

**FACTORS AFFECTING THE EFFECTIVE DESIGN OF A NATIONAL  
POSTGRADUATE ENTRANCE EXAMINATION AID APP AN EXPLORATIVE  
ANALYSIS USING THE EXAMPLE OF BAISE UNIVERSITY**



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### **ABSTRACT**

The purpose of this article is to provide suggestions for Baise University students to design a more efficient Postgraduate Entrance Examination Aid APP. A Postgraduate Entrance Examination Aid APP can naturally help students improve the review efforts for the Postgraduate Entrance Examination. This paper firstly found out the essential elements of a Chinese exam-oriented and knowledge-centered software in the Internet era through a large number of literature reading, and then carried out qualitative data collection based on the Design Thinking methodology including observation, interview, Empathy Map and Persona.

But it's worth noting that it is almost impossible to find too many interviewees to ensure the uniformity of sampling due to the relatively small number of students in Baise University who are willing to take postgraduate exams and the virus epidemic in China.

This paper is an exploratory qualitative analysis based on design thinking, which has certain reference value for relevant real product development.

*Keywords: Postgraduate Entrance Examination, Software Design, Learning Function, Incentive Mechanism, Virtual Community, Optimize Learning, User Care*

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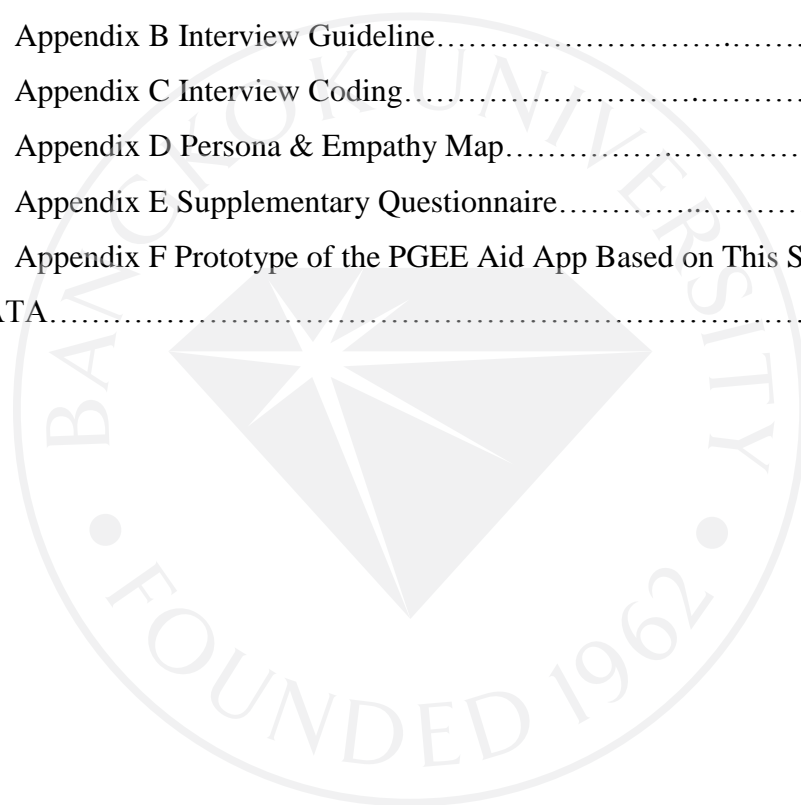
Chen Ruoxiang

## TABLE OF CONTENTS

	Page
ABSTRACT.....	iii
ACKNOWLEDGEMENT.....	iv
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
CHAPTER 1: INTRODUCTION .....	1
1.1 Research Background.....	2
1.2 Research Questions.....	4
1.3 Research Objectives.....	5
1.4 Research Scope.....	5
1.5 Organization of the Study.....	5
1.6 Definition of Terms.....	6
CHAPTER 2: LITERATURE REVIEW.....	8
2.1 Mobile Application Product Design.....	9
2.2 Software Content.....	14
2.3 Design Thinking.....	24
2.4 Summary and Conceptual Framework.....	28
CHAPTER 3: METHODOLOGY.....	30
3.1 Research Method.....	30
3.2 Data Collection.....	31
CHAPTER 4: DATA ANALYSIS.....	35
4.1 Finding of Observation.....	35
4.2 Finding of Interview.....	36
4.3 Finding of Empathy Map and Persona Building.....	39
4.4 Result of Supplementary Questionnaire.....	40
CHAPTER 5: CONCLUSION AND DISCUSSION.....	48
5.1 Conclusion.....	48
5.2 Discussion.....	52
5.3 Limitations.....	53

## TABLE OF CONTENTS (Continued)

	Page
CHAPTER 5: CONCLUSION AND DISCUSSION (Continued)	
5.4 Suggestions for Future Research.....	55
BIBLIOGRAPHY.....	56
APPENDICES.....	62
Appendix A Observation Recording.....	63
Appendix B Interview Guideline.....	69
Appendix C Interview Coding.....	94
Appendix D Persona & Empathy Map.....	141
Appendix E Supplementary Questionnaire.....	143
Appendix F Prototype of the PGEE Aid App Based on This Study....	149
BIODATA.....	157



**LIST OF TABLES**

	Page
Table 3.1: Information about Interviewees.....	32
Table 4.1: Respondents' Respondent gender and PGEE status.....	40





## LIST OF FIGURES

	Page
Figure 2.1: Hartson's Interactive Cycle	13
Figure 2.2: Conceptual Framework	29



## **CHAPTER 1**

### **INTRODUCTION**

In China, when domestic undergraduate students want to continue their master's or even doctoral studies after graduation, there are two ways to obtain admission to the target university with a graduate major namely: recommended graduate students exempted from the examination, and the National Postgraduate Entrance Examination.

As for the students who are recommended to be exempted from the examination, according to relevant regulations, this process basically consists of the following in order: The University announces the outline of this year's recruitment exercise, students preparing and sending materials, students' written examination interview, universities releasing the admission list and students' student status registration. This kind of graduate enrollment process in China is similar to that of overseas universities, but there is still a written test. However, as the admission details of this selection mode are mostly decided by the university itself, the enrollment quota is limited, and there are high requirements for students' academic performance and scientific research achievements during the undergraduate period. So there are very few people who get postgraduate admission through this channel every year. This approach is therefore beyond the scope of this article.

The National Postgraduate Entrance Examination is the stage that most Postgraduate students in China go through. This examination has some characteristics of quality-oriented education, but it is still the product of exam-oriented education system in essence. It is in a unified China national exam held by the education ministry of China, generally the registration channel of The Exam opens in September each year, and examinations will be held between December of this year and April of the following year in the form of written examination and secondary examination (written examinations and secondary examination' details will be described in subsequent chapters), about a week after comprehensive interview, admitted to the university will release the admission list.

Students who are accepted will register and study in September the following year, just like elementary, middle and high school students and undergraduates.

## **1.1 Research Background**

### **1.1.1 Status Quo of Postgraduate Entrance Examination**

In recent years, the number of applicants for Postgraduate Entrance Examination in China has increased rapidly. According to data released by China's Ministry of Education, from 2017 to 2022, 2.01 million, 2.38 million, 2.9 million, 3.41 million, 3.77 million and 4.57 million registered for the national Postgraduate Entrance Examination, respectively. The number of applicants for the 2022 Postgraduate Entrance Examination increased by 127 percent compared to 2017. According to relevant data from the Statistical Bulletin of the People's Republic of China on National Economic and Social Development 2021, in 2021, 1.177 million students will be enrolled in domestic graduate education. This shows that the admission rate of master's students in 2021 is only about 31.2 percent. Currently, the enrollment of postgraduate students in 2022 is still not finished, but according to the report on the implementation of the 2020 National Economic and Social Development Plan and the draft national Economic and Social Development Plan in 2021 adopted by the National People's Congress, the enrollment of postgraduate students in 2022 is 1.107 million. It can be seen that China's graduate enrollment rate will further drop to 24.2% in 2022 (National People's Congress of the People's Republic of China, 2020).

### **1.1.2 Development of Postgraduate Entrance Examination Training and Related Online Learning Software**

According to the data of "Kaoyanbang 2020 Postgraduate Entrance Examination Preparation Progress Survey" released by Kaoyanbang, more than 60% of the 8,678 students surveyed believe that video materials are good for learning, and more than 30% of the students will choose to participate in relevant coaching training to assist in exam preparation.

Han (2020) also believes that aid for postgraduate examination is more or less superior to some college students in terms of time planning, schedule management, learning focus differentiation and efficiency improvement. For those who lack self-learning ability, willpower weak students, can be regarded as an effective way to learn.

The development of mobile apps coupled with the multiplication of social employment pressure has promoted the development of online education apps to a certain extent. Online education Compared with traditional offline teaching, online teaching is more convenient, free from time and space restrictions, only need a smart phone, install the corresponding APP, online education, saving a lot of manpower, material resources and financial resources, which is an advantage that the traditional offline teaching mode cannot reach. Especially for students who take the postgraduate entrance examination, no matter they are still undergraduate students or already engaged in jobs, time is very precious. Online education largely saves the time consumed in the journey for students preparing for the examination and greatly improves the time utilization rate (Guo, You, Zhou, Gong, & Peng, 2020).

In addition, By Chance of COVID 19 Outbreak, the technology and new blending learning Online and offline classrooms effects in all paper-based works turn to be digital work and virtual.

In the article "The Construction and Application of MAER Text Book in The Era of Internet + Education", Song, C., Wu, S. and Chen, H. mentioned that in the current Era of "Internet + Education", New learning resources and modes such as MOOC/SPOC, mobile learning, piecemeal learning, classroom flipping, and hybrid learning are emerging and becoming the mainstream trend.

Liu, Zhang, Ye, & Liu (2018) also argue that Digital learning is the development trend of school and family education. As a result, the education industry which has a large number of college student users has huge development potential, and learning APP targeted at college students has a broad market in the future.

### 1.1.3 The Situation of National Graduate Entrance Examination for Students at Baise University

According to two internal documents of Baise University "Notification of Baise University on the Qualification Examination of Graduates of General Higher Education in 2021" (2021), and "Baise University's decision to recognize the outstanding individuals and related organizations who joined and passed the Postgraduate Entrance Examination for 2021 undergraduate students", only 54 of the 6,105 graduates of Baise university in 2021 passed the Postgraduate Entrance Examination, and of those 54, only seven were admitted to the graduate department of the 985 or 211 level (referring to the TOP1 and 2 level universities in China) and there are totally 9.09 million graduates from all Chinese universities during the same period, according to China's Ministry of Education. Only 0.88% of Baise graduates pass the Postgraduate Entrance Examination, well below the national average of 12.9 percent.

