keeps learners confident in their own ability to learn and progress.

Mechanics – Challenges, Competition, Cooperation & Feedback

Challenge, as the name indicates, is a challenging quiz that users have to solve at the end of each stage, combining learned concepts into a practical real-work simulation task. Through achieving challenges, users can not only deepen the understanding of what have learned but also gain a sense of accomplishment that motivates them to continue learning. Competition helps users to consolidate knowledge by memorizing basic concepts or conducting simple operations in a time-limited battle. Cooperation offer users opportunities to apply the knowledge with creativity and inspire each other in a study group. Feedback allows users to encourage each other and create a positive learning environment. When facing a difficult problem, one can't be too frustrated to carry on with the help of other users.

Components - Game Elements

1)Point

Along the learning journey, the platform allows users to earn KPI, an evaluation indicator like the point system in a game, through daily sign-in, learning, practicing, participating in quiz battles and cooperation projects. The value of KPI

decides users' employee ranking, including peer ranking, regional and global ranking, and reward will be offered weekly and annually. Through using the exclusive metric, KPI, to measure comprehensive performances within the platform, it is expected that users' study frequency and duration would be effectively increased, and user stickiness would also be enhanced. Consequently, these features all together could help users learn and practice from different perspectives, so as to achieve better learning outcomes.

2)Leaderboard

The Leaderboard is divided into Peer, Regional and Global Leaderboard. Peer Leaderboard shows the weekly ranking among friends, where users could compete with friends within their private social circle. Being a little more diligent by exhausting commutes or the time before bed to complete more practices, one may edge out his or her peers to top the rankings, from which one's sense of accomplishment and superiority gradually accumulated. While, Regional and Global Leaderboard reflects the ranking of all users, which actually does not meet the demand of most users, because it requires a large amount of time and effort to achieve a high ranking. It makes less sense for a learner who just wants to learn and manage Python. However, the small number of learners who ranked in the top 10% of the list are of great value in terms of product promotion. They are KOLs within the platform, who should be mentally or physically rewarded with bonus KPI, special certification or privileges to be activated as free publicity ambassador of the platform. A large number of potential users would be economically leveraged by these loyal users.

3)Badge

Badge is the best way to educate a novice to quickly figure out a growth system with complex features, because badges set clear goals for beginners, directing them where to go to push forward the storyline. First of all, in order to collect badges, users would constantly explore various activities to complete the specified tasks within the platform, then gradually develop habits. Second, the required number of completions would speed up the learning process and increase the frequency of use. Finally, the badge upgrading system gives users more room for advancement. In addition to guiding users and invisibly advancing progress, badges can also improve user experience. During the long Work-Promotion-Work loop, a "salary-

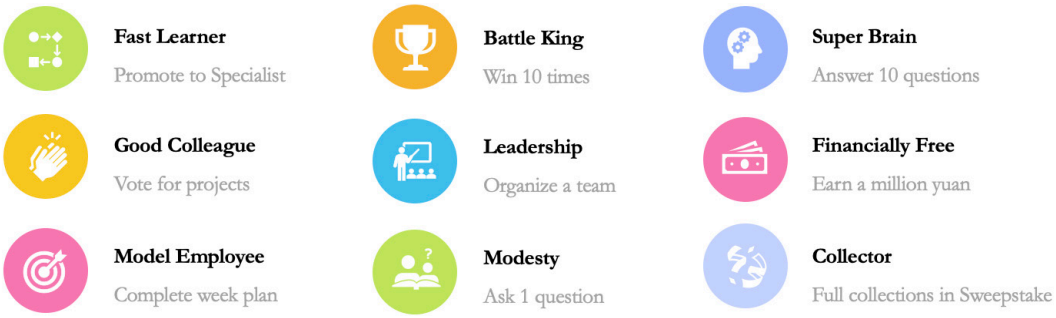

Figure 3.8 Badges

man" may feel fatigued and need fresh stimulation. A badge serves as a short-term encouragement which makes up for the sense of accomplishment that hasn't been fulfilled for a while, especially during the later stages when get promoted takes a longer time. Besides the regular badges mentioned above, hidden badges shown as question marks would greatly arouse curiosity, in which case users would spontaneously explore and share, resulting in higher user retention and acquisition.

4)Quests

Quests are presented as working tasks and given after the mentor's tutorials.

5)Boss Fight

Before stepping into the next stage, which means promotion in the story, users have to pass an assessment, that is, a more complex and comprehensive practical project.

6)Teams

Users can form teams or join in a team and create original programs collaboratively.

7)Virtual Goods Collections Unlocking

There will be a virtual currency, Salary, that can be used in sweepstakes to win, in other words, unlock office items. Users can collect items and display them in their private space. It takes time to unlock all items, and there will be hidden items every season, which could be refreshing and addictive.

8)Avatar

Users have their own work badges, including employee number, avatar, position information, and personal profiles on the private page.

3.3. User Interface Design

After completing the framework, flow, and elements design, the author designed 18 main user interfaces with Mocking Bot.

The illustrations are from unDraw[2], a open source website created by Katerina Limpitsouni. Part of the course content is referred to programming learning applications SoloLearn[3] and Mimo[4].

In this section, each page will be presented and introduced in order of operational priority, which demonstrates a clearer and detailed picture of the flow between features within the application:

- **Welcome Page**

Welcome Page gives a brief introduction of the background story and invites users to sign in. Click the purple button to enter the Registration Page. (figure 3.9)

- **Registration Page**

After filling in the basic information, users will receive an SMS verification to ensure the mobile phone number is valid. (figure 3.10)

- **Test Page**

Upon completion of registration, users directly enter the Test Page, with 5 questions to answer successively. The system will show results when the user tapping the options and automatically jump to the next question. (figure 3.11)

- **Result Page**

After the test, the system will identify the programming level of each user and generate a customized curriculum for her. For those who have learned basic knowledge, they are allowed to take the shortcut to advanced courses by skipping the fundamental classes. (figure 3.12)