On the one hand, the competitiveness of Baise university students in the Postgraduate Entrance Examination is not at the average level, but on the other hand, The research of designing an online learning platform for students of Baise University to improve their ability to pass the Postgraduate Entrance Examination has broad market prospects, and has positive practical significance for students of Baise University, Baise University itself and the local community of Baise city.

## 1.2 Research Questions

1.2.1 What factors of a Postgraduate Entrance Examination Aid APP can help students of Baise University to achieve better review efforts for the Postgraduate Entrance Examination and thus be more likely to pass the Postgraduate Entrance Examination?

1.2.2 How to improve the use experience of an Postgraduate Entrance Examination Aid APP?

1.2.3 How to design an ideal Postgraduate Entrance Examination Aid APP for Baise University students?

### **1.3 Research Objectives**

1.3.1 Improve the learning efforts of students using Postgraduate Entrance Examination aid APP to prepare for exams through more comprehensive and reasonable function and content adding.

1.3.2 Improve students' experience of using Postgraduate Entrance Examination aid APP through more reasonable interaction and UI design.

### **1.4 Research Scope**

1.4.1 Through reviewing relevant literature, sorting out and comparative analysis, the main factors affecting students' review efforts and APP use experience of Postgraduate Entrance Examination aid APP are determined.

1.4.2 The interviewees and research subjects of this article are former undergraduate students of Baise University who have taken the National Postgraduate Entrance examination, and (current) undergraduate students of Baise University who will take the National Postgraduate entrance examination.

1.4.3 Establish a corresponding APP prototype product interface through data collection.

### **1.5 Organization of the Study**

The first chapter of this paper describes the background of this study and the problem statement. The second chapter discusses the factors that may affect students' use of Postgraduate Entrance Examination aid APP and related theories according to the pertinent literature.

Then, in the third chapter, qualitative research methods based on design thinking are applied, including observation, interview, empathy map and Persona

(the sequence of each data acquisition process is discussed at the beginning of Chapter 3). In addition, an supplementary questionnaire is designed according to the previous corresponding survey results to provide some reference for the conclusion. The main qualitative results and additional quantitative results are discussed in the fourth chapter.

Then the relevant conclusions are drawn in Chapter 5. At the same time, this paper will compare the efficient Postgraduate Entrance Examination Aid APP discussed in this paper with the Postgraduate Entrance Examination Aid APP on the market.

Finally, the prototype of the Postgraduate Entrance Examination aid APP designed by this study are displayed and explained to some extent (as part of the appendices).

## **1.6 Definition of Terms**

### **1.6.1 Definition of Abbreviation**

In the following content, some nouns will be frequently used. In order to keep the structure of the paper concise, the following abbreviations of nouns are defined:

- 1) PG (Postgraduate)
- 2) PGEE (Postgraduate Entrance Examination)
- 3) DT (Design Thinking)
- 4) UI (User Interface)
- 5) BU (Baise University)

### **1.6.2 Definitions of Specific Nouns**

#### **Foundation Course**

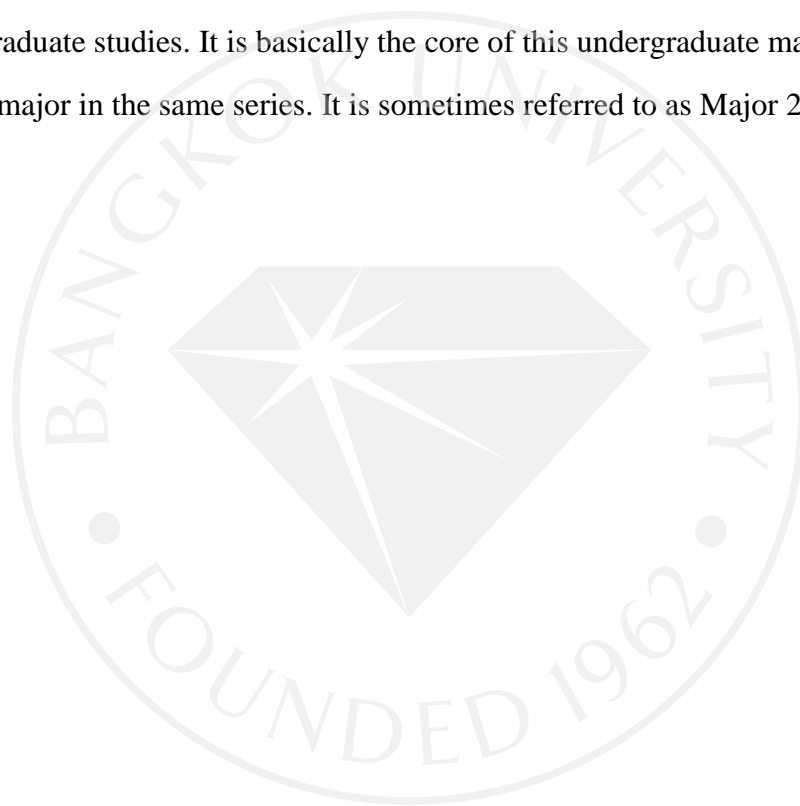
The Foundation Course is usually a specific important, foundational course taught in the first two years of the relevant undergraduate program.

### 1) Major-Foundation Course

The major-Foundation Course is a core Course that is taught basically in the second or third year of undergraduate study. It sometimes serves as a bridge between the Foundation Course and the Major Course. It is sometimes referred to as Major 1

### 2) Major Course

The Major Course is a core course taught basically in the third year of undergraduate studies. It is basically the core of this undergraduate major and the master major in the same series. It is sometimes referred to as Major 2.





## **CHAPTER 2**

### **LITERATURE REVIEW**

In recent years, due to the impact of the epidemic, China's commercial PGEE training has been transformed from offline and online training to unified online training, and various commercial postgraduate entrance examination auxiliary apps have also emerged rapidly.

However, by searching for the keyword PGEE Aid APP in Chinese Internet and Chinese academic database, there is only one academic article that fully meets the key words, and the main direction of this article is to discuss the general programming languages (such as C language, JAVA, etc.) used in the design of the PGEE Aid APP. The other related academic articles are aim at other aspects of the PGEE.

On the other hand, other articles about the PGEE Aid APP on social media are short and simple, mainly playing an enlightening role. Since this exam is based on exam-oriented education, most foreign studies on online learning apps are not applicable to this kind of exam.

As defined by Cherner, Dix, & Lee (2014), the PGEE Aid APP is defined as Instructive apps namely described as promoting rote memorization of content through drill-and-skill activities. These apps alert students to repeatedly practice a skill in order to increase their accuracy using the skill. They are related to test preparation apps that taught students the foundational skills and knowledge needed to be successful on standardized tests.

To sum up, this chapter will explain the nature of the PGEE Aid APPs as a test preparation APP that (probably) meets the actual situation in China, as well as the DT techniques needed for data collection and prototype development.

## 2.1 Mobile Application Product Design

### 2.1.1 Basic Principles of Mobile Application Product Design

Du (2006) states that APP development usually satisfies mobility, friendly interaction and platform consistency.

#### 1) Mobility

The biggest feature of online learning apps lies in their mobility. Users only need a mobile device to use the APP for online learning at anytime and anywhere, which is highly practical. Compared with the traditional classroom teaching mode, online courses are more flexible and convenient (Guo, et al., 2020).

A Mobile learning APP is mainly informal communication, it requires to be carried on anytime and anywhere and to have strong flexibility; It can be considered that good mobile Network services will affect user's attitude to use a mobile learning APP. Furthermore, access to Instant Messaging services anytime and anywhere will have a positive influence on the users' adoption attitude (Liu, et al., 2018).

#### 2) Friendly interaction

The design of a PGEE Aid APP should follow the friendly interaction design principles, be concise and clear in the UI design of the APP, present a high-quality, visual interface with icons and pictures, and enhance the user's comfortable experience. At the same time, the occupation of mobile device storage space by the APP should be reduced as much as possible and the interface loading process should be as short and smooth as possible (Guo et al., 2020).

The system in these mobile devices should be developed to target changes in perceived usefulness. The instructors or administrators can then demonstrate to the students how the system would benefit the students' learning process and help them to easily grasp the learned contents. Therefore, it's critical that the system should be designed up-to-date and user-friendly (Yang, 2020).

### 3) Platform consistency

At present, the commonly used mobile devices are tablets and smartphones, with IOS and Android as the leading platform operating systems. The differences between different devices must be fully considered in the design, and the differences should be solved by technical means as far as possible to facilitate later maintenance and update (Guo, et al., 2020).

In addition, a study by Yang, (2020) showed that computer self-efficacy plays a significant role in affecting learners' perceived usefulness, ease of use, and attitude toward the online resources or apps, thus influencing the users' intention to continue using the resources. The author also emphasizes that multitude and administrators should make every effort to improve the students' computer self-efficacy. Before the students begin using the e-learning system, it is suggested that a training session should be arranged in the classroom or in the computer lab to familiarize them with the learning system. Such training enables the students to be more receptive to the self-learning environment and help remove the technological problems they may encounter during the learning process. Students who have difficulty accessing the system may feel reluctant to accept or use it.

#### 2.1.2 Mobile Application UI Design and User Experience

Li (2020) thinks the influence of software UI on user experience from the following three aspects:

1) Interface artistry and user experience: without considering the actual situation, the design with artistic feeling is easier to be understood than the design with rational logic, because artistry emphasizes the "aesthetic effect" for users in visual expression. Experimental observation shows that "aesthetic effect" is a way for users to accept art, and artistic design is easier to be adopted.

2) Emotionalization of interface and user experience: emotionalization of interface is the central interface for communication between products and users. Users are social groups with perceptual and rational cognition, so any design should

be deeply rooted in people's hearts. The key to elaborating emotion through design lies in expressing the emotional connotation of the interface through the scientific design of the page, which is also the core of building user communication experience. In terms of building interface emotion and user experience, designers can consider from the user's psychological point of view and design reasonable applications according to the user's desire, so as to meet the user's needs.