2 unDraw. `https://undraw.co/illustrations`

3 SoloLearn. `https://www.sololearn.com/`

4 Mimo. `https://getmimo.com/`

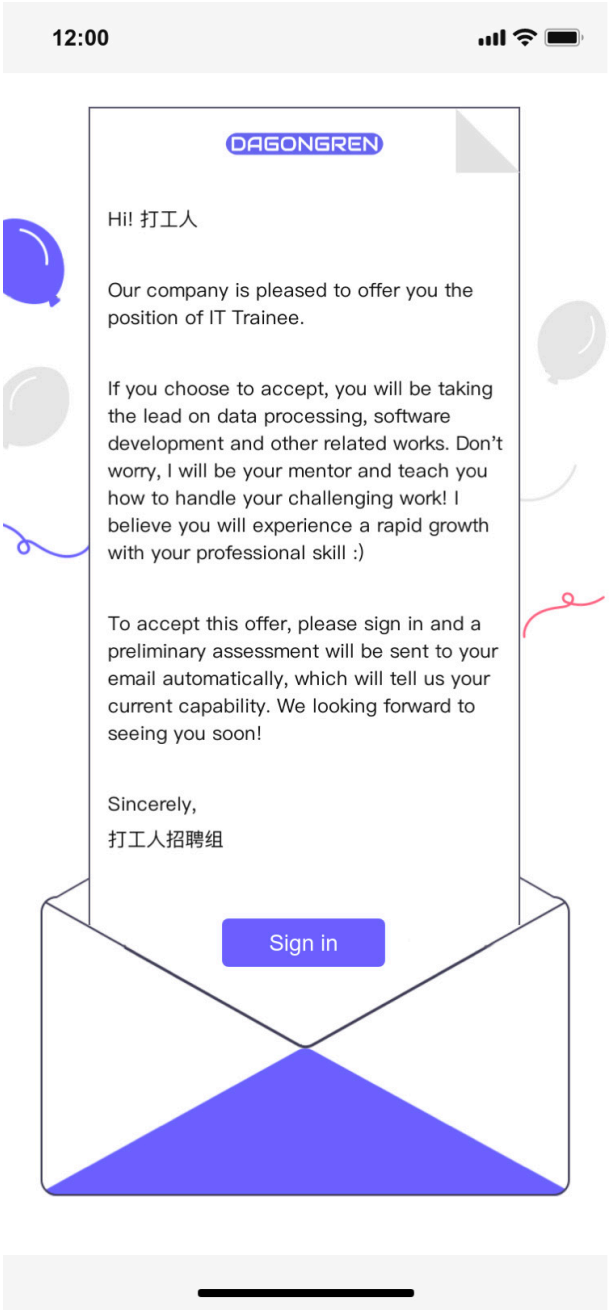

Figure 3.9 Welcome Page

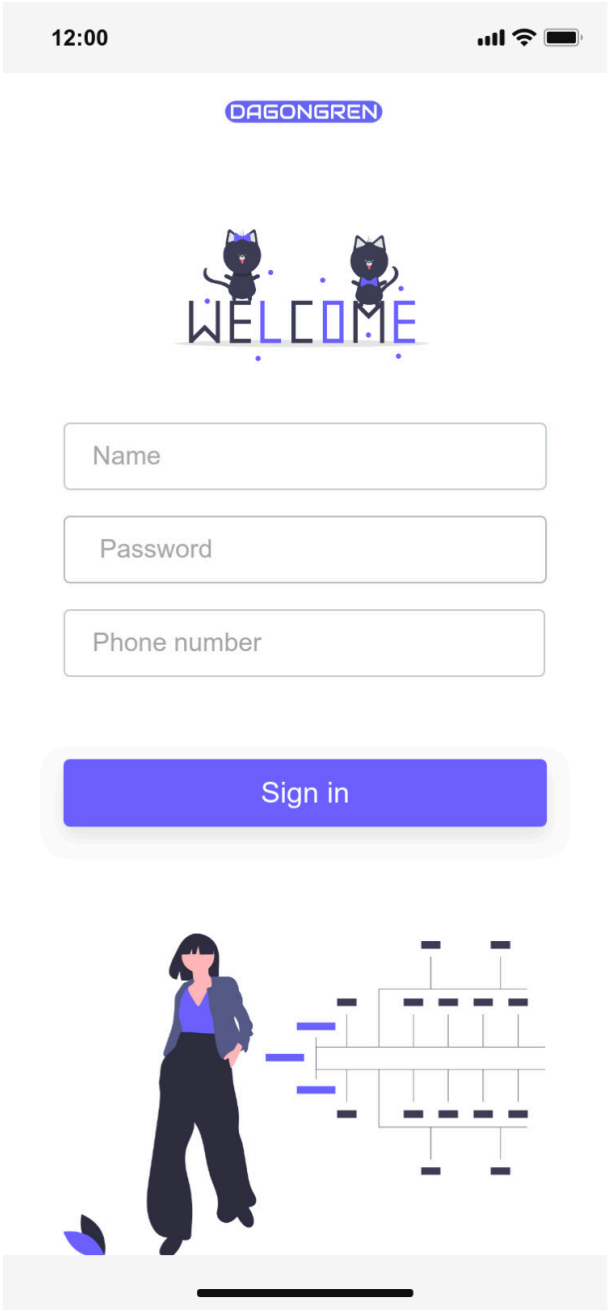

Figure 3.10 Registration Page

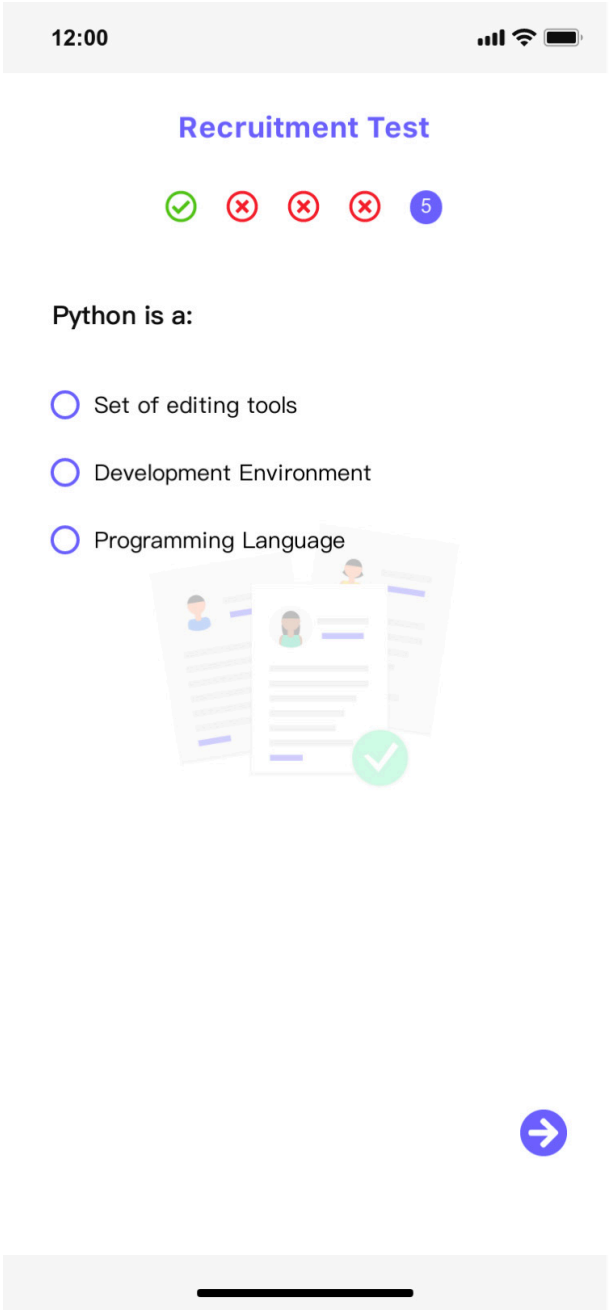

Figure 3.11 Test Page

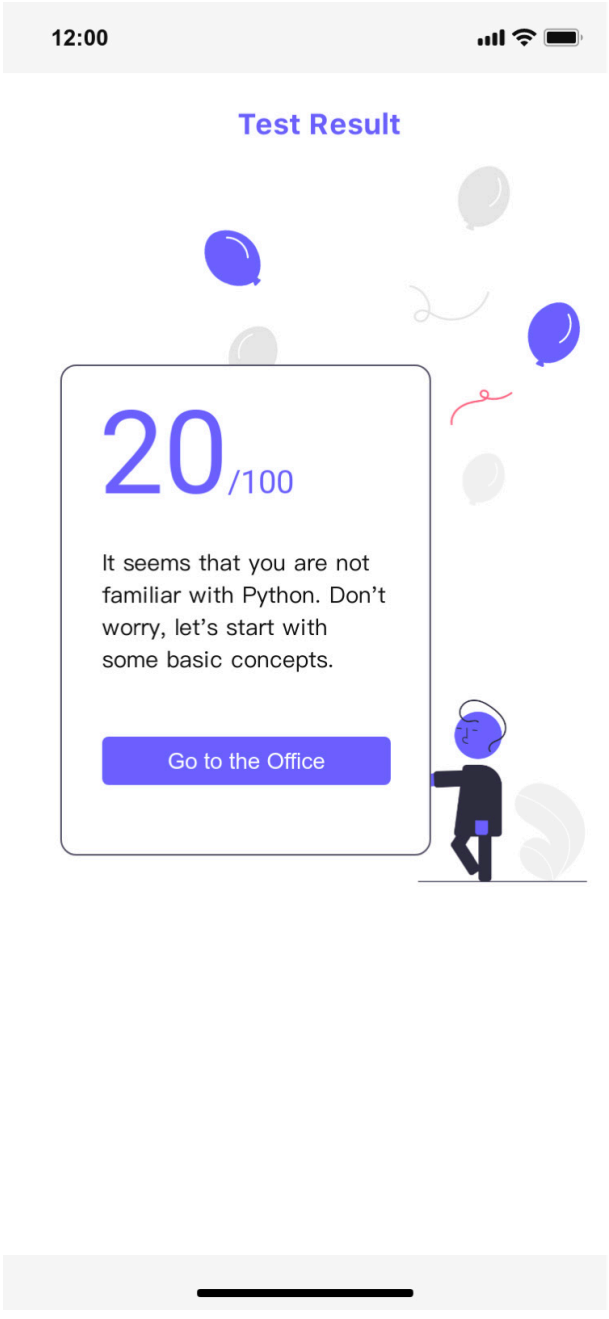

Figure 3.12 Result Page

- **Punch-in Page**

Before entering the Home Page, users have to punch-in. They can earn KPI by daily punch-in and will get bonus points after seven days, which helps users to form learning habits. This feature is expected to be served as effective supervision that many users need, reported in the survey. (figure 3.13)

- **Home Page**

Main features are included on the Home Page. On the top left of the page, users can see their level information and enter the private page by tapping the user icon. On the top right of the page displays users' KPI, the indicator related to all activities within the application. On the bottom, there lies the main menu with a learning module in the middle sided by two social features. Besides the core learning function, the author prioritizes the forum and team features to connect individual users to meet the interaction demands of users. Other additional features can be found on the top right of the curriculum. In the center, users can check the curriculum by swiping the screen vertically. For the ongoing course, users will see the title, content, duration, and rewards of the course; for learned courses, their performance was evaluated according to the 3-star rating, and they can decide whether to review the lesson one more time to improve the grade; the unstudied curriculum and projects are locked. Lastly, above the list are greeting words and days of use. (figure 3.14)

- **Course Page**

The class presents in the form of texting. A virtual mentor is going to give instructions by teaching and asking questions such as multiple choice or fill in the blank, in the middle. The system will check the answer immediately and allows users to make five mistakes at most, counted by the heart icons on the top right of the page. (figure 3.15)

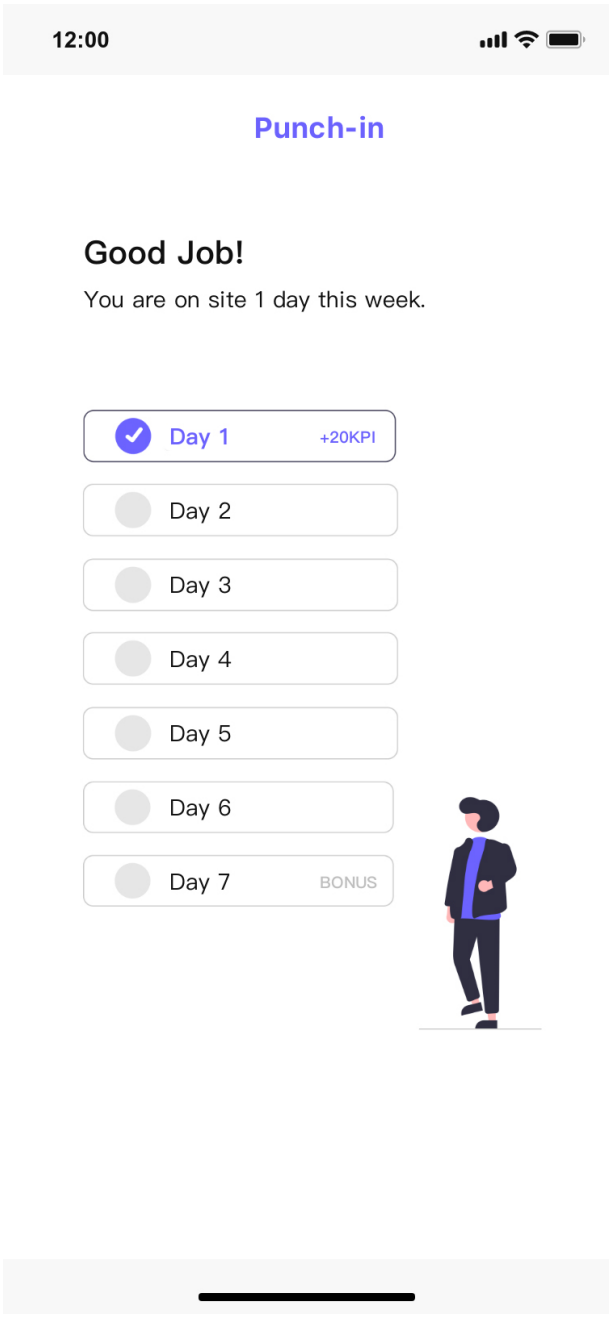

Figure 3.13 Punch-in Page

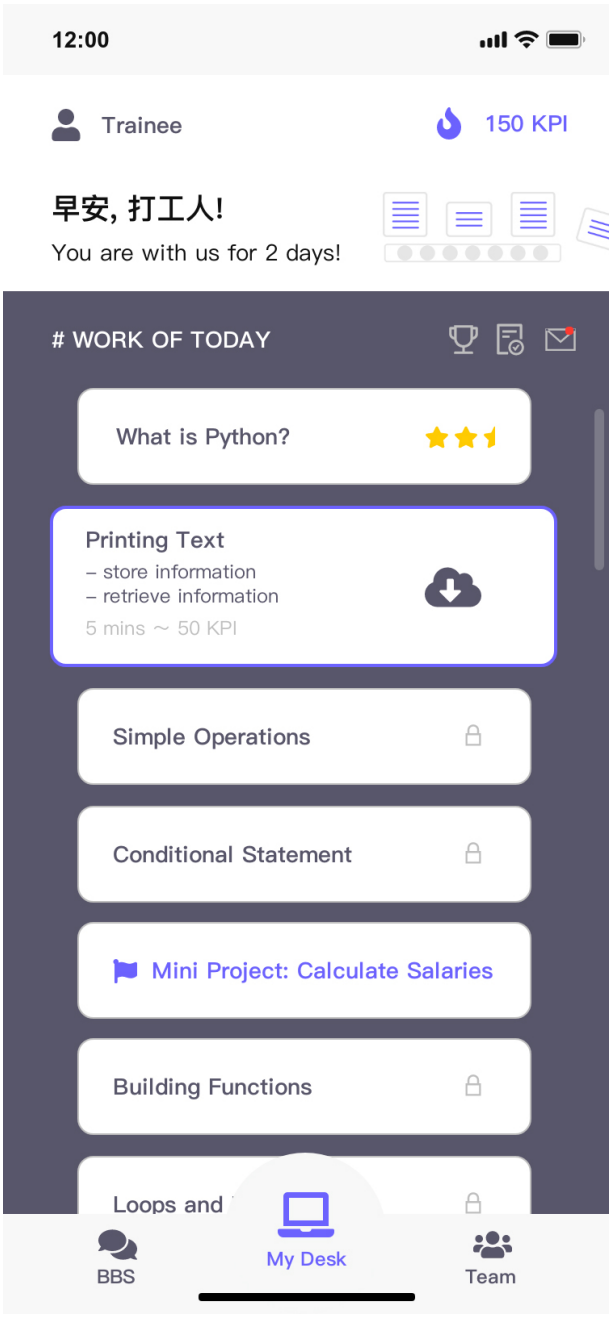

Figure 3.14 Home Page

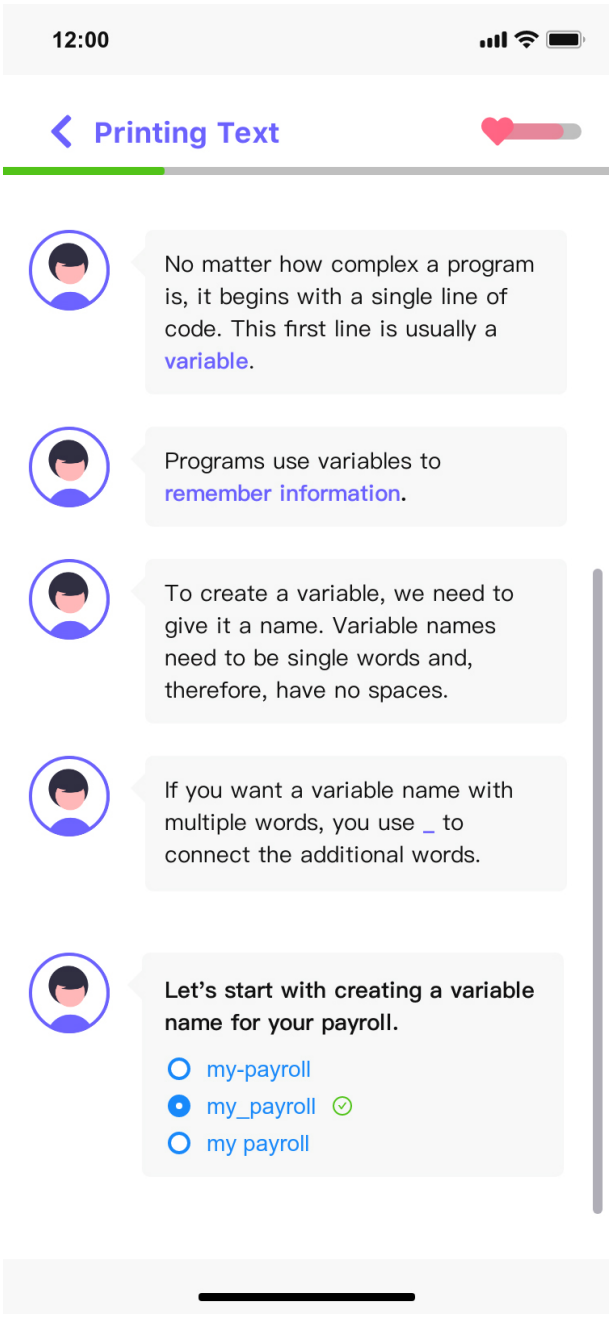

Figure 3.15 Course Page

- **Assignment & Practice Page**

At the end of each class, users will be assigned a practical task that they might encounter in the real workplace.

The application simulates the real coding environment, in which users can code directly with their phone. Swiping horizontally, users can check the original data materials and run to see results. When getting stuck, they can also exchange KPI for a hint. Above the keyboard, the left code icon indicates operators and functions and will show predictions in the bar when typing to facilitate users to code more quickly. Besides, users can clear the code and run code with the other two icons on the right. (figure 3.16 & figure 3.17)

- **BBS Page**

On BBS, users can share texts, pictures, videos, codes, and asking questions. When a code file is shared, it will present as a link leading to the simulated coding environment, where users can check the code and play with it. When posting a question, users can attach keywords to it to make it easier for searching and reviewing by others. After receiving useful answers, the user could turn the question into “Solved” status. Besides, users can leave comments on, forward, or vote for a post. Different from traditional reverse chronological order, the new order approach, based on the number of votes, is adopted here to help users screen high-quality contents and encourage them to produce more valuable contents. Users can also search for specific contents with the searching bar. (figure 3.18)

- **Team Page**

More intensive interactions can be achieved by building a team with other users to work on a big project. Team feature provides powerful project management tools including planning with Outline, setting schedules with Timeline, monitoring status of every step with Progress, and open shared files with Project. It allows users to join in one project at a time. By tapping the avatars of other team members who are online, users can individually chat with them. (figure 3.19)

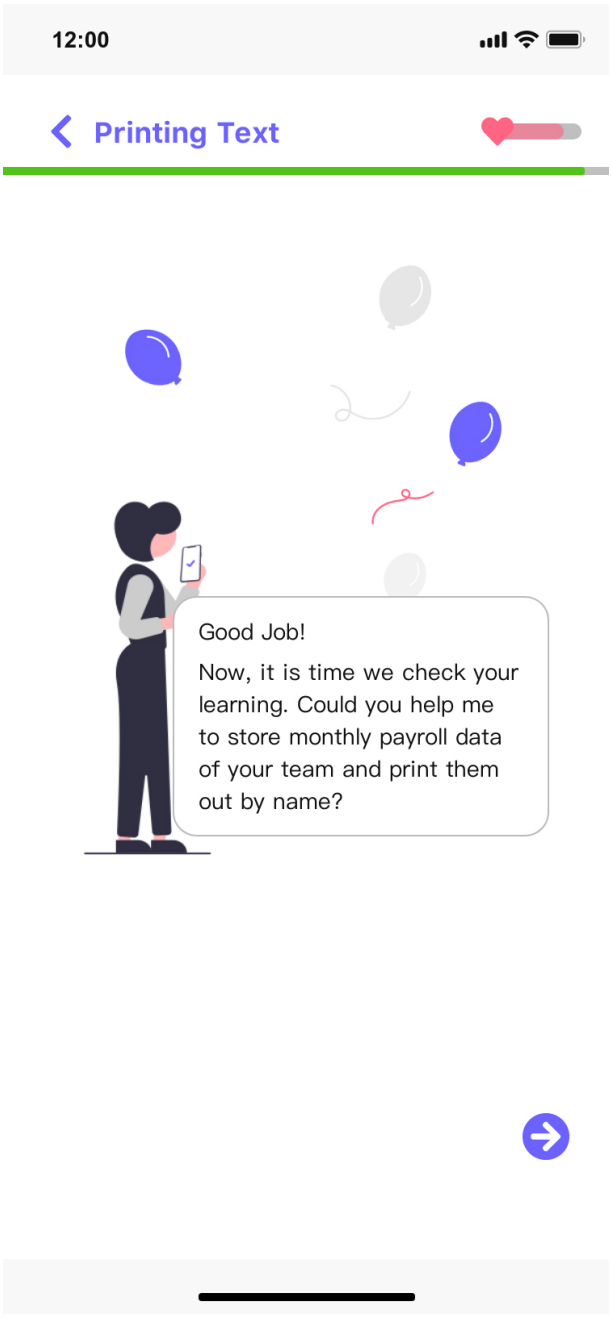

Figure 3.16 Assignment Page

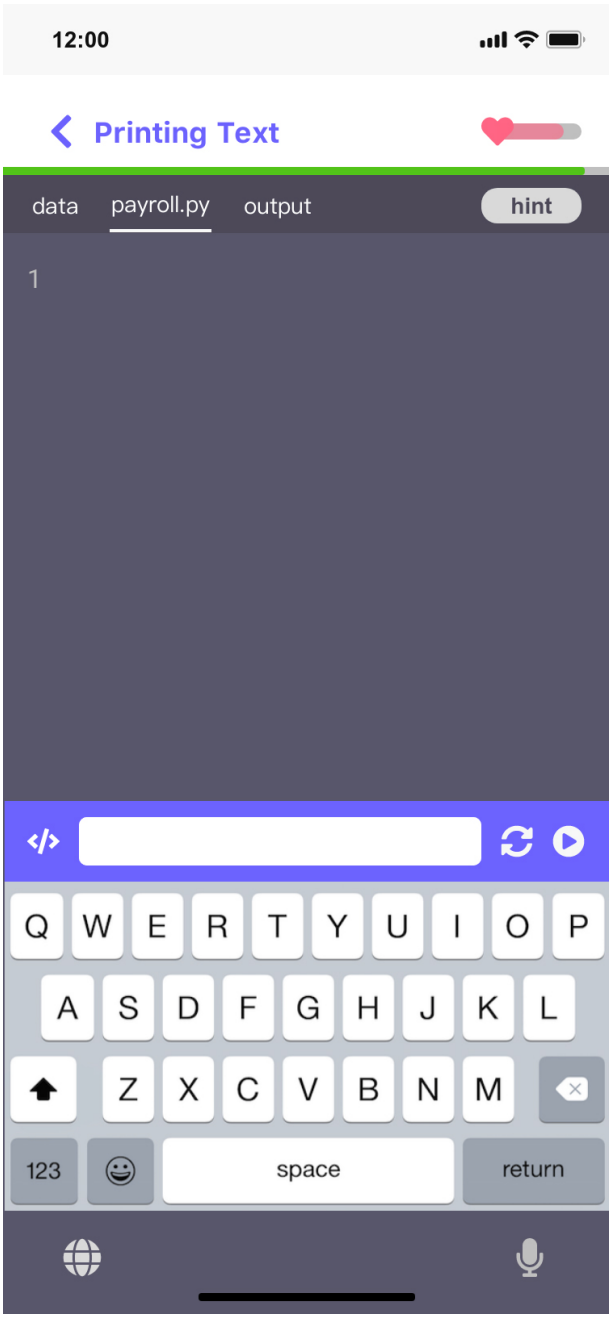

Figure 3.17 Practice Page

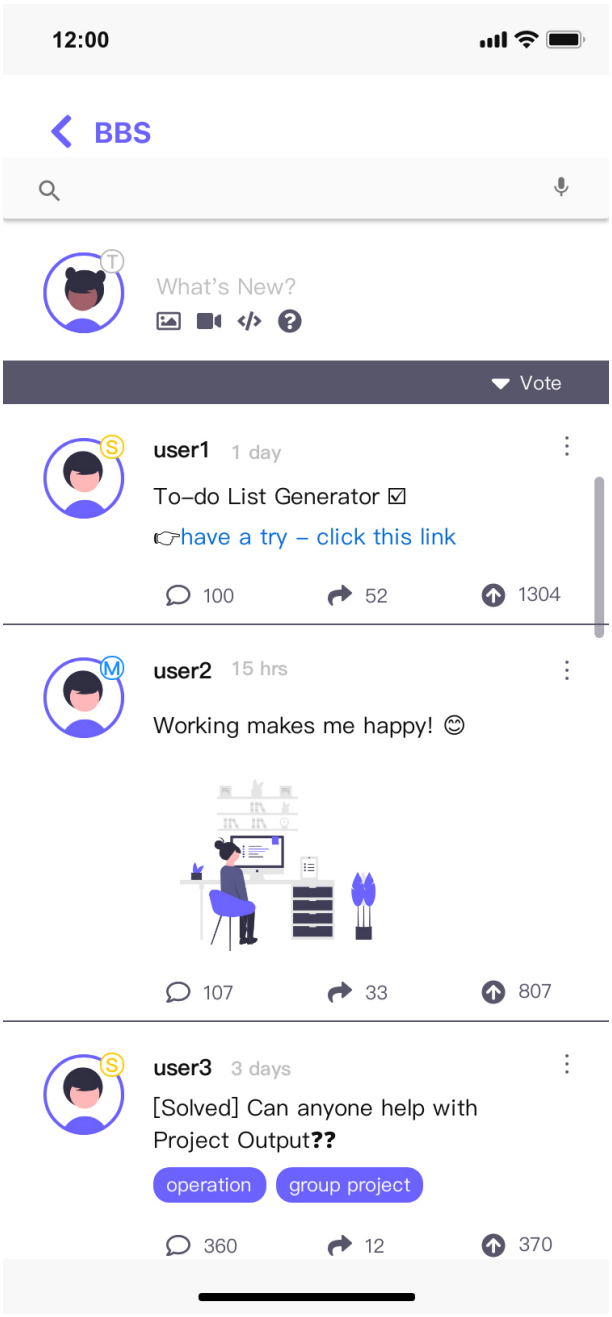

Figure 3.18 BBS Page

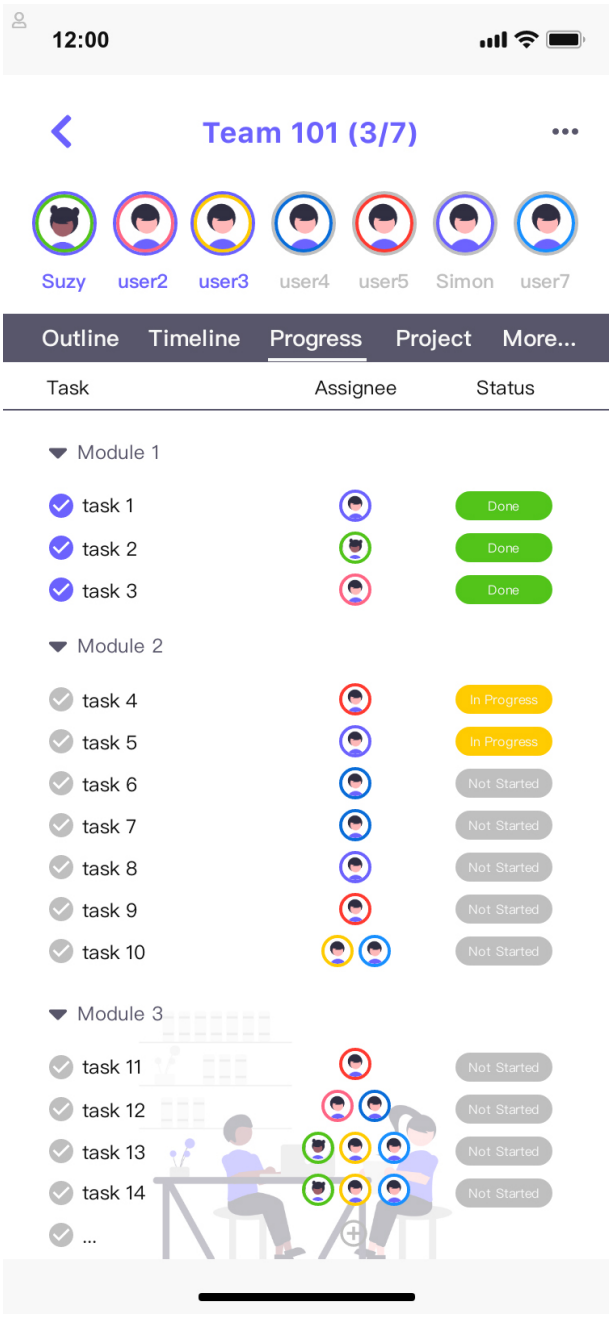

Figure 3.19 Team Page

- **Battle Page**

Battle simulates the scenario when one competes with her colleague for a critical project. They have to prove their capability to the leader by answering several questions. On this page, users are automatically matched with a random opponent, but they are allowed to change the opponent or invite a friend if they want. In one round, there will be 10 multiple choices or fill in the blanks, which can be done in minutes that could be addictive. (figure 3.20)

- **Achievement Page**

In the Achievement library, users lighten the greyed icons through completing specific tasks, which require them to use all features several times. (figure 3.21)

- **Message Page**

The same as other messaging apps, the instant message feature supports individual and group chat. Users can also find official accounts in the chat list, where they can not only receive official notifications but also contact customer service. (figure 3.22)

- **Chat Page**

On the chat page, users can send text, stickers, and files including pictures, videos and other files. (figure 3.23)