3) Interface function visualization and user experience: The so-called "function visualization" is to let users quickly and concisely understand the functional properties of the product. A guitar, a football, they all have that quality. Users, without professional training or training, can naturally find its functional attributes. This is called "visibility of functionality." "The visibility of functions is obvious, and users will be skilled in operating the product in a short time.

#### 2.1.3 Theory of Affordance

Affordance was first introduced by perceptual psychologist Gibson in the book *The Ecological Approach to Visual Perception*. Affordance was originally understood as "describing the 'directly perceived behavioral relationships' that exist between the environment and animals, which have since been extended to include the behavioral relationships between objects or environments and people." (Gu & Mu, 2015) For example: chair provides the affordance to sit down when tired, to stand on the back of the chair when high objects are needed, and to place clothing packs on the back of the chair when returning from an outing. Affordance allows people to focus on the possible uses of the properties of an object in a particular environment or situation, rather than on a single use defined by its particular properties (Zhang & Wang, 2018).

Based previous research, Norman (1988) extended the affordance concept to product design and human-computer interaction, emphasizing the affordance under certain contexts. While Gibson considered Affordance to exist independently of experience and culture, Norman (1988) took Affordance to refer to psychological and cognitive abilities, linking Affordance closely to past knowledge and experience.

Therefore, Donald emphasizes that the features of the product itself should have features that can let users know its function and operation mode that is, self-evidence of the product itself (Wu, 2019).

Since Norman's (1988) definition of perceived affordance is vague, Hartson (2003) made some improvements and proposed the following four affordances in interaction design and evaluation contexts: Physical affordance, cognitive affordance, sensory affordance, functional affordance.

Hartson (2003) defines physical affordance as design features that help, assist, support, and promote the subject to perform certain behaviors to accomplish certain things.

1) Cognitive affordance is a design feature that can help, assist, support, and promote the subject's thinking and learning.

2) Sensory affordance is a design feature that can help, assist, support and promote the subject to feel through the senses.

3) Functional affordance is about functionality with an intent or purpose (high level of user implement ability), operability to meet the user's purpose, and the use of feedback to reflect invisible results (Zhu, 2020).

The affordance of the four user interface design affordances are illustrated in the following ways:

1) The Physical Affordance can be a button label that tells people what can happen when they press a button;

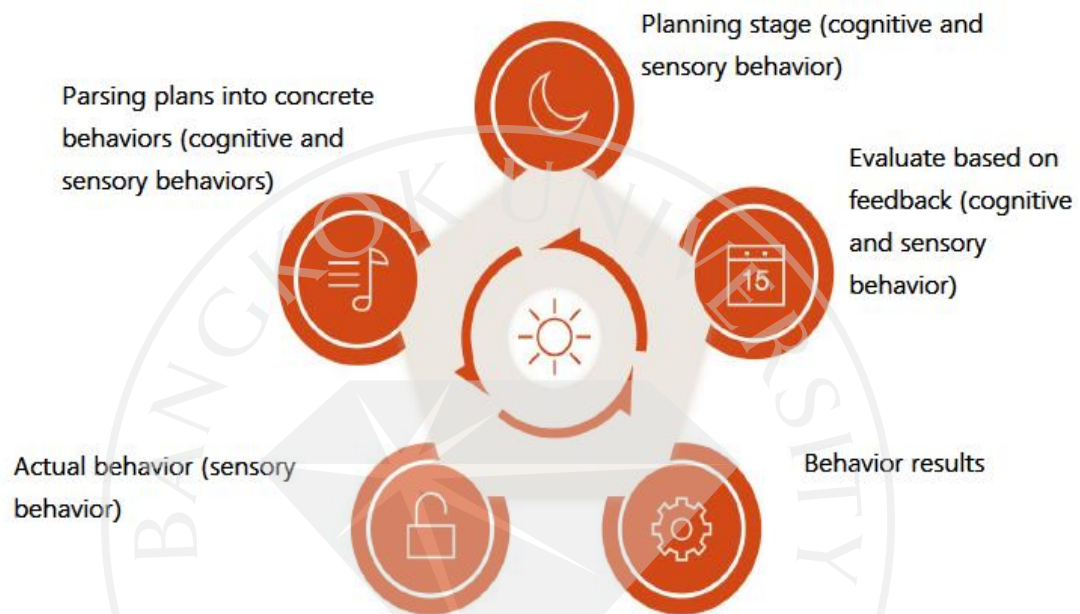
2) The cognitive affordance can be a button that is large enough to be pressed accurately;

3) The sensory affordance of the buttons labels is large enough for people to read;

4) The functional affordance represents the built-in ability to classify a range of numbers (once the user presses the categories button).

Hartson (2003) improved this theory and applied it in the process of human-computer interaction, forming an interaction cycle as shown in Figure 2.1

Figure 2.1: Hartson's Interactive Cycle



Source: Hartson, R. (2003). Cognitive, physical, sensory, and functional affordances in interaction design. *Behaviour & Information Technology*, 22(5), 315-338.

Hartson (2003) is proposed after the above interactive cycle and four affordances, stages of behavior model, put forward with the combination of Norman (1988) formed based on the functional availability of user behavior architecture, and points out that the architecture is not only applicable to the interaction in real life, can also be applied to a virtual environment, human-computer interaction and the interaction between any emerging related equipment, products and systems. He also mentioned that the cognitive affordance permeates the whole interaction process and is the most important affordance in the user behavior architecture.

It is worth noting that the learning process using the online learning APP is also a human-computer interaction process, that is, the interaction between people and the virtual environment, which is determined by the characteristics of mobile language learning itself. Human-computer interaction in this learning mode also belongs to the interaction between learners and the environment, which conforms to theory of Affordance proposed by Norman (1988) and Hartson (2003). The human-computer interaction function design of APP itself is one of the environments mentioned in the theory of availability, and the perfection of its design will have an impact on learners' use experience, willingness, learning efforts, etc. (Zhu, 2020)

## **2.2 Software Content**

### **2.2.1 Learning functions**

As a PGEE Aid APP, the core of the content is naturally the learning functions include the function of tutoring test items and the function of previous exam practicing. The annual PGEE consists of the following two processes:

1) Written examinations be like Yu (2007) place states, according to Ministry of Education "about adjusting national master graduate student entrance examination subject notice", since 2003, China has changed the arrangement of the PGEE's exam subjects, the major course test in the original written examination subject will be put in the secondary examination to undertake. At present, the PGEE written examination includes four subjects: political theories, foreign language, foundation courses and major-foundation courses.

Among them, political theories and foreign language subject cover the most widely, so political subject is issued by the Ministry of Education of China for students from all parts of the country with the same topic. Non-foreign-language-major students are divided into the English (1) group and the English (2) group according to the degree of correlation between the students' targeted PG major and English. Normally, English (1) is more difficult.



In addition, mathematics exists as a relatively special test subject. All students who choose the science or engineering majors, as well as economics and some management majors, must take the mathematics test, which replaces the foundation course. And this subject also according to its relevance with the major, divided into mathematics (1), mathematics (2), mathematics (3), the difficulty in descending order. The Ministry of Education will also issue math questions of corresponding difficulty to students who apply for relevant majors.

The exam paper of the foundation courses and major-foundation basic courses are compiled by each university according to the PGEE outline formulated by the National Education Commission every year. The tests will then be distributed to students after being approved by the State Education Commission. Students who register for different PG majors will receive different papers and questions.

Tan (2008) believes that the PGEE outline formulated by the National Education Commission every year strictly delineates the scope and difficulty requirements for students of various PG majors, the outline is one of the most authoritative and useful reference materials for all students, and it is also the basis for teachers to teach. In the syllabus, the content marked as "students need to know roughly", "students need to understand the logic", "students can apply it to practical cases" are often the main test points. In addition, Tan also thinks that the examination papers of the past years are of great significance for understanding the types of the PGEE test questions, understanding the ideas and priorities of the proposition side, strengthening the answering skills and develop accuracy in answering.

## 2) Secondary examination.

As stated by Yu and Ma (2007), since 2003, the tests of major courses have been carried out in the secondary examination. The secondary examination includes oral English speaking ability test, written test of major courses and comprehensive interview.



3) The final admission of graduate students is based on the overall score ranking, the total score includes the score of the written exam and the score of secondary exam, the score of the secondary exam generally accounts for 30%-50% of the total score. It is worth noting that universities can exercise veto power during Secondary examination. As long as the student does not pass the Secondary examination, no matter how high he gets in the written examination, he will have failed. The importance of secondary examination is self-evident. (Tan, 2020)

Students need to sort out the contents of comprehensive interview, English speaking test and the test of major courses, clarify the interview questions and answer ideas, and conduct intensive simulation drills for the interview. Conduct all-round practice from behavior, speech expression, logical thinking, professional quality to improvise and so on. Especially Right before the secondary exam, students must find opportunities to focus on training and do it freely in the examination room (Zhang, 2019b).

To sum up, the learning function of this PGEE Aid APP mainly includes the function of tutoring test items and the function of previous exam practicing. To achieve the function of previous exam preparation, previous exam papers need to be collected as much as possible from official databases.

About tutoring test items, there are two training modes: Massive Open Online Course (MOOC) and live broadcast teaching. MOOC is an online course aimed at unlimited participation and open access through the web. Essentially these are format distance learning of short courses (Santhi, 2020) .MOOC can let learners learn repeatedly. Advancement in Edtech, live broadcast teaching has been a game changer. They offer a virtual classroom learning experience which includes Interactive Live Classes and a Structured Study Plan methodology (Krishnan, 2020). Guo et al. (2020) believed that under the condition of online teaching, online teachers should rationally slice knowledge according to the characteristics of online teaching to improve students' learning efficiency.

According to Liu, et al. (2018), learning content needs to fully consider the users' starting point of learning, their learning motivation and preferred learning style. Learning content should be pushed according to the users' learning rule and pushed according to the users' learning rule characteristic.

Miao, Liu, Guo, & Chen (2015) suggest that students who are currently studying for a master's or doctoral degree could be employed to teach training courses for PGEE counseling. This measure has the following advantages: the age gap between teachers and students is small, and communication is convenient; In addition, these kinds of teachers have a wealth of their own preparation materials and experiences, with greater reference value.