- **Private Page**

Private Zone contains personal profile, achievements, and point system. Users can edit profiles on this page, as well as see the information of level, KPI, number of wins, badges, and number of flags completed. There are some additional functions such as Note, where users can review what they have learned, Flag, which is the weekly goals set by the user themselves and the ranking. As for the point system, users can check their KPI, which turns to weekly Salary, and use salary in Sweepstake to win Collections of office items that can be used to decorate the desk displayed in the center of the private page. (figure 3.24)

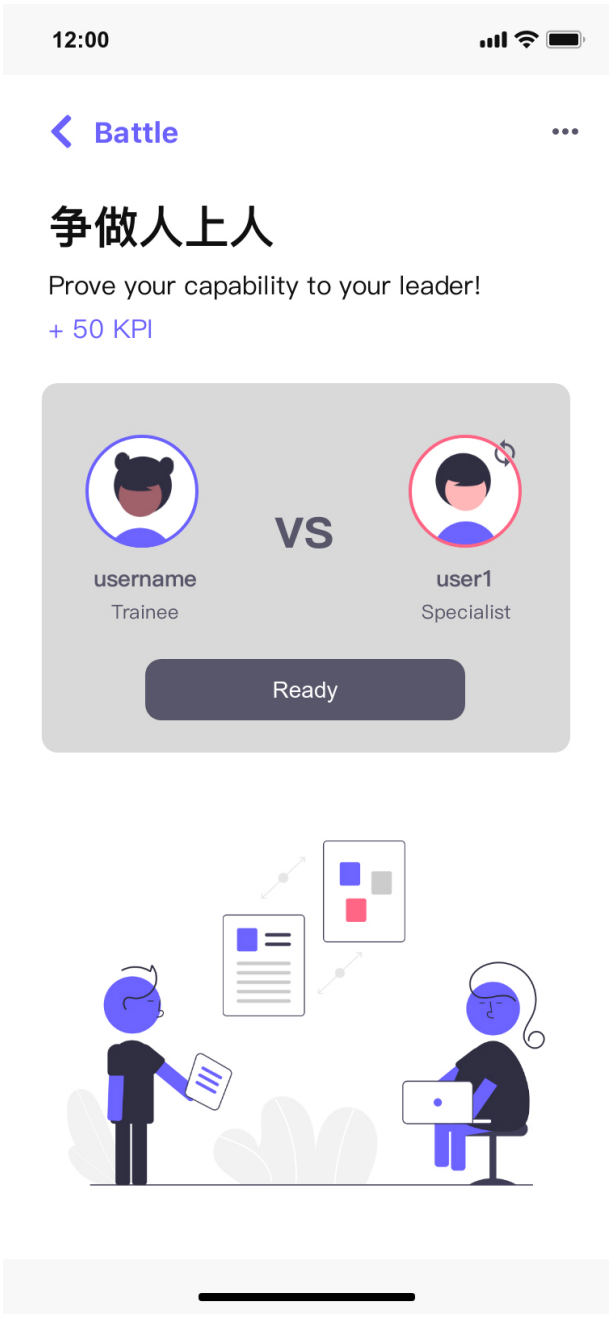

Figure 3.20 Battle Page

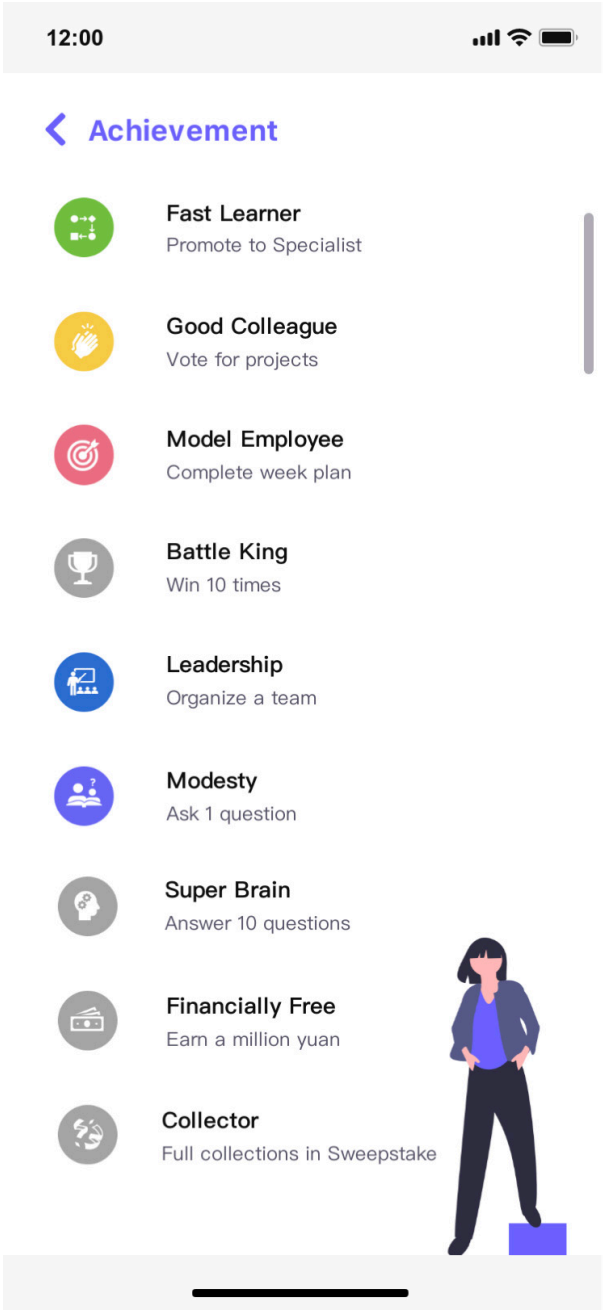

Figure 3.21 Achievement Page

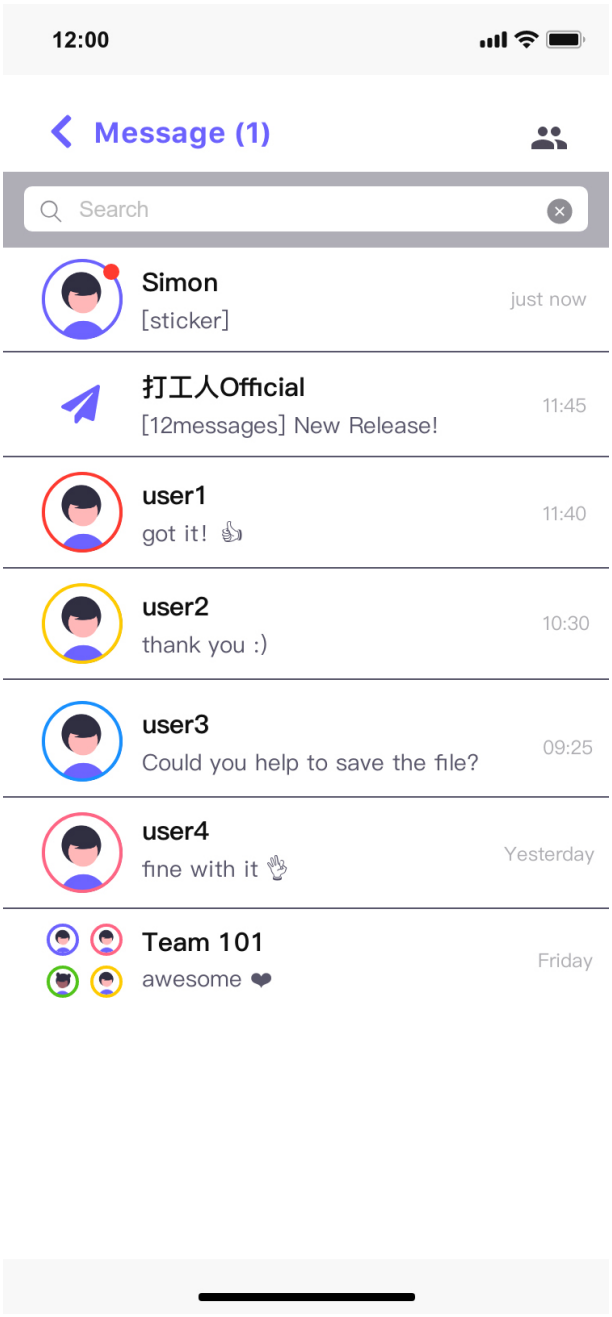

Figure 3.22 Message Page

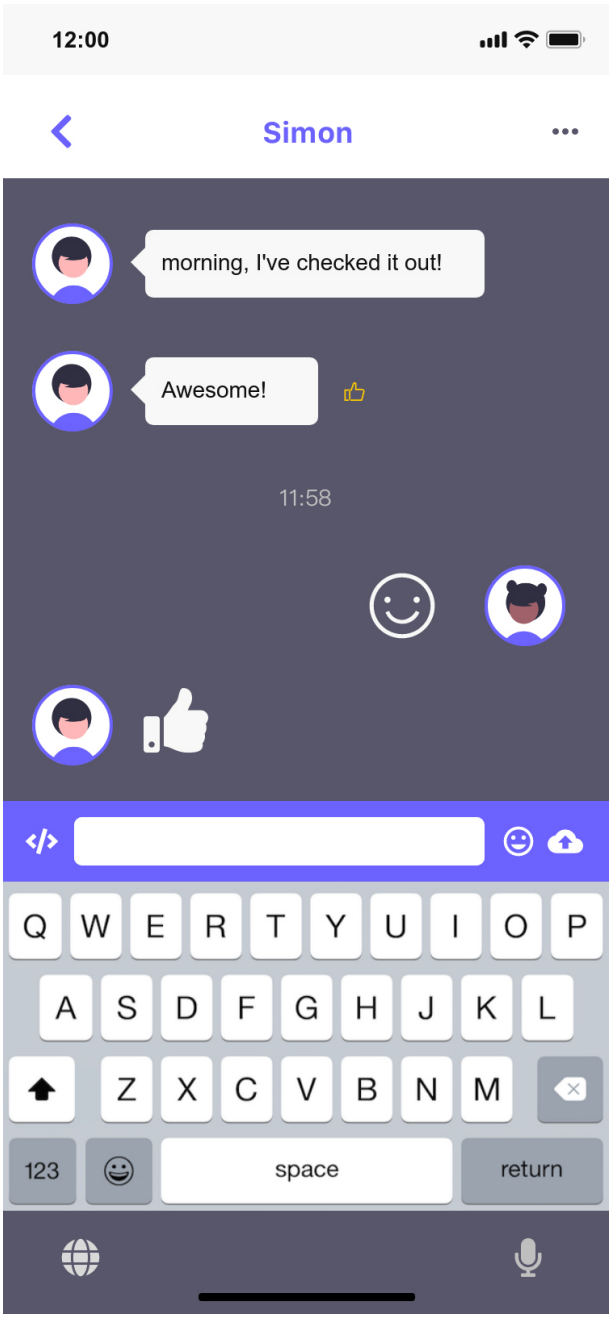

Figure 3.23 Chat Page

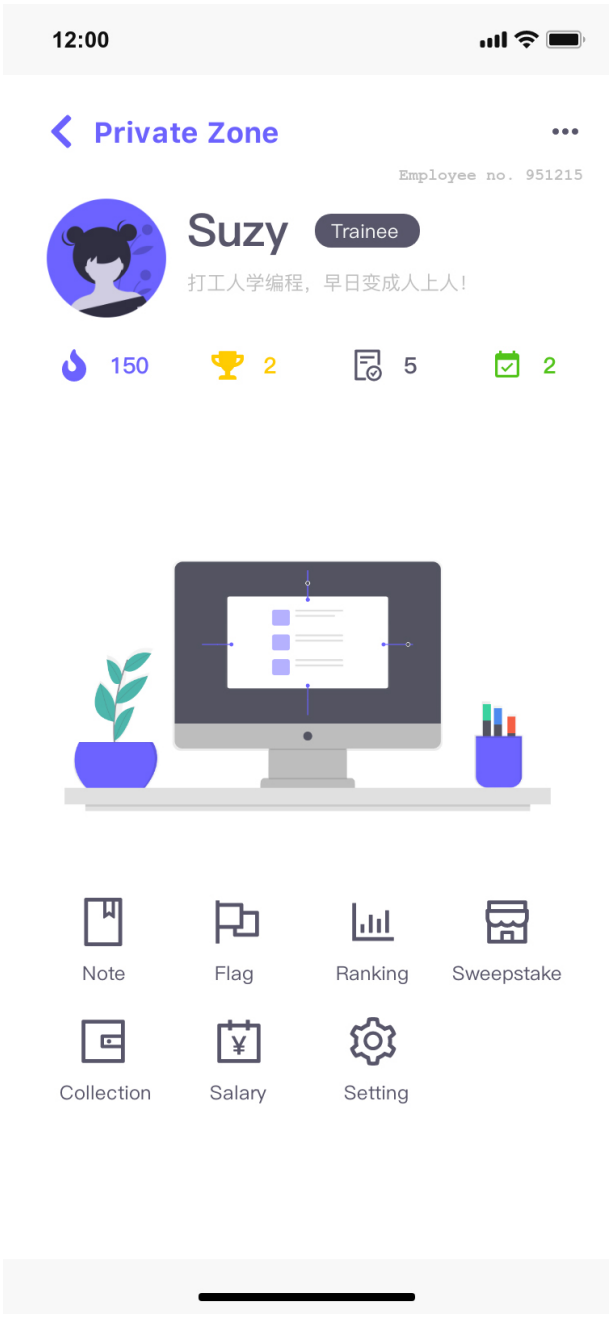

Figure 3.24 Private Page

- **Ranking Page**

Swiping horizontally to see Peer Ranking, Regional Ranking, and Global Ranking. The ranking will be updated by the end of every week. Hard-working users can win special badges and Annual Best Employee Awards. (figure 3.25)

- **Sweepstake Page**

Tap the box to open the gift with 200 yuan. On this page, users know how much money they have in the account and how many boxes they have opened. The text below reminds them to be careful with their balance. (figure 3.26)

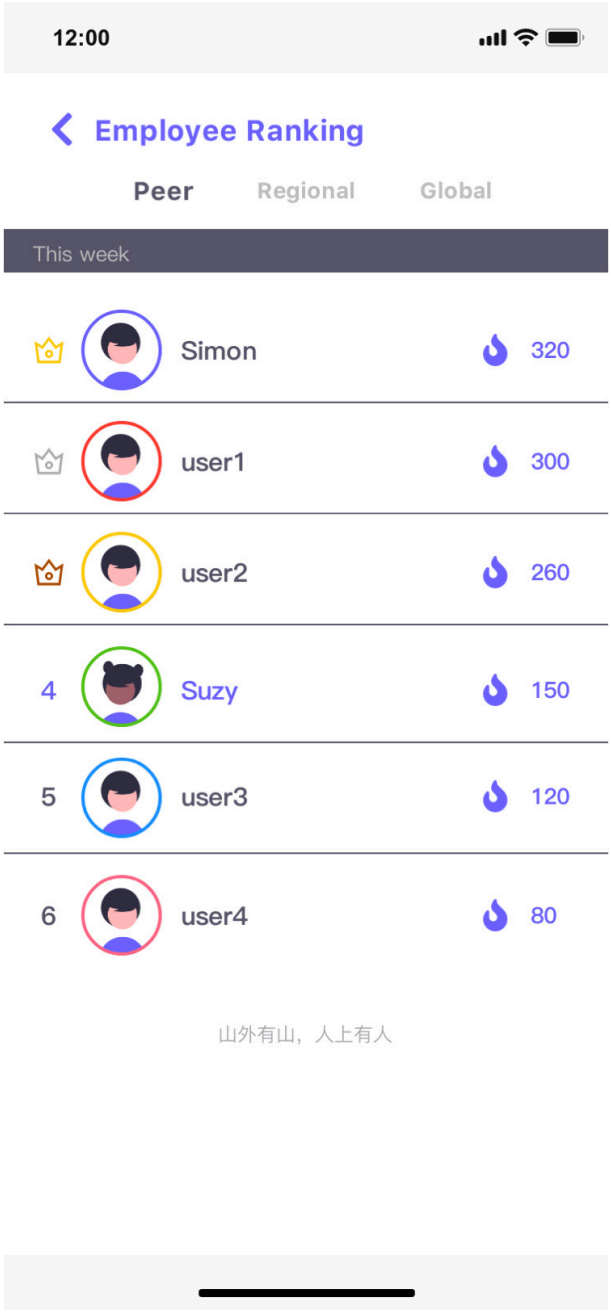

Figure 3.25 Ranking Page

Figure 3.26 Sweepstake Page

Chapter 4
Evaluation

In this chapter, qualitative analysis and quantitative analysis are adopted to verify the usability and effectiveness of the design.

In the qualitative analysis, three target users were invited to participate in usability testing to use the application and share their experiences and perspectives. Before evaluation, the author interviewed them respectively to verify that they have the intention to learn programming, thus they are likely to give honest feedback and put forward constructive suggestions on the product. Then, in the usability tests, the participants were told to explore the application freely; meanwhile, the author observed their operation paths and whether they had any problem with the operation. After each trial, the author conducted a semi-structured interview with the participant to collect their opinions and feelings such as whether they felt fun and motivated by the gamification design and whether they are willing to learn programming with such an innovative approach. In the end, the participants also proposed their ideas for improvement, which were adopted in the modified pages.

In the quantitative analysis, sixteen target users were divided into two groups for a/b testing. Two versions of learning materials with the same content were shown to users at random: one was similar to the paragraphs and exercises in traditional textbooks, and the other was to simulate real-time chat with a virtual mentor conducted via online meeting software. The data of duration and accuracy were tracked respectively to prove the learning efficiency of the design. Users were also surveyed after the experiments on their subjective views on the learning mode.

4.1. Usability Testing

4.1.1 Persona

First of all, the author collected basic information of the three participants, including personal information, usage scenarios, expectations, motivations, and frustrations.

Zhang is a graduate student majoring in Finance, living in Nanchang, Jiangxi Province, China. She would like to learn Python to do quantitative investment and mine data. She is busy with school work, so she hopes to use the fragmented time to learn programming. Her learning goal is so clear that she hopes that the learning content is customized to help her apply what she has learned. She is easily demotivated by failure, therefore, she expects the application to include a certain incentive mechanism and social features. Wordy concepts make her feel pressured.

Xue is a commercial executive with a year and a half working experience in the field of international trade, living in Tianjin, China. She has no clear learning goals but wants to improve her competence in the workplace through learning programming. She hopes that she can continue to create various projects along the learning process, so that she can not only have an idea about the practical significance of programming but also increase the sense of accomplishment. She also hopes that the course could be entertaining and interactive. She is worried that her enthusiasm would soon disappear, so she needs supervision to encourage her to keep learning. In addition to the regular point system and daily punch-in, she expects a surprising bonus.

Yuan is a data analyst with one-year of working experience in the field of the Internet, living in Beijing, China. She has no experience in programming, but she has to frequently communicate with developers at work. She would like to learn some basic knowledge of Python to facilitate data analyses and improve collaboration efficiency with colleagues. She hopes that the platform would allow her to discuss codes with other learners forming a positive learning and community atmosphere; help her to filter study partners with similar backgrounds to work on projects together; provide different project options so as to meet her customized needs. Long lecture videos and advertisements are annoying to her.

In summary, when asked what kind of programming learning platform they are expecting, they expressed their concerns for “practicality”, “stimulation”, “supervision”, “interaction” and “customization”. In contrast, they would be demotivated by the “single-student” learning environment, abstruse concepts, impractical knowledge, and traditional classroom without encouraging incentives.

4.1.2 Operation

After the preliminary interview, the author asked the participants to freely explore the product and observed their actual operation in order to evaluate the usability of the product. The operation paths of the participants are basically the same, which can be traced as the following route:

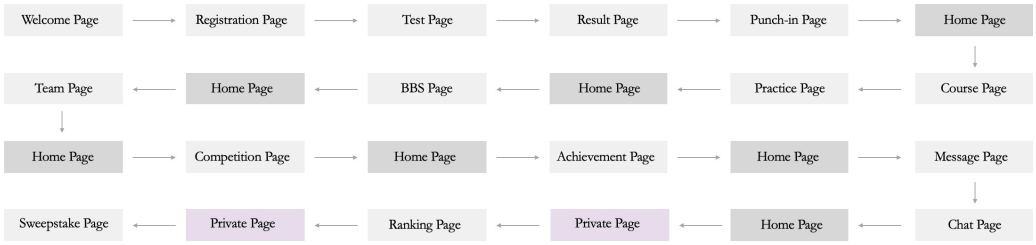

Figure 4.1 Operation Path of Participants

This result is consistent with the author’s original design intention. After completing the registration and capability test, users firstly need to “punch-in” and then arrive at the home page. Because this is a platform that combines learning and socializing, the bottom menu of the home page has the study page in the middle, flanked by the other two social functions: BBS and Team. Therefore, the curriculum directly attracted participants’ attention at the first glance. They explored the learning process and practice fluently. After returning to the home Page, they visited the BBS and Team Project successively from left to right. After finishing the main menu, they noticed three small icons at the top right of the curriculum which leads them to Battle, Achievement, and Messages, from left to right as well. They discovered Private Zone finally. All participants recalled

that they noticed the icon at the very beginning but were soon attracted by the courses. It seems that users are accustomed to the existence of the personal page on any application, thus they have little curiosity about it. In the usability test, the participants experienced no obvious operational difficulties. All the functions are quickly discovered and explored in order of priority.

4.1.3 Feedback

The author collected feedback from the participants immediately after the usability test to gather their most intuitive and complete views and feelings. They were asked to share their feelings from three perspectives: visual design, functional design, and emotional design.

Visual Design

- **The user interface looks adorable.**

Participants agreed that the tone and overall style are lovely, and the color looks smart and professional. Compared to the design of other programming learning platforms that are most oppressive and technological, this application makes them feel relaxed both visually and psychologically.

- **The instructions are clear.**

The interface is simple and clean so that they know where to go next according to the theme color. Xue indicated that the function button distribution is reasonable with priorities: “ *The icons are well-chosen, I easily understand what they mean.”*

Functional Design

- **Customized course based on the result of the test is helpful.**

Zhang and Xue agreed that, for experienced learners, through the entry test, they can locate their current programming level and attend courses tailored to their needs, so that they can skip the basics, which would save a lot of time.

- **The learning-and-practicing mode provides instant self-examination.**

For the participants, the biggest fear is that they think programming is too hard to master. Through learning-and-practicing mode, they can immediately examine whether they have fully understood a certain concept and know where they make a mistake, step by step, from easy to difficult, from simple to complex.

In addition, according to Zhang and Yuan, this method helps them effectively solve the time conflict. They can pick up their mobile phones anytime and anywhere to study and practice without too much burden, unlike the traditional long lectures.

- **The practical projects highlight the meaning of learning programming.**

Three participants expressed an expectation for practicality before the test. They were afraid of wasting time on something impractical at work, as Xue emphasized that there was always a gap between what have learned and what to be done in real-life practice. They all agreed that the simulated project based on real work scenarios is both meaningful and interesting.

- **The positive atmosphere of the community is an effective motivation for learning.**

Social features were highly appreciated as a distinctive characteristic of the application. Xue said: " *The traditional video course brings a lot of difficulties for me, so I think it is necessary to have such features on the self-learning platform. I can get timely help when I encounter problems, and at the same time I can see other learners share their experiences and progress.* "

" *By communicating with other learners on the forum, problems can be solved quickly, otherwise it could be frustrating for me.* " Zhang added.

Yuan shared her online learning experience that when she studies by herself, she quickly loses patience and interest if she has no friends to discuss with: " *I need friends to make progress together and we motivate each other to keep the passion to go further.* " She also mentioned that " *the VOTE function is very innovative, which helps me to automatically screen high-quality content.* "

- **Forming teams helps users make new friends and improve competence.**

" *Team is one of my favorite features.* " said Zhang, " *It enables me to find like-minded study partners, who can supervise and encourage me, and let me know the charm of team cooperation because team spirit is a very admirable merit, which requires that we should not only think about ourselves. Our leadership, coordination, and management capabilities can also be enhanced through teamwork.* "

Yuan agreed that for someone who has no programming background like her, this feature gives her opportunities to work on challenging projects with experienced teammates. Considering the platform conversion rate, users are likely to invite their friends to work on a project together on the application. Therefore, this is also a good design in terms of user acquisition. She added that she can also meet people with the same hobbies, which satisfies her social needs.

- **Battle feature makes good use of fragmented time to consolidate what has learned.**

Zhang and Xue agreed that the competition enables them to consolidate knowledge while competing with others. It is motivating for them because they have to learn more and practice more to get more wins to earn additional KPI.

" *A game takes minutes but contains a couple of questions. It is very efficient and convenient for a busy employee like me to review the knowledge.*" Yuan added.

- **Achievements and Sweepstakes will increase the frequency of use and enhance platform stickiness.**

Xue expressed her love for the ideas: " *Achievement icon and sweepstakes perfectly fit the young females' taste. I believe many girls enjoy collecting good-looking well-designed items, such as virtual clothes in Nikki, characters in Onmyoji, and decorations in Animal Restaurant. It is critical that the items are collected for a certain use. Travel frog, for me, is a case of failure. In the beginning, I was attracted by the adorable visual design, but I soon realized that it was meaningless to collect the useless items. However, in this application, I collect the office items in order to decorate my own desk. I would be very satisfied to earn them, play with them, and show them off to friends. In addition, it provides a private zone for me, thus it becomes more than a place to learn.* "

Moreover, Yuan believed that everyone likes making money and shopping, and the KPI-salary-sweepstake cycle reflects the reality, which makes it engaging and

addictive.