#### 2.2.2 Incentive mechanism in the software

According to Tang (2016), due to the influence of traditional values, Chinese college students' economic sources mainly come from their families, and the imperfect scholarship system and social security also restrict students' willingness to take part-time jobs, which leads to the weak economic ability of college students at present.

In this case, making these students use more functions in this APP at a lower cost will naturally attract more students to use this software.

In the context of mobile Internet, traditional marketing methods can no longer meet the diversified content needs of users, and big data marketing and precision marketing have become the focus of attention from all walks of life, among which incentive is an important factor affecting people's behavior (Guo, 2019).

Currently the design of most popular incentive structures for gamified apps towards rewarding the user after the task has been completed (Garaialde, Cox, & Cowan, 2021). Li & Ke (2018) believe that the bonus point system has been widely used in various industries. After investigation and internal data analysis, they come to the following conclusions: Users who are active in points exchange during the user life cycle will have longer loyalty and use software; In addition, taking points exchange activities as a means of long-term service care and business development is conducive to

magnifying the value of points and improving users' sense of gain and value. Leaderboards are thought to achieve this by giving the points an immediately understandable value, by acting as a metric for social comparison, and by giving users information about the boundaries of performance (Bowey, Birk, & Mandryk., 2015; Garcia, Tor, & Schiff., 2013).

Guo (2019) also believes that encouraging users to share with prizes can attract more potential users' attention and enhance brand influence and brand value. For individual users, sharing behaviors with rewards may obtain certain material or spiritual rewards on the one hand, and spiritual and social benefits which can enhance their social value on the other hand.

To sum up, an Incentive system can be designed for the PGEE Aid APP, the system is quantified in terms of bonus point. Through this system, the coverage of paid content and functions to a certain extent can reduce the use cost of students. The bonus point is mainly obtained by user activation and software content sharing. On the one hand, points can be used as proof in the activity ranking to enhance students' social accomplishment. On the other hand, points can also be used to exchange for some training courses or other daily life rewards that originally need to be paid.

### 2.2.3 Virtual community construction

Rheingold (1993) puts forward the definition of virtual community for the first time. He believed that virtual community is a group of people who are familiar with computer network, through communication and exchange with each other, reach a certain degree of understanding and start to share knowledge and information, and form a caring group for each other to some extent.

As an extension of virtual community, virtual knowledge community has not been defined clearly, concretely and uniformly in the existing literature, and scholars have different definitions and connotations for this kind of community.

Xu (2020) believes that virtual knowledge community has the following characteristics: The subjects of virtual knowledge community are mainly high-quality

professionals; the main content of virtual knowledge community is knowledge exchange. The operation of virtual knowledge community is supported by network platform.

There are four critical social components in an online learning community: communication, collaboration, interaction, and participation (Lock, 2002).

This virtual knowledge community also allows students to have the ability to share their work and thoughts with each other electronically (Cherner et al., 2014).

According to Chen (2013), student-centered activities and collaboration are fundamental to the increased opportunities for learners to take more responsibility for their studies. Collaboration is a social activity that can foster the development of self-regulated learning. In other words, the students need guidance for self-directed study to bring awareness to the learning potentials of their mobile devices because they are already using them in their everyday lives. They just need to be provided with more guidance, collaborative opportunities, and resources to further support their learning needs.

Using the public platform, pushing message and other functions can set up the interaction platform between students and students, teachers and students, increasing the interaction efficiency and promoting meaningful learning (Liu et al. 2018). Hsu and Ching (2013) also argue that extending one's learning community can help sustain learning opportunities.

In view of the PGEE Aid APP envisaged by this paper, a virtual community can be set up to enable students to share their knowledge on the methods of examination preparation, examination experience and the choice of target universities, etc. They can also quickly contact the operator on the use of the software in the community in time and conveniently.

#### 2.2.4 Helping students optimize learning

1) The software should help students optimize their learning and review methods. The meaningful learning state in Ausubel's meaningful learning theory can be the state that this function is trying to help students achieve. According to Ausubel,

Meaningful Learning, is a promising strategy in a formal teaching situation, which consists of non-arbitrary and non-literal interaction of new knowledge with relevant prior knowledge (subsumption). Thus, from successive interactions, a given subsumption progressively acquires new meanings, becomes richer, more refined, more differentiated, and is capable of serving as an anchor for new meaningful learning (Agra, et al, 2019).

In short, meaningful learning is the process in which signs or combinations of signs acquire psychological meaning. Meaningful learning is the process of incorporating new knowledge into the original cognitive structure and constantly reorganizing the original knowledge structure. On the one hand, the new knowledge acquires practical significance, and on the other hand, the original knowledge structure changes correspondingly (Zhang, 2017).

According to Ausubel's theory of meaningful acceptance learning, the traditional way of knowledge acquisition, in which teachers indoctrinate unilaterally and students accept learning mechanically, is not "acquisition" in the real sense. Ausubel believes that to truly realize meaningful learning, three basic conditions must be met, namely, the content of students' learning has potential significance; Learners have appropriate concepts in their cognitive structure that can assimilate new knowledge; Students demonstrate a willingness to learn meaningfully. The potential significance of the learning content, that is, the learning content must be scientific, logical and valuable. On the premise that the learning content has logical meaning, students are more likely to internalize knowledge into their minds and form their own knowledge shelf.

Appropriate concepts that can assimilate new knowledge exist in learners' cognitive structure. Assimilation is an important stage in Ausubel's theory of meaningful learning, whose core idea is that new meaning is acquired through the interaction between new and potentially meaningful concepts (knowledge), and previously learned concepts or propositions. This process is a key part of meaning learning and an important stage in keeping knowledge in mind. Learners have a desire to learn

meaningfully. In teaching practice, many students engage in rote learning because they do not have the heart to learn meaningfully. In order to truly realize meaningful learning, besides the above two conditions, learners must also have the intention of active learning and meaningful learning, that is to say, students must have the willingness to actively stimulate the original knowledge in cognition and establish an impersonal and substantive connection with new knowledge (Ren, 2021).

2) Students' review plan is also a very important part of the whole review process. Helping students optimize their review plans and keeping them on schedule through a series of means is also a task of the PGEE Aid APP.

The preparation period for the PGEE is basically from the end of the second semester of the third undergraduate year to the first semester of the fourth undergraduate year (i.e. from July to December each year).

Although some students also choose to make specific preparations at the beginning of the second semester of the third undergraduate year ((i.e. March), but the preparation before the publication of the annual PGEE outline is often not targeted because it is usually published from July to September. At the same time, since students are still required to take the courses required for their undergraduate degree in the third and fourth years of their undergraduate studies, the PGEE reviewing schedule is particularly important.

First of all, Zhang (2019a) believes that students who intend to take the PGEE should make early planning such as the choice of targeted major and targeted university as soon as possible in the second year of undergraduate study. The earlier the planning, the earlier the planned knowledge reserve can be made. Of course, Zhang (2019a) also mentioned that some students will make temporary changes to their intended universities and majors from September to October of the same year because the PGEE outline does not meet expectations or the entry threshold of the current target university is too high.

Chen (2008) argues that, students should make a review plan for the PGEE as soon as possible before July of the year of the examination. Normally from the perspective of the timeline, from July to early October is the first stage of review, October to early December is the second stage, early December to the exam is the last stage. First of all, in the first stage from July to early October, the review content is highly

knowledge-intensive and informative, and the time spent is as short as possible, so the importance of this period of review time is self-evident. Researcher suggests students should have corresponding review plan and target every month even every week. During this period, students may feel boring but they had to force themselves to complete the task that sets, so that advance the following job smoothly. Of course, if students feel too tired to review at this stage, they cannot achieve the desired efforts, so they can properly participate in some of the remedial classes taught by experts, to help themselves to solve some theoretical difficulties. Secondly, in October to early December, the main task is in the previous stage review, grasp the basic knowledge of the premise, and strive to apply basic theory and basic knowledge to the analysis of real problems. Although the amount of knowledge needed to be mastered in this stage is not as much as in the previous stage, but the requirement of knowledge understanding and knowledge application have reached a higher level. Therefore, the students should focus on the understanding of knowledge rather than simple memory at this stage. Lastly, students must make good use of the period between December and exams. In this stage, students should further comb the whole knowledge system on the basis of understanding and make final preparations.

Zhang (2018) also suggested that students make detailed study plans for examination subjects, including the study of professional course bibliography and other reference materials, and plan and allocate according to the amount of review time, which can be realized by means of time flow such as GANTT chart, and then follow up and implement according to the plan. Mind mapping is also an important way to build



knowledge and help prepare for exams.

The comb of mind map is not only to establish a framework, but also to associate memory, grasp the overall knowledge network of the subject to be reviewed, and make it easier to review and memorize (Zhang, 2018). In addition, the construction of mentality should be done well. According to the relevant data of the survey conducted by Wang and Zhang (2014), among the 98 students who participated in the postgraduate entrance examination investigated, 51 students failed to achieve the score they had achieved in the virtual exam in the formal written exam.

Finally, the preparation for secondary exam should be arranged as soon as possible. The time of review for the second interview depends on students' target major and knowledge basis (Zhang, 2018).

The survey of Wang and Zhang (2014) also showed that having meaningful contact with the target adviser as soon as possible after passing the written exam could increase the success rate of passing the secondary exam and thus successfully passing the PGEE.

From this perspective, the content pushed in PGEE Aid APP should help students optimize their learning methods. In addition, there should be a special module in the APP for students to set up review plans, and the APP should also put forward suggestions for students to make review plans from the perspective of big data.

#### 2.2.5 User Care

From the process of PGEE, the information is divided into register information, college information, tutor information, preparation information, and information of basic necessities of life. Each examinee needs to read a lot of paper media and collect electronic information on the Internet. It will cause a lot of waste of resources and time, and there will also be bias in information screening. At this time, the information service of PG entrance exam is particularly important (Pan, Wang, & Zhang, 2018). Pan, et al. (2018). Also think that if the operator can provide timely and personalized information services for students, through the convenient and fast network platforms, students can



get information at any time, participate in online interaction, Meet information needs and save human resources and material resources. Then what a relief that is for them. This actually echoes the previous section.