Emotional Design

Zhang recalled that online courses usually took a long period of time, during which she was easily distracted, and learning efficiency was low. There was little interaction as well. This application opened up a new approach to learn online, in which the progression, competition, and collaboration make her feel that learning is as easy and fun as playing a game.

Xue thought it makes sense for her because combined with the background story, it simulates a lot of real application scenarios. " *The designer has a deep understanding of the target market segment, and a good grasp of young females' preferences in both visual and stimulation design.* " As an experienced simulation game player, she found the application helpful and attractive, especially the feature of desk decoration. " *I can' t wait to put a cup of hot bubble tea on my desk in the winter.* " she said excitedly.

Yuan also gave positive comments: " *Different from traditional video classes, the design of the simulated workplace is very fresh to me. It is of great practical significance. I can imagine that I would strive for KPI and make money on the platform just as what I do in real life. If this application is launched in the app store, I would definitely download and use it.* "

Overall Review

Participants reviewed their previous expectations and frustrations, and measured to what degree the application met their needs and overcome their worries with a 5-point Likert scale. The results indicated that the application met their expectations and avoided frustrations to a great extent. (figure4.2)

4.1.4 Improvement

Finally, the author discussed with three participants the drawbacks of the application as well as the solutions, summarized is as follows:

1) Customized Appearance

- Display Light color in the daytime and shift to Dark color after sunset;

To what extent does it meet your expectations?	Average
Learn from the scratch	5
No time restriction	5
Motivating that makes me want to continue without frustration	4
Can coding on my own while learning	5
Make clear what work can be done with the language	5
Entertaining projects	4
Solve problems in time	4
Have interactive features, such as forum for solving problems and discussion	5
Personalized content, segmented scenarios for different kind of work	3

To what extent does it avoid your frustration?	Average
Too much to remember	3
No basic computing knowledge	5
Takes too much time	5
Not practical	5
No incentives and adequate supervision	4
Plain progress without fun or surprising bonus	5
No interactions	4
Too hard to understand	5
Annoying advertisement	5

Figure 4.2 Review of Expectations and Frustrations

- Add festival limited appearance.

2) Customized project

- During registration, users' professional fields, and learning objectives are collected, so that different types of practical projects are customized according to their demands, such as data-analysis-oriented, machine-learning-oriented projects.

3) Enhance the connection between virtual and real world

- Form an alliance based on users' school and company, so that users can find more learning partners in real life, enhance the sense of belonging, and bridge the online and offline scenarios;
- Utilize word-of-mouth mechanism to win more new users for the platform;
- Recommend similar users, such as alumni, colleagues, etc.

4) Supervise each other

- User can catch friends that haven't punched in for 3 days and take a certain amount of KPI of them, in which way users will log in regularly to prevent their KPI from taking by others.

5) Too much content on home page

- Separate the course list into a solo page;
- Display user's personalized office desk on the Home page, showing their badges and office decorations that satisfy their sense of accomplishment;
- Move the “message” icon to the Private page.

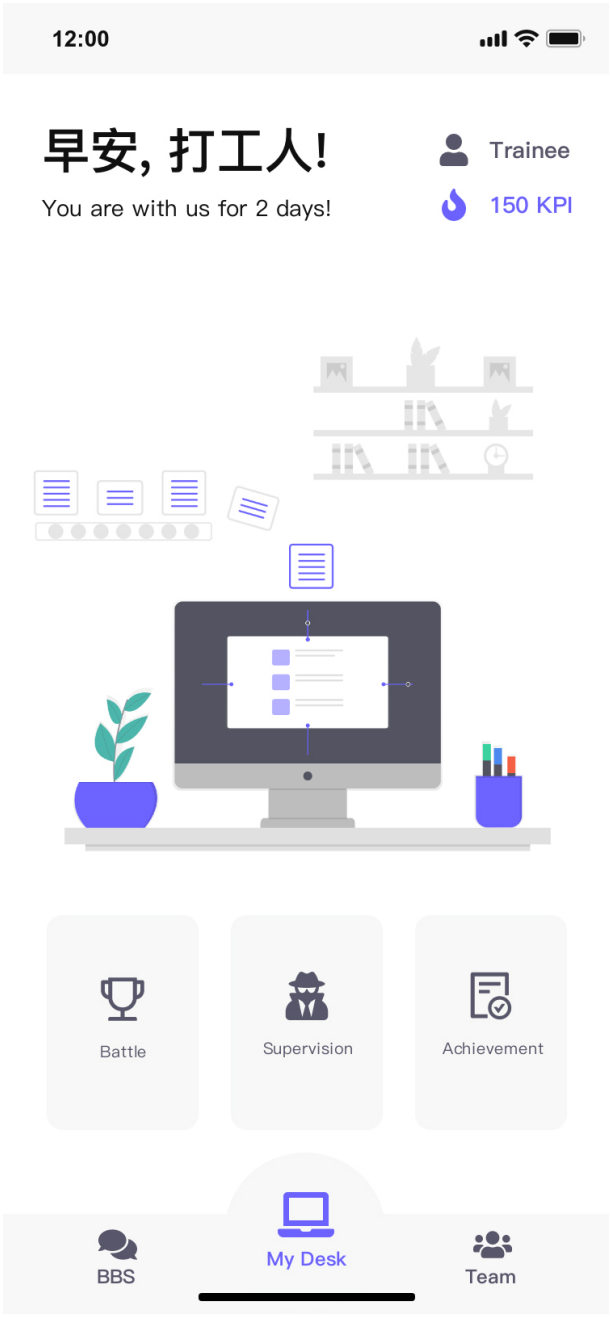

Figure 4.3 Home Page (Modified)

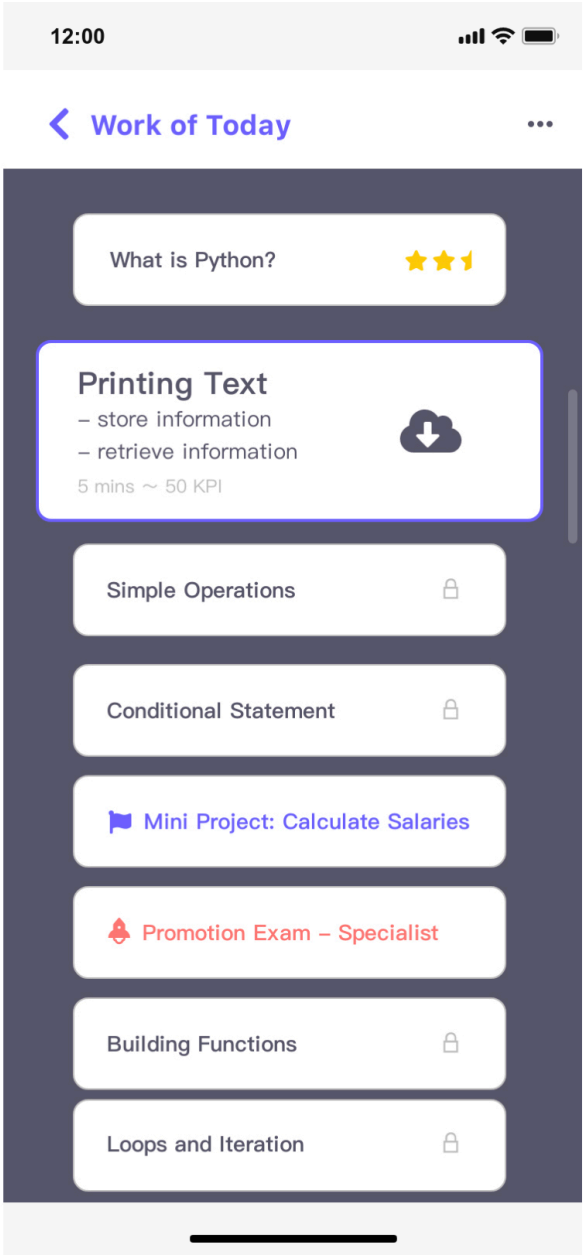

Figure 4.4 Curriculum Page (Added)

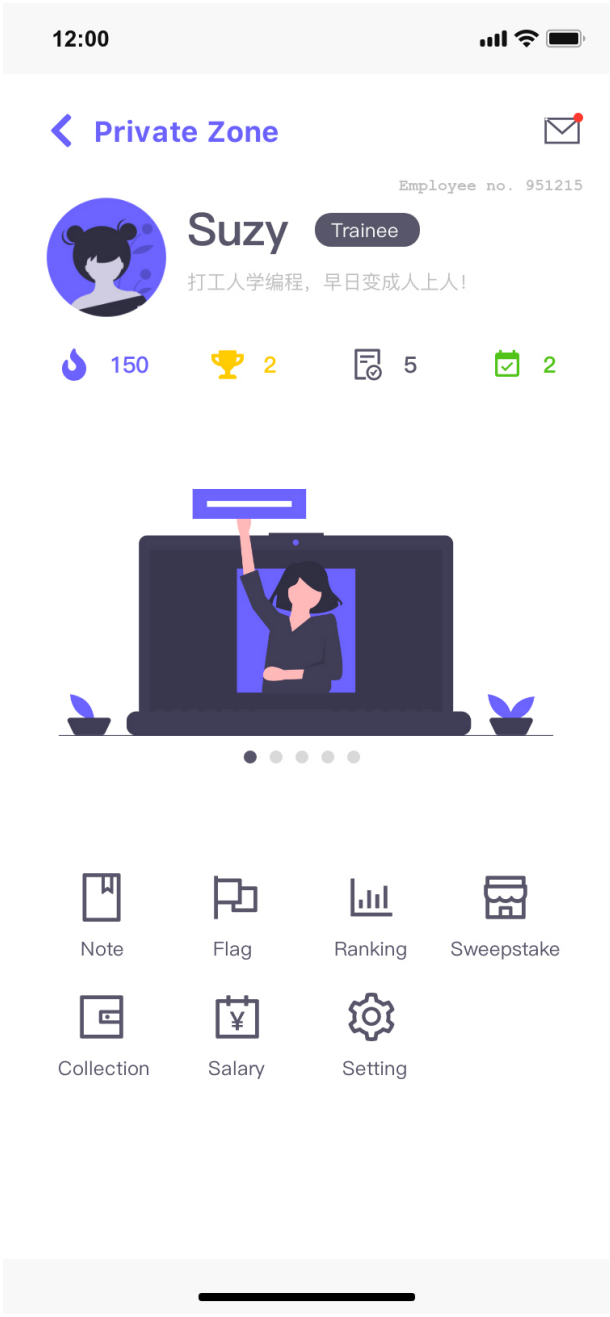

Figure 4.5 Private Page (Modified)

4.2. A/B Testing

For the teaching part, the author conducted an a/b testing to measure user learning efficiency and satisfaction via WeChat, Voov Meeting, and Zoom. In the experiment, 16 target users without Python experience were randomly served with two versions of Python learning materials and questions. The five prepared questions range from easy to difficult. The first four correspond to four different concepts, and the last one examines the comprehensive application of all concepts learned by users. The participants are provided with the same basic python knowledge presented in two different approaches: one is traditional text and quizzes, the other is personified text leading to each question. For the control group, the approach is similar to self-study by reading textbooks, users were told to learn and digest by themselves, to identify the related key points when solving quizzes and figure out errors without instant help. For the experimental group, users followed the guidance and instructions of a virtual mentor in the form of a simulated instant chat, in which users are expected to be more concentrated, digest and apply knowledge in time, run and examine their code in a simulated programming environment.

The author measures the learning efficiency by tracking on time for study and completing quizzes respectively, as well as accuracy; the participants' feedback is collected through questionnaires to measure user satisfaction. It can be seen from the chart (figure 4.6) that, compared with the traditional textbook learning mode, it took a much shorter time for learners to complete the experiments with higher accuracy when experiencing a gamified learning approach with a background story, an interactive conversation and quests. Learners in the experimental group took an average of 38 minutes to complete the whole experiment, while those in the control group spent about 11 minutes more to finish. Users in the experimental group took an average of 5 minutes more on the learning part compared to the control group, which can be explained for the following two reasons. On the one hand, for the experimental group, the concepts are linked with introductory and guiding words that would take a few minutes to read; on the other hand, the learning pace is subjected to the conversation flow, so that users need to make sure they understand the knowledge before they can progress to the interspersed questions. Thanks to the engaging “working guidance and tasks”, the experimental group

spent about 16 minutes less completing the 5 quizzes, within which 4.375 questions were correctly answered on average. In contrast, users in the control group not only spent more time answering the questions, but they could hardly get the answers right, with an average of 1.375 questions correctly answered. (figure 4.7)

Experimental Group

User	Total Duaration/sec	Study Duration/sec	Quiz Duration/sec	Accuracy	Difficulty	Interestingness	Willingness to Continue
user1-1	2460	1254	1206	80%	2	4	5
user1-2	1440	934	506	100%	1	5	5
user1-3	3300	2220	1080	80%	4	4	5
user1-4	2520	2070	450	100%	3	5	4
user1-5	1680	1083	597	100%	2	4	5
user1-6	2040	1221	819	100%	1	5	5
user1-7	3000	2222	778	40%	2	3	5
user1-8	1800	1303	497	100%	3	5	5
Average	2280	1538.375	741.625	88%	2.25	4.375	4.875

Control Group

User	Total Duaration/sec	Study Duration/sec	Quiz Duration/sec	Accuracy	Difficulty	Interestingness	Willingness to Continue
user2-1	2700	687	2013	20%	4	3	3
user2-2	2400	1060	1340	20%	5	3	2
user2-3	2520	1834	686	40%	4	4	3
user2-4	2280	970	1310	20%	3	2	1
user2-5	4080	1507	2573	20%	4	3	3
user2-6	3360	2177	1183	60%	5	4	3
user2-7	4200	490	3710	20%	4	3	3
user2-8	2160	995	1165	20%	5	4	4
Average	2962.5	1215	1747.5	28%	4.25	3.25	2.75

Figure 4.6 A/B Testing Result

Based on the quiz answers and feedback given by learners of the control group, there are 5 main problems summarized as follows:

1. After reading the material once, they thought they already understood, but when facing a quiz they had no idea how to apply the knowledge to solve an actual problem;
2. When they learn a lot at a time, they are easy to confuse the concepts, leading to wrong code usage or not getting the optimal solution;
3. It takes time for them to study, trial and error to actually digest knowledge;
4. They have no idea what is wrong with the code, and have no one to ask for immediate help, which makes learning difficult;

Experimental Group

User	Q1 Accuracy	Q1 Duration/sec	Q2 Accuracy	Q2 Duration/sec	Q3 Accuracy	Q3 Duration/sec	Q4 Accuracy	Q4 Duration/sec	Q5 Accuracy	Q5 Duration/sec
user1-1	1	16	1	92	1	141	1	357	0	600
user1-2	1	13	1	63	1	51	1	155	1	224
user1-3	1	13	1	74	0	183	1	364	1	446
user1-4	1	17	1	82	1	52	1	139	1	160
user1-5	1	7	1	170	1	80	1	115	1	225
user1-6	1	5	1	115	1	265	1	76	1	358
user1-7	1	6	0	141	0	148	1	171	0	312
user1-8	1	5	1	97	1	120	1	105	1	170
Average	100%	10.25	87.5%	104.25	75%	130	100%	185.25	75%	311.875

Control Group

User	Q1 Accuracy	Q1 Duration/sec	Q2 Accuracy	Q2 Duration/sec	Q3 Accuracy	Q3 Duration/sec	Q4 Accuracy	Q4 Duration/sec	Q5 Accuracy	Q5 Duration/sec
user2-1	1	13	0	315	0	506	0	446	0	733
user2-2	1	14	0	102	0	123	0	536	0	565
user2-3	1	35	1	90	0	120	0	249	0	192
user2-4	1	13	0	453	0	137	0	431	0	276
user2-5	0	9	1	240	0	373	0	836	0	1115
user2-6	1	23	1	316	1	334	0	312	0	198
user2-7	1	5	0	967	0	1092	0	480	0	1166
user2-8	1	6	0	126	0	580	0	248	0	205
Average	87.5%	14.75	37.5%	326.125	13%	408.125	0%	442.25	0%	556.25

Figure 4.7 Details of Quiz Results

5. They tend to overlook details such as switching input method, misusing case, etc.

There are 3 design differences between the materials for the two groups to improve the learning efficiency. First of all, the design adopts the teaching method of learning-and-practicing, inserting a related question after every knowledge point, which allows users to learn step by step. In this way, users could consolidate and absorb knowledge in time. Precise and orderly practices help users think logically when facing challenging problems. Secondly, the error reporting function in the simulated programming environment allows learners to immediately identify where the error is to avoid repeating errors. Finally, the form of chat would prompt users to pay attention to details, remind them of error-prone codes, which could be helpful for especially beginners to automatically extract key information instead of by themselves.

Through the survey after the a/b testing, the author learned the subjective views of participants on the two different learning modes. For users in the experimental group, their learning difficulties were relatively low (2.25/5), and their interests in learning Python and willingness to continue were high. For users in the control group, the knowledge is relatively difficult (4.25/5), however, this does not greatly affect their interest in learning Python (3.25/5). When asked whether

they were willing to continue learning in this way, most users hold a neutral attitude, indicating that textbooks would be helpful as complements to lectures. In addition, 62.5 percent of users indicated that they were motivated by the rating system, which means that when they get three stars, they would be encouraged to continue learning and go forward to the next level, while given two stars, they would go through that level again if time permits.

The author also used the Correl Function to analyze the correlation between variables including duration, accuracy, degree of difficulty, interestingness, and willingness to continue. For users in the experimental group, the correlation coefficient between accuracy and degree of interestingness is very strong (0.8825). It is supposed that high accuracy satisfies the user's sense of accomplishment to a large extent, and therefore has a positive impact on their learning interests. Besides, study duration and accuracy rate are negatively correlated (-0.6132), and total duration is negatively correlated with the degree of interestingness (-0.5981). The possible explanation for these results is that learners with strong receptive ability learn and absorb quickly, therefore not only the accuracy is high but the interest is consequently enhanced, while it takes longer time for some learners to digest, which may result in low accuracy and have a negative effect on learning interest. However, learning frustration is inevitable. Hence, it is crucial to add appropriate incentive systems, assistance, prompts, and other gamified elements to alleviate negative emotions to a certain extent. For those self-study users in the control group, more time results in higher accuracy, for the study duration and accuracy show a strong correlation (0.8462). Similarly, accuracy and degree of interestingness indicate a positive correlation (0.6110). Moreover, study duration and quiz duration are negatively correlated (-0.5608), which reflects the fact that after going through the materials once, they think they understand but actually not, so they need more time on reviewing and solving problems.

Chapter 5
Conclusion

5.1. Conclusion

Making programming learning fun was the original intention of the project. This project focuses on Python, which has become popular in recent years and has a big potential market. Programming for kids that emphasizes thinking development is fun enough, however, when it comes to mastering the skill that is applicable in the real workplace, programming education becomes boring and abstruse. The author realized the problem and hopes to solve the pain points of adult learners, especially for females, through gamification.

Gamification is not creating a game just for fun, otherwise, users can choose to play a real game. It is important to combine the game with target activities. In DAGONGREN, users are motivated by KPI, in the condition that they cannot be too fast with the learning progress, they would spend more time practicing, battling, working on projects with others, which are the activities good for consolidating the knowledge. Therefore, in such a progressive design accompanied by an indicator, users will spontaneously be engaged in more learning activities and also be motivated by the results. It is also critical to endow KPI with useful functions rather than a meaningless number, such as ranking and other desirable rewards. In order to simulate real life, the background story connects all features and makes them more reasonable and fun in certain scenarios, which may remind them of their own experiences, such as competing for opportunities, coordinating teamwork, sharing work experiences, making friends with newbies, etc.

DAGONGREN received positive feedback from target users for providing them with fresh experience with programming that they never had before using other learning approaches. This application offers adequate stimulation, interaction and supervision users need when learning to program. More importantly, it leads

to better study efficiency and outcome compared to the traditional learning approach. Although online education faces many difficulties, gamification could be a powerful tool for course design.

It is admitted that the a/b testing of this study has some limitations. Firstly, the sample size of the test is not large, which may lead to overestimation or underestimation of data differences between groups. Secondly, the test has study scope limitation, because the test subjects are basically people with higher education in first- and second-tier cities, with similar educational background and life experience, thus they may only reflect the learning effectiveness of the certain group. Thirdly, part of the test results is self-report data and users may have certain psychological expectations after being informed of the experimental content, which will affect their judgment on the level of the options. Finally, some confounding factors may affect the results of the experiment. For example, because the tests are conducted remotely, users may have an inevitable state of distraction; although the users are told to try their best to answer the questions, some users took longer time to figure out the correct answer, while others gave up quickly because of difficulties.

5.2. Future Work

The commercialization of DAGONGREN was not included in this study. It is worthy of further study on its profit model and marketing strategy. Unlike traditional video classes, this application offers a lot of room for creativity.

For example, in terms of pricing, users have to pay for advanced courses after the trainee level, otherwise, they can only attend basic courses. KPI will be more useful in this case, which can be used to exchange for discount coupons. Because users can accumulate a KPI by participating in such as Battles, in this way, more users are likely to stay in the platform and create an active community environment in the initial stage.

Additionally, the desk decoration is also a potential place to play with. Through cooperation with stationery, food or beverage companies, the application can release collaboration office items, such as the first cup of milk tea in the Winter, in order to, on the one hand, draw sponsorship, on the other hand, attract loyal

customers of other brands. Brand collaboration can also be expanded into an “ online + offline ” mode to increase the exposure of both sides.

Although DAGONGREN only offers new possibilities for Python learning, this innovation can be applied in the design of any other course. The key to creating a successful gamified educational product is to specifically grasp users' pain points and stimulate their internal motivation through appropriate game elements and design. It requires a designer to understand not only why games work, but also what users truly want.

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Appendices

A. Pre-Survey Questions

Q1. How many programming languages have you learned?

- Never (show Q2)
- One (show Q6, Q7)
- Two or more (show Q6, Q7)

Q2. Do you plan to learn programming?

- Yes, I tried to learn but gave up. (show Q3, Q4, Q5, Q8)
- Yes, but I never learned before. (show Q3, Q4, Q8)
- No.

Q3. Why do you want to learn programming?

- Work requirements
- Prepare for future
- Personal interests

Q4. What programming language do you want to learn?

Q5. Why did you give up programming?

- Of little use at present
- Too boring
- Too difficult to continue

- Lack of supervision
- Have no time
- Have no study partner
- Other reasons

Q6. How do you usually learn programming?

- Online courses
- School curriculum
- Reading paper or digital books

Q7. What difficulties have you encountered while learning programming online?

- Can't communicate with lecturers
- One class takes too long
- Hard to truly understand
- Lack of social features
- Not useful in real life

Q8. What features will motivate you to keep learning?

- Supervision
- Competition
- Progression
- Practice
- None of above

B. A/B Testing Survey Questions - Experimental Group

1. How difficult is this course for you？ 1 - 5
2. How interesting is this course for you？ 1 - 5
3. How do you like the instant reply? 1 - 5
4. How do you like the rating system? 1 - 5
5. Are you willing to continue learning Python in this way? 1 - 5
6. What difficulties did you encounter in this course?
7. How does the rating system affect your willingness to continue learning? Will it demotivate you? Or motivate you to go back and learn again?
8. When the program reports an error, would you be willing to get the answer directly or take the time to study it by yourself?
9. Do you have any other comments or suggestions?

C. A/B Testing Survey Questions - Control Group

1. How difficult is this course for you？ 1 - 5
2. How interesting is this course for you？ 1 - 5
3. Are you willing to continue learning Python in this way? 1 - 5
4. What difficulties did you encounter in this course?
5. Is the course generally fluent for you?