Li & Ke (2018) believe that operators provide services rather than products. Care bundling is an internal term used by telecom operators. It means to understand the needs of users, think what they think, and help users to design their own solutions. Care is the entry point, bundled service is the process, and users enjoy the additional services provided by the operator and express satisfaction in the result. Such a service plan not only facilitates users, saves users' expenses, but also increases users' stickiness and builds a win-win situation for users and operators.

From this point of view, an effective PGEE Aid APP can provide valuable additional services for students around the postgraduate entrance examination. It makes it more convenient for users to solve the surrounding matters related to the PGEE (such as the introduction of the target university and the official website link, the ranking of the target master major of the target university in the domestic universities with similar majors, examination registration, examination materials submission, the surrounding information of the written exam and the secondary exam's exam venue, etc.)

## **2.3 Design Thinking**

How to better discover students' needs for the PGEE Aid APP in the next stage of interview and questionnaires, and convert their needs into the actual functions or specific attributes of this effective PGEE Aid APP requires certain innovative thinking techniques. DT is one of many innovation process methods that can help achieving this aim.

### **2.3.1 Definition, discussion and thinking skills of DT**

Design thinking is a problem-solving approach which reduces a number of broad design methods into a simple replicable framework, and is utilized in an ever-increasing number of settings to address a growing variety of challenges (Baker &

Moukhliiss, 2020). DT assumes the perspective of the customer or user, so much so that in some circles it is referred to as human-centric (Gruber, De Leon, George & Thompson, 2015).

This perspective calls upon empathy to better recognize and address the human and often tacit needs of user-customers. It also involves probing for lived experiences, including thoughts, feelings, and the meanings people attach to what they do or have (Carlgren, Elmquist, & Rauth, 2014).

Another perspective assumed by DT is that designers should expect to fail early and often (Brown, 2009; Lockwood, 2009).

Liedtka (2015) found that, paradoxically, by welcoming failure, DT reduces the likelihood of user-customer dissatisfaction by permitting less costly and timelier adjustments. The process phases in DT vary by version, but they usually include problem definition, discovery, ideation, and prototyping/testing. While the overall thrust is to move progressively through phases, DT is distinctive in its emphasis on cycles of divergence and convergence within phases (Leifer & Steinert, 2011).

In the divergence phase, designers produce an array of ideas, and in the convergence phase that follows, they sort them, sift through them, and decide on which to pursue. The steps within each phase can be repeated to reduce bias while maintaining forward momentum. There is a distinctive feature of DT is the notion of problem discovery. The DT process assumes that the problem may need to be found or recast. Since the wrong problem may have been identified initially, DT starts with a search for the problem anew, revisiting the search even as it proceeds to later steps (Liedtka, 2015). DT works only when tools and methods used are aligned with this new way of thinking. According to experience of Brenner, Uebernickel, and Abrell (2016), deployment of appropriate methods is one of the core success factors of DT projects.

There are several specific tools that are widely used to briefly describe how a DT works:

1) Empathy Map: The empathy map analyzes talks and interviews with stakeholders, especially end customers. These talks are categorized into four categories: “Say” (quotations and central terms), “Do” (observed behaviors), “Think” (assumptions of thoughts) and “Feel” (emotions).

2) Whys: The 5-Why method’s basic premise is: in the course of analysis, participants repeatedly ask “Why”, leading everyone deeper into the root-cause of a problem or some similar phenomenon. The number of Why-Questions is not limited to five, as the name suggests. Instead, the number five is an indicator that it is important to ask multiple times “Why”.

3) Persona-Method: The persona method comes originally from the research area of human-computer-interaction. Personas are, according to Cooper (2004), artificial, invented persons as archetypes, they embody the behavior or personality characteristics of a group of persons, e.g. digital natives of the age 16-19. These personas are named-for example Jack, Ludwig, Hayasaka. The naming of personas facilitates their use in the DT.

4) Observation: The observation of stakeholders, especially customers, is a proven method to reveal obvious and hidden needs. During, or after, the observation of a person, clarifying questions can be asked. When shadowing, researchers accompany a person over a longer period of time as closely as possible. Through the intense and uninterrupted contact, one can observe the use of a product or service, as well as activities before and after, which are often very important and may lead to reformulation of the challenge.

5) Storytelling: This method originally comes from marketing and is based on the idea that a well-told story captures more attention than a lengthy PowerPoint presentation. Within DT projects, storytelling is used to present innovative ideas or solution possibilities effectively (Quesenbery & Brooks, 2010). In many DT

projects, videos emerge, parallel to the prototypes, showing the prototype in a real-life situation or within a process. These videos can be seen as one form of storytelling.

### 2.3.2 Application of DT

DT is widely used as a research method in studies Mabogunje, Sonalkar, and Leifer (2019) used DT to discuss Redesigning Social Organization Schmieden, Mayer, Taheri, & Meinel (2019) studied the design of MOOC from the perspective of DT. Tanner and Landay (2019) discussed how to produce good designs. Dolata and Schwabe (2016) studied how to embed DT in information system. Brenner et al. (2016) gave several examples of DT's application to software development:

1) Hasso Plattner, one of the founders of SAP, acknowledged the potential 10 years ago. He then initiated and financed the d. School at Stanford University and built a large area for Design Thinking at the Hasso-Plattner-Institute at the University of Potsdam. Based on concepts, knowledge, and experience from these ventures, he anchored Design Thinking as the central innovation method within SAP.

2) Flemo-Private Car Sharing (DT Project at the University of St. Gallen): car sharing is becoming an interesting alternative to buying or leasing a car. In 2011, Audi AG asked the Institute of Information Management of the University of St. Gallen to develop innovative ideas for car sharing. Together with the University of Modena and Reggio Emilia, Flemo was developed: a concept for car sharing in the private environment. The basic idea behind Flemo: multiple family members, neighbors or friends share a car. The source for this solution was intensive conversations with customers all over the world, where it became apparent that car sharing in the private environment can be an efficient way of reducing cost and improving ecological behavior. Private car sharing reduces certain risks: people sharing a car know each other, motivating them to take care of the car.

Flemo is centered on an app connected to the car electronics via a box. Through this app, the user can set the maximal reach of the car, maximum speed, reserve the car and do the billing. In December 2014, Audi AG began trial runs of a similar

concept with the name "Audi Unite" in Stockholm, Sweden. Again, this project shows how important it is to talk to existing and future customers and identify their needs. With the help of the DT process, it was possible to find new innovative solutions. In this example, DT combined Customer Needs with Innovative New Technology. In the next chapter, the research method of this paper will be carried out based on DT.

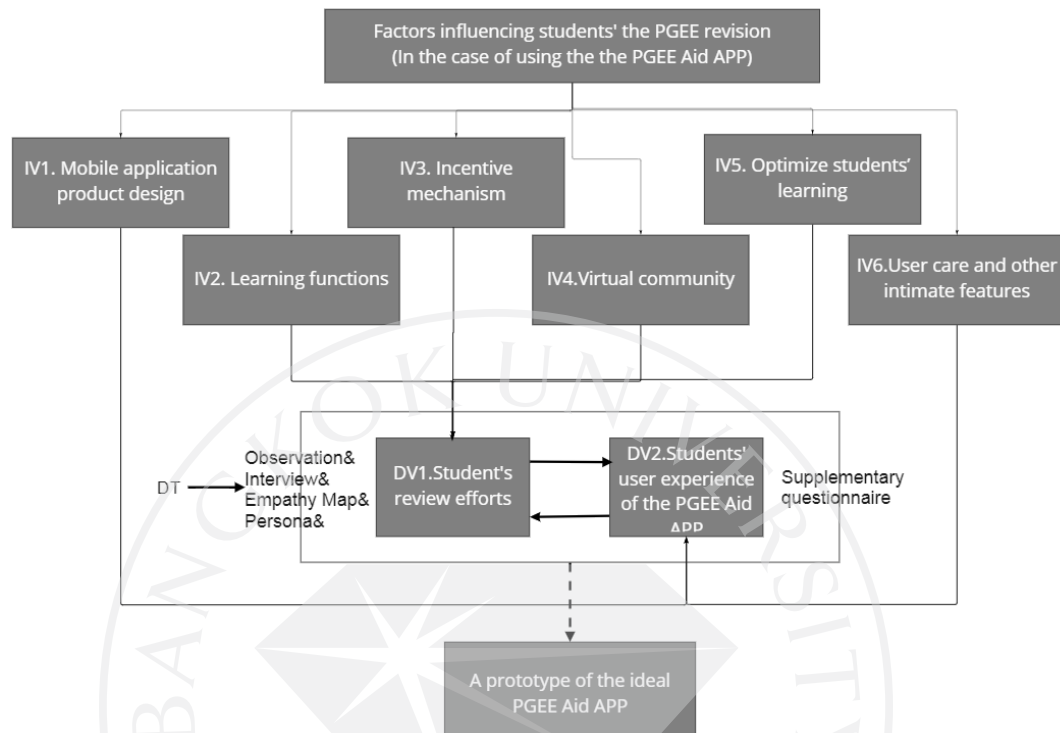
## **2.4 Summary and Conceptual Framework**

Section 2.1 introduces the importance and design principles of the PGEE Aid APP's UI and interaction. Section 2.2 introduces the functions and contents of an effective PGEE Aid APP. For students who conduct PGEE review with the help of the PGEE Aid APP, these two aspects are the two objective factors that affect the review efforts the most.

Section 2.3 introduces the DT method and summarizes needed perspectives and related tools. This part provides guidance on how to interview students and formulate questionnaires. It also plays a very important role in subsequent data collection and analysis, conclusion formation and product prototype construction.

The conceptual framework of this paper is as follows:

Figure 2.2: Conceptual Framework



## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Research Method**

This explorative study employs in essence a qualitative research design based on the Design Thinking method and some of its investigative techniques. In recent years, researchers such as Mabogunje et al. (2019) and Schmieden et al. (2019) argued that DT can also be viewed as a business research method.

Based on the literature review, the research conceptual framework and variables were organized.

Subsequently, based on the principle of DT and thinking techniques, The construction of The interview, Observation, was successively carried out.

The interview data were analyzed by using narrative coding and Persona method and Empathy map building.

Finally, based on the data obtained by these thinking techniques, a small scale questionnaire survey was conducted to quantitatively explore the validity of the data.

In summary, this study mainly carries an exploratory study according to the following steps:

- 1) Review the relevant literature on higher education Quality Evaluation, and identify the relevant factors that affect students' preparation for the PGEE.
- 2) Download the existing commercial PGEE Aid APPs and use them for a short time.
- 3) Students were observed in the classroom revising for the PGEE.
- 4) Combined with the previous steps, interview planning was carried out through DT techniques.
- 5) Conduct interviews and code the responses.

6) Further DT analysis was performed using the Empathy Map and Persona.

7) Based on the data obtained in the previous steps, questionnaires were written and distributed to a small scale for validation.

8) The findings and conclusions are drawn, and a prototype of The PGEE Aid APP based on this study is made.

### **3.2 Data Collection**

#### **3.2.1 Observation**

The researchers first observed the revision behavior of randomly selected students who were preparing for the PGEE in the classroom building no. 1 of BU's DONGHE Campus. Two observations were made, each for at least one hour.

Then, the researcher selected two commercial PGEE Aid APPs with the largest download record and the largest software volume and one with the median download record and median software volume in the MIUI APP market for temporary experience.

Through the above two activities, the researcher has a preliminary understanding of how students conduct the actual review of the PGEE and the functions of the current PGEE Aid APP, which provides a basis for subsequent interviews and questionnaires. Summary reports of the conducted observations are presented in Appendix A.

#### **3.2.2 Interview**

In this session, interviews were arranged with respondents who had already taken the PGEE. The interview was conducted with open-ended structured questions. Inspired by the 5WHY thinking technique, the researcher asked subsequent follow-up questions based on the actual situation after the interviewees answer. Thereby, the questions were not limited to the WHY question. The detailed format of the interview guide is shown in appendix B.



The interviews were conducted from June 20 to July 6, 2022. Eleven students were interviewed for 10-15 minutes. All their answers were recorded. The summary table of the interviewees and their personal PGEE status is shown in Table 3.1. The qualitative analysis coding and evaluation of the interview is presented in Appendix C.

Table 3.1: Information about Interviewees

Interviewee	Targeted Master Major	Undergraduate Major	Personal PGEE status	Date of interview
A, male	Communications Engineering	Communications Engineering	Passed the PGEE	20/6/2022
B, female	Applied Economics	Economics	Failed	22/6/2022
C, male	Medicine (Orthopaedic)	Clinical Medicine	Preparing for the PGEE right now	23/6/2022
D, female	Subject education (Ideological and	Ideological and Political Education	Passed the PGEE	24/6/2022
E, female	Laboratory Medicine	Laboratory Medicine	Failed/ Preparing to try again	28/6/2022
F, male	Nursing Science	Nursing Science	Failed/ Preparing to try again	28/6/2022
G, male	Urban Planning	Urban Planning	Failed	29/6/2022
H, female	Medicine (Ophthalmology)	Clinical Medicine	Passed the PGEE	29/6/2022

(Continued)

Table 3.1 (Continued): Information about interviewees

Interviewee	Targeted Master Major	Undergraduate Major	Personal PGEE status	Date of interview
I, male	Computer Science and Technology	Computer Science and Technology	Failed	30/6/2022
J, male	Electronic Information	Microelectronics Sciences and	Passed the PGEE	2/7/2022
K, female	Subject education (Ideological and	Ideological and Political Education	Passed the PGEE	6/7/2022

### 3.2.3 Empathy Map and Persona

Compared with those who did not pass the PGEE and those who are currently reviewing for the PGEE, respondents who successfully passed the PGEE have relatively more convincing views on review methods, review plans and views on the PGEE Aid APP. Therefore, in this part, the researcher summarized the common characteristics of all interviewees who passed the PGEE by creating an Empathy Map and a Persona to obtain further findings to supplement the interview data. The Empathy Map and Persona for this group are shown in Annex D.

### 3.2.4 Supplementary questionnaire

Although the research method of this study is mainly based on DT technique. However, in order to verify the data obtained in the first three sections, the researchers developed a questionnaire for small scale distribution and data collection. This part does not involve in-depth SPSS analysis, but simply discusses the distribution of answers. The contents of the questionnaire are presented in Appendix E.

This survey was conducted from July 9 to 11, 2022, and was distributed through Wenjuanxing. Wenjuanxing is the largest questionnaire distribution platform in China, which makes it convenient for respondents to fill in questionnaires and also provides some basic data analysis functions for respondents. The address of the questionnaire at <https://www.wjx.cn/vm/Q2k2b8F.aspx>, A total of 33 respondents filled out the questionnaire.



## **CHAPTER 4**

### **DATA ANALYSIS**

#### **4.1 Finding of Observation**

Using observational techniques, the researcher made the following findings:

##### 4.1.1 Observe the students' PGEE review in the classroom

1) Students usually take long or short breaks every 15 minutes when reviewing. Some relaxing or mildly entertaining functions can be arranged in the PGEE Aid APP, mainly in the form of jokes or interesting knowledge questions and answers. This can make students in the review process will not be too tired.

2) Due to the hot and humid summer in Baise city, the exchange of cold drinks can be added into the Incentive mechanism of the PGEE Aid APP. Can make students feel uncomfortable in the review process.

##### 4.1.2 Experience the commercial PGEE Aid APP on the market

1) No matter what kind of the commercial PGEE Aid APP it is, the previous exam practice function is the core of them. An efficient PGEE Aid APP must collect as many exam papers as possible from the past year (for example, within 5 years or 10 years) for students to practice.

2) As the Donghe Campus of BU mainly concentrates on students majoring in science and engineering, they will face with a large number of calculation questions in the three PGEE test subject of Foundation Course, Major-Foundation Course and Major Course. However, among the relevant functions of the current commercial PGEE Aid APP, it is quite inconvenient to input various mathematical symbols, which may also be the reason why most of the observers used paper materials for review in Part One observation, because it is much faster to write those mathematical symbols with a pen than to input them in the software. Therefore, it's necessary to consider about how to optimize the input of these professional symbols to ensure that students majoring in science and engineering can use the PGEE Aid

APP as easily as students majoring in literature.

3) In both APPs, a PGEE countdown is set on the front page to remind students to review. But there is a loophole, if students do not open the APP, then the function is effectively disabled.

4) In the two APPs, there are no intimate auxiliary functions to help students conveniently solve the issues that are weakly related to the PGEE. For example, psychological counseling for students during the revision process, or test registration direct link, test site traffic information and so on. What is missing from this section is the same as the section discussed in 2.2.5.

#### **4.2 Finding of Interview**

By coding the responses of all interviewees, the researchers found the following:

1) Students prefer to get official information about the PGEE from the Internet. In an efficient PGEE Aid APP, links pointing to the official websites of universities and educational institutions can be added to help students better obtain information.

2) Add an interactive communication community in the PGEE Aid APP, so that students who are preparing for the PGEE can communicate with each other about college choices, and they can ask successful experiences of students who have already passed the PGEE, etc.

3) In an efficient PGEE Aid APP, the learning function is mainly realized in four directions. The first is the practice of past exams. The second direction is to provide live tutorials and MOOCs. The third direction is to help students or build knowledge framework for students. The fourth direction is to provide the PGEE outline, tutoring materials, and electronic textbooks.

4) There is no clear and precise learning method that can guide the review of the PGEE for all master's majors. Ausubel's theory is only an ideal state and a

general guideline. In practice, the revision of the PGEE still requires students to spend a lot of time, and there is no shortcut.

5) The APP should be able to help students make review plans for time or subjects in the APP.

6) If the APP can help students optimize their review plan in real time according to their own situation, students' review experience and review will be better.

7) Students may have psychological problems in the review process. If the APP can provide psychological counseling, students' psychological pressure can be reduced faster.

8) One of the biggest advantages of such software over traditional paper materials is portability. In many public places where paper review materials are not convenient (such as taking public transportation or during campus internships), students can use the PGEE Aid APP to memorize knowledge points, such as reciting English words.

9) Due to the mobility of software, developers and content providers must consider how to divide knowledge into small parts for students to review in spare time during the implementation of the above functions.

10) As students are sensitive to the pricing of paid content, they can be attracted to use some content that needs to be paid for by converting it into free exchange through certain user behaviors.

11) As students revise for the PGEE, It takes a lot of time every day. The designer must ensure that the user's eyes are comfortable while using the PGEE Aid APP.

12) In the stage of overall software design and server erection, the designer must consider how to ensure the stability of the data link between the user and the background server when using the APP and the security of the data in the server.

13) Compared with other majors, the busy undergraduate internship schedule and the uniqueness of the PGEE may make medical students prefer to use PGEE Aid APP for revision.

14) Error analysis and error statistics can be added to the past exams practicing of the software to help students review better.

15) Collecting statistics of popular exam topics over the years in the software can guide students to revise more effectively

16) Designers should consider how to keep the software engaging so that students don't stop learning when, for example, they receive messages from social software,

17) Since students majoring in science and engineering will face a large number of calculation questions in the PGEE, The PGEE Aid APP must have access to input tools for special symbols so that students can easily and quickly input special mathematical symbols when they use the PGEE Aid APP for review.

18) Since students who are reviewing for PGEE are very sensitive to the time spent, designers must consider optimizing the loading time and network response time of PGEE Aid APP to improve students' use experience as much as possible. Otherwise, students will waste meaningless time due to the excessively long loading and software lag. This will reduce students' favorable impression of the APP.

19) It's relatively easy to help students make or optimize review plans, But how to urge students to complete the review according to the plan needs to be considered.

20) If a communication platform can be established within the software, it is an important supplement to the content of the software, because students have other sources of information, and mutual communication can spread some information that is not covered by other parts of the software. This is also helpful in improving user engagement.

21) In order to ensure the use experience of the software, designers should ensure that there are as few bugs in the software as possible, and keep communication with users to ensure that feedback on bugs can be received in a timely manner. Operators also need to consider how to reduce advertising damage to the user experience.

22) To ensure the professionalism of software, designers and operators should ensure the validity and authority of the content source as much as possible.

23) In the PGEE, except for English, political theory and mathematics, the rest of the subjects are set by universities themselves. So if operator could collect as many past exams as we could from every subject in every university, It will attract more students to use the APP for revision.