D. A/B Testing Learning Material - Experimental Group & Control Group

Python基础（实验用–实验组）

【对话文本】

hi，欢迎加入我们。

我叫Lisa，今天起担任你的mentor。我会一步步带着你了解python，学习python。这样你就能逐渐独立完成公司的任务和项目了。

工作之余，也欢迎你去BB社区分享你的工作心得、和同事抢业绩、创建项目团队，为活跃公司气氛做贡献，表现好的话有机会获得更多KPI。

好了，废话不多说，我们开始吧。

python是一门编程语言，易学、简洁、高效。相信你身边有不少人已经在学习这门语言了。它能有效提升我们的工作质量和效率，其应用广泛包括爬虫、数据分析、自动化办公、机器学习等。

不用紧张，python是十分新手友好的编程语言。有问题可以及时向我提问。只要你跟上我的节奏，你一定会很快上手的！

注意！python内需使用英文字母、标点和符号。

现在请你把输入框调整为英文输入法，为接下来的工作作准备。准备好了吗？切换完毕后，请回复“ready”。

太棒了！准备工作完成。今天你的任务是打印咱们团队的工资单。我相信你肯定会用Excel完成这项工作，但今天我们来试试用python解决这个问题。

我们将依次学习打印、赋值和计算，学完之后希望你能立刻上手完成我们的工作任务。加油吧！

在学习打印之前，我们先认识一下常量。

常量包含数字（整数和浮点数，如123和2.3）和带引号的字符串（如'hello world'）。

常量是不会改变的量，我们通过常量与计算机交流，交流方式通过print（）函数来实现。

例如，我想要告诉计算机我的名字叫Lisa，我会这样对计算机发出指令：
print ('我叫Lisa')

在这行简单的代码中，'我叫Lisa'是字符串，是一串文字信息。计算机收到了这部分信息后，通过print ()函数打印出来结果。

终端输出的结果就是：我叫Lisa

仔细观察，字符串是不是被单引号包围？引号包围的任何文字和符号都会被毫无保留的打印出来，计算机会和复读机一样直接复述引号内的内容。

当一句话中已经有了单引号怎么办？

没错，用双引号。例如print ("let's go")，终端便会输出let's go了
如果print ('let's go')，系统就会报错了你知道为什么吗？

出现了单数的引号，该打印哪个部分？计算机感到很困惑。

那么，三引号又会造成什么样的效果呢？观察下面的代码：
print('''I am
hungry
right now''')
>
I am
hungry
right now

看出来了吗？三引号实现自动换行，否则引号内的内容会像接龙一样连在一起。

复习一遍，复述内容用单引号，单引号出现则用双引号，想换行用三引号。记住了吗？

现在你来小试牛刀一下，你还没和我介绍你自己呢。请你写三句话自我介绍，包括你的姓名、出身和爱好，一句换一行。试着用python语句打印出来。

太棒了，很高兴认识你xx。

引号的出现，告诉了计算机：你复述就对了，不用理解内容。因此引号里可以出现各种文字符号，甚至可以出现火星文，葬爱家族表示很赞。

那么常量为数字呢？这时候就不用引号了，例如print (123)。

因为计算机它读得懂数字，而且它不仅读得懂，还能直接进行数学运算。

理解了上面这句话，那么我来考考你，
当代码框内为print (1+1) 时，终端会输出哪种结果？
a. 1+1
b. 2

对了，计算机就是这么聪明。数学运算的部分我们后续会继续探索。
当我们打印的是数字时，直接输入数字或正确的数学运算就可以了，不用带上引号。

现在我们来认识变量。在python中，你可以自由选择变量名。

但值得注意的是，变量名最好为容易读懂、简洁的英文和数字或它们的组合，否则在代码很长的时候会造成混淆和错误。

以下哪个适合作为“小明”的变量名？
a. 小明
b. ming
c. abc

答对了！
变量名中不允许包含空格，用“_”作为空格。

以下哪个适合作为“小明的年纪”的变量名？
a. 小明的年纪
b. ming_age
c. ming age

太棒了！
之后你要打印组里的成员的工资单，那么你会给“小明的工资”取什么变量名呢？
ming_salary

没错！
变量名是你让 Python 分配一些内存，然后把一些东西储存进去，这个过程被称为赋值。

”=”在这里作为赋值符号，而不是数字公式里的等号。

我们试着存储小组成员的工资数据：小明本月的工资为9000元。
ming_salary = 9000

本月，小李的工资是7300元，小张的工资是8100元。请将他们的工资存进电脑，并分别打印出小李和小张的工资。

完全正确！
听说工资最高的员工还可以获得在原有工资基础上额外的100元奖金，那么
ming_salary = 9000
ming_salary = 9100
print (ming_salary)
>9100

观察上面的代码，前面的数据被覆盖了。当同一变量被赋值多次，则打印最终结果。

需要注意，python中有一些保留词具有它们自己的意义，不能被用于变量命名。比如我们刚才学到的“print”，另外还有“if”、“continue”、“break”等带有特殊功能的词语。

恭喜你学完第一节，获得三星！
继续学习吗？

学完了常量、变量、赋值和打印，我们接下来学习运算。

认识运算之前先来看看三种python常见的数据类型。

首先是字符串，英文是string，在python中简写为str。
字符串是指在引号中的内容，可以为任何文字、符号或组合，如’你好’、”123”、’#@！’

刚才我们说过，引号中的内容python是读不懂的。你说什么，它就复述什么。

观察下面的代码：
greet_ch = ’你好’
greet_en = ”what’s up”
print (greet_ch)
print (greet_en)
>你好
>what’s up

那么我们在制作工资单的时候，最终要打印出“小明的工资为9100元”时，
请补全下面的代码：
print (小明的工资为9100元)

太棒了！

接下来是数字，计算机看得懂的数字。
分为整数，integer（简称int）和浮点数float（没有简称，直接输入float）。

整数（int），例如0、23、699，和数学的概念一样。
print (1683)
>1683

在python中整数的运算结果永远精确。
回顾一下一开始我们做的第一道练习：
print (1+1)
>2

浮点数（float）是带小数点的数字，如3.0，1.8，-0.6372。
print (168.3)
>168.3

认识了三个数据类型后，我们再来看一下python运算符。

+、-、*、/ 加减乘除（使用率很高的哦）
% 取除法余数
// 取除法整数部分
** 幂
…

和数学一样，python的运算法则是：从左到右、括号优先、乘除优先。
很简单吧？

和数学不一样的是，“+”还有另一个功能！
运算符中的“+”，帮助我们连接字符串和数字。这叫做数据拼接。
字符串拼接可以将字符串的内容连起来，数字拼接则输出运算结果。

观察下面的代码，字符串通过“+”连起来了：
period = '本月'
name = '小明'
outcome = '的工资是'
salary = '9000元'
print (period+name+outcome+salary)
>本月小明的工资是9000元。

上面四个变量被赋值后，都是字符串类型，因此可以直接相连。
print括号中，是不需要加上引号的。

我们再看一个数字拼接的例子：
之前我们已经试过使用python计算“1+1”等于2了，现在给你加点难度，
我们公司规定，工资最高的员工可以获得工资基础上10%的奖金。本月工资最高的小明他已经有了9000元，请你用python算一下他加上奖金后最终能获得多少工资？

请补全下列代码：
ming_salary = 9000
ming_bonus =
ming_salary =
print ()

太棒了，看来你已经掌握了数字运算。

我们再观察一下下面的代码
num = 123
grade = 'good'
print (num+grade)
>SyntaxError: invalid syntax

你知道为什么系统报错了吗？

当我们把不同类型的数据放在一起，是无法进行拼接的，这时候就需要用到数据转化。

敲重点：

【字符串转化】
- 转整数（文字类和小数类无法转换）：int ()

print (int ('2.5'))
>ValueError：invalid literal for int() with base 10: '2.5'
- 转浮点数（文字类无法转换）：float ()

【整数转化】
- 转字符串：str ()
- 转浮点数：float ()

【浮点数转化】
- 转字符串：str ()
- 转整数（抹零取整）：int ()

```
print (int (2.5))
>2
```

回顾上面的例子，我们怎么样才能连接“good”和“123”呢？
我们需要把整数“123”转换成字符串才可以和“good”连接

```
num = 123
grade = 'good'
print (str (num)+grade)
>123good
```

让我们来debug试试，下面代码中的bug显而易见了吧？

```
period = '本月'
name = '小明'
salary = 9000
print (period+name+'的工资是'+salary+元)
```

bug有几处？分别是什么问题？
正确的代码应该是什么呢？

真棒，看来你吸收的不错。我们目前学完了打印、赋值、数据类型、运算符和数据转换，这些知识足够你帮我们打印工资单了。

恭喜你学完第二节，进入阶段练习吗？

请编写正确的代码，把大家的工资数据先存进电脑，然后打印使得终端输出以下内容。
别忘了工资最高的员工可以获得他工资基础上10%的奖金。

本月小明的工资是9000元，
本月小李的工资是7300元，
本月小张的工资是8100元。
请打印：公司应发共（输出运算结果）元工资。

第一步：把三人的工资分别存进电脑。
第二步：计算三人的工资总数。
第三步：打印结果。

恭喜你完成考核！

感谢你参加本次试验！

Python基础（实验用–对照组）

注意：python内需使用英文字母、标点和符号

1、打印与变量

常量

包含数字（整数和浮点数，如123和2.3）和带引号的字符串（如'hello world'）
常量是不会改变的量，我们通过常量与计算机交流，交流方式通过**print（）函数**来实现。

print（）函数

此函数告诉计算机，把括号里的内容显示出来。
分为以下四种形式：

- 不带引号：让计算机读懂括号里的内容，并打印结果

```
print (1+1)
```

> 2

- 带单引号：让计算机直接复述引号中的内容

```
print ('hello world')
```

> hello world

- 带双引号：效果同上，如果引号内包含单引号，则使用双引号

```
print ("let's go")
```

> let's go

- 带三引号：同样是直接打印内容，可以实现换行

```
print('''I am
hungry
right now''')
```

> I'm
> hungry
> right now

变量

你可以自由选择变量名，但值得注意的是，变量名最好为容易读懂、简洁的英文和数字或它们的组合，否则会造成混淆和错误。变量名中不允许包含空格，一般使用“_”作为空格。
变量名是你让 Python 分配一些内存，然后把一些东西储存进去，这个过程被称为赋值。
“=”在这里作为赋值符号，而不是数字公式里的等号。

```
apple = 2
people = 30
print (apple)
print (people)
```

> 2
> 30

区分 apple == 2，此时“==”为python里的等号，等同于数学里的“=”。

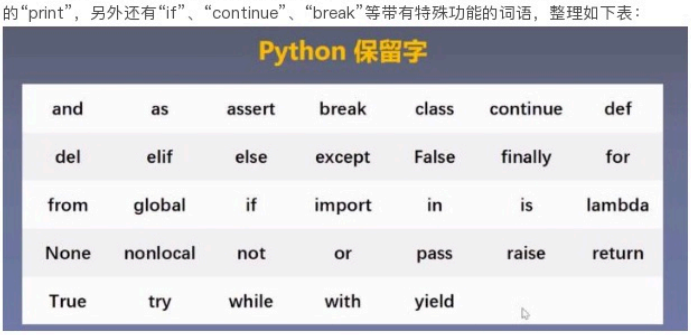
另外，当同一变量被赋值多次时，前者被覆盖，打印最终结果。

```
people = 30
animal = 5
people = 20
print (people)
```

```
20
```

保留词

python中有一些保留词具有它们自己的意义，不能被用于变量命名。比如我们刚才学到的“print”，另外还有“if”、“continue”、“break”等带有特殊功能的词语，整理如下表：



2、数据类型与转换

三种常见数据类型

- 字符串（str）：引号中的内容，可以为任何文字、符号或它们的组合，如’你好’、”123”、’’#hello world 你好世界#’’

```
greet_ch = '你好'
greet_en = "what's up"
print (greet_ch)
print (greet_en)
```

```
你好
what's up
```

- 整数（int）：0、23、699 （运算结果永远精确）

```
print (1683+1)
```

```
1684
```

- 浮点数（float）：带小数点的数字，如3.0，1.8，-0.6372 （运算结果存在误差）

```
print (168.3)
```

```
168.3
```

python运算符

+、-、*、/ 加减乘除
% 取除法余数
// 取除法整数部分
** 幂

运算法则：从左到右、括号优先、乘除优先

数据拼接

用“+”拼接，字符串和数字均可拼接。字符串拼接可以将字符串的内容连起来，数字拼接则输出运算结果。不同类型的数据是无法进行拼接的，这时候就需要用到数据转化。

```
print (123good)
```

```
SyntaxError: invalid syntax
```

数据转化

字符串转化：

- 转整数（文字类和小数类的字符串无法转换）：int ()

```
print (int ('2.5'))
```

```
ValueError: invalid literal for int() with base 10: '2.5'
```

- 转浮点数（文字类字符串无法转换）：float ()

整数转化：

- 转字符串：str ()
- 转浮点数：float ()

浮点数转化：

- 转字符串：str ()
- 转整数（抹零取整）：int ()

```
print (int (2.5))
```

```
2
```

当不确定数据类型的时候，可以通过“print (type ())”来查询某一变量的数据类型。

```
num = 123
print (type (num))
```

```
<class 'int'>
```

请依次完成以下练习：

【练习】

1、代码框内为print (1+1) 时，终端会出现哪种结果？

a. 1+1

b. 2

2、请编写代码，使终端能输出以下句子，一句换一行。

我叫小明，我的员工号为123456，

我的爱好是摄影和户外运动。

初来乍到，请多多指教！

代码：

3、本月，小李的工资是7300元，小张的工资是8100元。

请将他们的工资存进电脑，并分别打印出小李和小张的工资。

代码：

4、请指出下列代码的bug并修正：

```
period = '本月'
name = '小明'
salary = 9000
print (period+name+'的工资是'+salary+元)
```

bug有几处？分别是什么问题？正确的代码应该是？

5、本月小明的工资是9000元，本月小李的工资是7300元，本月小张的工资是8100元。注意，工资最高的员工可以获得他工资基础上10%的奖金。

请应用赋值、运算、打印等，编写正确的代码，使得终端输出以下内容。

公司应发共（运算结果）元工资。

代码：