#### **4.3 Finding of Empathy Map and Persona Building**

Through the building of Empathy Map and Persona for the interviewees who have passed the PGEE, researchers have made the following additional findings:

4.3.1 Although students who have passed the PGEE are no longer users of the PGEE Aid APP, compared with students who are reviewing for the PGEE and those who have not passed the PGEE, their review methods are relatively more effective, their review experience is relatively richer and more accurate, and their review materials are relatively more complete. If they can be attracted to the PGEE Aid APP for experience sharing through some material rewards, it will undoubtedly be a huge supplement to the APP content, and it can attract more students who are reviewing for the PGEE to use this APP.

4.3.2 Perseverance is essential to complete the PGEE review as planned, as students are expected to devote all their free time to the review at least four and a half months each day outside of normal undergraduate study and internship. This kind of intense mental work can't be done without firm conviction. Although perseverance is difficult to cultivate in a short time, students can be encouraged to pay more attention



to the construction of mentality by putting corresponding articles or videos in each content section of the APP.

#### 4.4 Result of Supplementary Questionnaire

##### 4.4.1 Demographic data of respondents to the questionnaire

In terms of gender, there are 12 males and 21 females. In terms of the PGEE situation of the interviewees, there are 21 interviewees who are reviewing for the PGEE, 3 interviewees who have passed PGEE, and 9 interviewees who have not passed the PGEE. Cross analysis of the above two conditions can get the following table:

Table 4.1: Respondents' Respondent gender and PGEE status

	Male	Female	Total
Preparing for it	6	15	21
Passed	0	3	3
Not Passed	6	3	9

## 4.4.2 Respondents' attitudes towards functions and design in the PGEE Aid APP

Table 4.2: Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	S. D.
1. I think the Review Reminder function in the APP can be helpful to enhance my review efforts.	6.06%	3.03%	51.52 %	39.39 %	3.242	1.342
2. I think the Countdown of PGE Exam function in APP can help enhance my review.	6.06%	0	48.48 %	45.45 %	3.333	1.394
3. I think the function of making review plan according to time shaft and test subject can enhance my review efforts.	6.06%	6.06%	42.42 %	45.45 %	3.272	1.359
4. I think that, when I complete a certain stage of review according to the review plan and get certain material or spiritual rewards, I can improve my experience of using this APP.	6.06%	0	36.36 %	57.58 %	3.455	1.471

(Continued)

Table 4.2 (Continued): Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	T. D.
5. I think I can get some material or spiritual rewards when I share some high-quality contents of the software with my friends, which can improve my experience of using this APP.	9.09%	3.03%	33.33 %	54.55 %	3.333	1.394
6. I think that, adding the function of combing knowledge points or constructing knowledge framework for specific subjects into the APP can improve my review efforts.	3.03%	0	42.42 %	54.55 %	3.485	1.490
7. I think the function of the previous exam practice or the mock exam can enhance my review efforts.	3.03%	0	42.42 %	54.55 %	3.485	1.490
8. I think the functions of error analysis related knowledge link and error statistics after simulated exams on the APP can improve my review efforts.	0	3.03%	42.42 %	54.55 %	3.515	1.510

(Continued)

Table 4.2 (Continued): Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	U. D.
9. I think that, if I can obtain the PGEE outline, the E-book of each course and other teaching auxiliary materials on the APP, it can improve my review efforts.	0	3.03%	48.48 %	48.48 %	3.454	1.470
10. I think obtaining the live tutorial and MOOCs about the PGEE on the APP can improve my review efforts.	0	6.06%	48.48 %	45.45 %	3.394	1.431
11. I think an interactive community can help me better choose the target university, obtain examination materials or communicate with seniors, so as to enhance my review efforts.	3.03%	6.06%	39.39 %	51.52 %	3.394	1.431
12. I think functions like short jokes can make me have a rest when I review, so that I can review better. It would be better if the jokes were relevant.	3.03%	12.12 %	45.45 %	39.39 %	3.212	1.325

(Continued)

Table 4.2 (Continued): Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	V. D.
13. I think the function of psychological counseling can reduce my psychological pressure during review, so that I can review better.	0	6.06%	51.52 %	42.42 %	3.364	1.413
14. I think adding relevant information of the target university (enrollment phone number, direct link of the official website, navigation of the geographical location of the university, comprehensive strength analysis, historical admission rate, etc.) in the APP can enhance my experience of using this APP.	3.03%	3.03%	42.42 %	51.52 %	3.424	1.451
15. I think adding relevant information about the target major (employment prospect of the major, ranking of universities with the major, etc.) in the APP can enhance my experience of using this APP.	3.03%	3.03%	42.42 %	51.52 %	3.424	1.451

(Continued)

Table 4.2 (Continued): Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	W. D.
16. I think the direct link function of the PGEE registration in the APP can enhance my experience of using this APP.	3.03%	3.03%	51.52 %	42.42 %	3.333	1.394
17. I think if this APP can provide the surrounding information of PGEE exam site (map navigation, nearby accommodation, etc.), it will enhance my experience.	3.03%	0	57.58 %	39.39 %	3.333	1.394
18. I think the interface pattern and color arrangement of this APP should take into account the protection of users' eyes, so that my eyes will not get tired too fast when I use this APP for review.	3.03%	0	54.55 %	42.42 %	3.364	1.413
19. I think the design style of this APP should be rigorous and simple but attractive, so that I can better focus on the PGEE revision.	3.03%	0	48.48 %	48.48 %	3.424	1.450

(Continued)

Table 4.2 (Continued): Respondents' attitudes towards functions and design in the PGEE Aid APP

Strongly disagree	Disagree		Agree		Strongly agree	
1	2		3		4	
Question	1	2	3	4	Mean	X. D.
20. I think the operation logic of this APP must be friendly, and the storage space and memory space of the software should not be too large.	3.03%	6.06%	45.45 %	45.45 %	3.333	1.394
21. I think when I have achieved a good review effort by using this APP, I will be more willing to continue using this APP or recommend it to others.	3.03%	0	42.42 %	54.55 %	3.485	1.490
22. I think if this APP gives me good experience, it will also help me enhance my review efforts from the side.	3.03%	0	48.48 %	48.48 %	3.424	1.450

As can be seen from the above data, the vast majority of respondents remain welcome to the function and design concept proposed based on the previous data.

To sum up, through the supplementary questionnaire survey, the rationality of the conceptual framework of this paper is also verified to be reasonable to some extent. It also shows that the data obtained by qualitative analysis using DT is relatively effective.





## **CHAPTER 5**

### **CONCLUSION AND DISCUSSION**

#### **5.1 Conclusion**

To sum up, the underlying design of software is the key to determining the user experience and the basis for realizing software functions. The functionality of the User Care category can also help improve the User experience. The Incentive mechanism can also increase the stickiness of non-paying users and expand user groups.

Learning function is the key to determine the learning efforts, it provides students with a review channel. The Optimize Students' learning category is more like a guide to improve learning.

The virtual community is a supplement to other parts of the software and plays a role in promoting students' learning efforts and use experience.

The learning efforts and experience of students using the PGEE Aid APP are mutually promoting. If students obtain good learning efforts by using the APP, their experience will naturally improve. If the APP brings them a good use experience, it can also help to enhance their review efforts to a certain extent.

In order to achieve this virtuous cycle above, the implementation of each part is described in detail below.

##### **5.1.1 The software design of the APP**

Software design is the foundation of content implementation. Good use experience can help improve students' the PGEE revision efforts.

First of all, it is necessary to carry out targeted optimization for different terminals and different systems, so as to make the interaction of software adapt to the operation habits of users, page loading time in the software is not too long, and the operating memory of the phone that needs to be used is not too large. So that even students with older phones can get a relatively good use experience.

Secondly, in the design of the page, it is necessary to use colors and patterns that make students' eyes not quickly tired, such as light green or pictures with low contrast

Finally, a secure server must be set up to convince students that their review materials are safe on the server. At the same time, students should be assured that the operators will not cut server costs due to operational problems and put the safety of students' review materials at risk. Considering that this PGEE Aid APP is designed for BU, if it is also operated by BU, students can have more confidence in information security due to the official nature and reputation of BU.

#### 5.1.2 Learning functions

Learning function is the core of a PGEE Aid APP. As an efficient PGEE Aid APP, its learning function includes four parts that are presented in the order that students work through it in chronological order of usage:

First of all, it provides complete electronic review materials for students, including the PGEE outline, textbooks of various subjects and authoritative reference books.

Secondly, it provides a knowledge framework construction function, which can be built by the operators or students themselves with the help of tools such as Mind Mapping. Moreover, the system will also recommend the content of knowledge framework construction according to the popular test points in recent years, so that students can be more targeted in the construction of knowledge framework and review.

Thirdly, students can also get MOOCs and Live broadcast teaching courses, or even one-to-one tutoring in the APP to help their PGEE review. MOOCs and Live Broadcast Teaching courses can be free or fee-paying, but students can also earn rewards for a series of activities within the software in exchange for fee-paying courses, as described in a later section. One-on-one online tutoring is usually expensive, so this feature is not discussed in this article.

Lastly, it provides a complete function of past exam practice. Students can find all the exam papers in the last 5 years in the software. Students can practice answering the questions on these papers continuously in the software. This APP is equipped with an input tool for special mathematical symbols, so that students majoring in science and engineering can practice calculation problems in the APP. And after the practice can get the system to give the error analysis, related knowledge links, and error point statistics and score statistics and so on. The system can also carry out the proposition according to the popular test points, in order to create a paper that does not appear in the past exam but also conforms to the popular test points.

#### 5.1.3 Incentive mechanism

Due to traditional factors in China, most undergraduate students do not have independent financial resources, so they are very sensitive to the pricing of products and services they need to pay for. However, the paid pricing of educational products is generally relatively expensive, which is also the reason why some students prefer to buy paper materials for review.

In the efficient PGEE Aid APP described in this paper, if part of the paid services can be converted into rewards for users' sharing and active behaviors, some students with poor economic foundation can be attracted to use it. As this APP is a learning guidance APP, the ideal sharing behavior is to share the content in the software to the social platform, which can also attract new users to experience the APP. Active behavior is bound to the execution of the review plan, which will be described later.

#### 5.1.4 Virtual community

A PGEE Aid APP with built-in communication community can also help students access materials more quickly that may not be available in other sections of the software, which is an important supplement to the content of the software. Students can also communicate in the community about the choice of target university and target

major, review methods, and even encourage each other, which is quite effective in alleviating the psychological pressure existing in students' revision.

#### 5.1.5 Optimize students' learning

Software needs to guide students to meaningful learning based on their own professional background. The software should help students to associate and remember new knowledge based on old knowledge, so as to finally establish a knowledge framework, which is consistent with part of the content mentioned in 5.1.2.

In order to keep the students' willingness to learn meaningfully, the APP must help students set in the software conforms to revise their plan, and when they completed a certain stage of the review, they not only consolidate the old knowledge, according to the design of the 5.1.3, they can also get some MOOC that need to be paid, so as to promote them to review again or willingness to learn.

Of course, in this process, students may also need to be urged. The display of exam countdown and push messages to remind students to review can also strengthen students' attention to review.

From the interview, the researcher knows that students often did not review as planned in the actual review, which is often due to the irrationality of the plan. Therefore, if PGEE Aid APP can check the rationality of students' review in real time and give optimization suggestions, it can also reduce unnecessary time waste of students.

#### 5.1.6 User care

These functions are rarely or almost not involved in other commercial PGEE Aid APPs. In chronological order, the functions of this section include the following sections:

First of all, the first function is the presentation of relevant university and major information provided by the software when students choose the target university and major in the early stage. Students can easily find the ranking and admission rate of a certain major in the software, as well as the employment situation.

The next is the decompression function and psychological counseling provided by the software in students' review. In the process of review, due to the heavy workload of PGEE revision and the time conflict between review and daily study, students often have great psychological pressure, which is not only bad for review, but also bad for students themselves. The provision of psychological counseling can solve these problems well.

Later, when the PGEE registration is open, the software provides the PGEE registration link direct connection function.

Finally, in a few days before the PGEE's two exams, the software will provide location navigation of the PGEE written examination and secondary examinations' sites as well as information of transportation and accommodation nearby.

These additional functions can enable students to realize most of the things related to the PGEE in one APP without using browsers or other apps for additional information collection, thus saving students' time and increasing students' favorable impression on the software.

#### 5.1.7 Prototype

The prototype of the PGEE Aid APP formed based on the conclusions above is shown in Appendix F.

## 5.2 Discussion

Compared with commercial PGEE Aid APPs on the market, the efficient PGEE Aid APP discussed in this paper has the following advantages:

First of all, as the efficient PGEE Aid APP discussed in this paper is designed for BU, if it is eventually operated by BU, this software can gain an innate information advantage. According to the interview, the researcher learned that the database of past exams in the commercial PGEE Aid APP is not complete at present. Some universities may be reluctant to disclose their propositions to these commercial organizations for reasons of confidentiality. However, Baise University and other universities are

government-run universities and have natural advantages in mutual communication and access to information. With this advantage, the PGEE Aid APP can build a more comprehensive database than other commercial apps.

Secondly, as this APP is operated by BU, its can gain more investments from stable sources like the government than that of other commercial apps can do. Therefore, the proportion of advertising and paid-for functions in the APP can be reduced, which are two of the main factors that reduce students' use experience.

Third, as the user Care category of other commercial PGEE Aid apps has few functions, this efficient PGEE Aid APP can enhance students' perception and enhance their experience when using this APP. Thus, the gap between this APP and other commercial PGEE Aid APPs is opened.

### **5.3 Limitations**

5.3.1 First of all, the PGEE Aid APP is only a tool to help students review. Whether students pass the PGEE or not is more related to the factors of students themselves. Students' PGEE scores are the result of their review efforts, their mentality on the days of the exams and various emergencies.

Secondly, most students will not only rely on the PGEE Aid APP or not at all for revision.

Therefore, it is difficult to study the domination of the PGEE Aid APP on the pass rate of the PGEE in practical operation.

Thus, the direction of this study is limited to the qualitative influence of the PGEE Aid APP on the review efforts, rather than the quantitative study of the PGEE Aid APP on the pass rate of PGEE.

5.3.2 There is very little discussion in this article about how products make money to survive. Although this product is defined as a product operated by BU, its operational capability should always be considered, because the University cannot invest endlessly.

Although Incentive mechanism is discussed to some extent in this paper as a replacement for payment-based schemes, it is unlikely to be 100%.

In the supplementary questionnaire, part of the reason why respondents expressed such high enthusiasm for PGEE Aid APP is that the questionnaire did not mention the pricing of services and content at all. When it comes to this, the answers may vary considerably.

However, data on operating costs are often kept as trade secrets and are difficult to obtain, especially for non-practitioners. This is the biggest reason why this article didn't cover it.

The researcher conducted all interviews with students in the same category of undergraduate and graduate majors. Students whose undergraduate and graduate majors are not in the same category cannot be interviewed because they have not been found. The number of such students is relatively small, but since they will be doing more difficult revision than other students, other discoveries may be made from them. In addition, not so many interviews and questionnaires were conducted

5.3.3 As the PGEE revision and examination are across a year of behaviors. More data can be obtained if a student can be found and regularly interviewed and observed from the time he or she begins revision until the completion of the PGEE. However, as this will hinder the review and daily life of research subject, it is not necessarily operable.

5.3.4 Since the researcher is not a practitioner or has relevant professional background in the field of mobile Internet, this study is only described from the perspective of an enthusiast who keeps an interest in Internet software products, and only discusses the nature of the PGEE Aid APP from the perspective of consumer demand.

As for the properties that the PGEE Aid APP should have according to this study, this paper only describes their general outline, and does not involve how to realize these properties. Strictly speaking, the specific expression and realization of

each property can be written as a separate paper. Therefore, the APP prototype in Appendix F may not fully summarize the viewpoints discussed in the paper.

#### **5.4 Suggestions for Future Research**

5.4.1 Since the design of operating cost and paid content pricing is not involved in this study, if people with relevant background conduct similar studies in the future, they can conduct in-depth and specific discussions from the above aspects. Or researchers with a background in software development can discuss the ways and possibilities of realizing the functions discussed in this paper from the level of software design.

5.4.2 Although the efficient PGEE Aid APP discussed in this paper is designed for BU, but if it is limited to a single university, the upper limit of potential users will be limited. If university alliance within a certain range can be formed, share this APP or other resources. On the one hand, it can further strengthen communication and data sharing between universities and break through resource barriers. On the other hand, it is also beneficial to the sustainable operation of the APP. Future studies may discuss the feasibility of this aspect.



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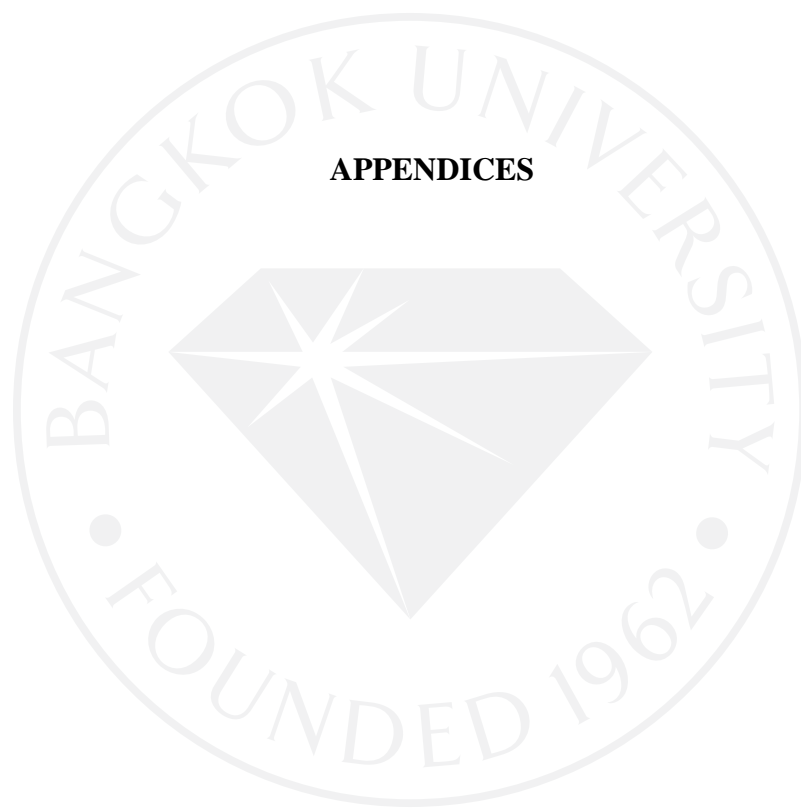
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**APPENDICES**

## Appendix A

### Observation Recording

#### Part 1: Observing students in classrooms who are preparing for the PGEE

The researchers chose to observe students preparing for the PGEE in a classroom on Baise University's first campus (DONGHE Campus) (the subjects did not know they were being observed). The time was chosen on weekend nights, as Baise University usually does not arrange classes for students during this time. For one thing, there are more spare classrooms; for another, students have time to do what they want to do. (For students who want to take the PGEE, this is also a good time to prepare for the exam.)

#### 1) Observations made on the night of June 11, 2022

Time: 20:00 to 21:15

Objects: two students majoring in science and engineering, both male.

Review behavior: Practice answering questions from past exams. (On the basis of speculation, a large number of calculations are needed in the PGEE for students in science and Engineering majors. They have a scratch paper on their desk, and these students write down the idea and the process of the operation.)

The review behavior of the two subjects was carried out through paper materials. Each man carried a bottle of water.

Object a takes A simple break of about one to two minutes every 15 minutes.

Object B takes a relatively large break every 30 minutes, standing up and stretching, and also checking his phone for a minute or two. Subject B went to the bathroom 75 minutes later.





1) Observations made on the night of June 12, 2022

Time: 19:52 to 20:52

Object: Two students majoring in science and engineering, A is female and B is male.

Review behavior: Practice answering questions from past exams.

The review behavior of the two Objects was carried out through paper materials. Each Object carried a bottle of water.

Object A looked back at the researcher after the researcher entered the classroom. She checked her phone between 20:20 and 20:35 and went to the bathroom at 20:52.

Object B browses his phone for one to two minutes between 19:55 and 20:30.)



## Part 2: The experience of the commercial PGEE Aid APPs in the market

The researchers chose to search for the term GRADUATE School Entrance Exam in the app marketplace. KAOYAN BANG (The name of the APP stands for Graduate Entrance Examination Assistant) with the largest downloads and volume and QIANBI KAOYAN (The name of the APP means pencil for the Graduate Entrance exam) with medium downloads and volume were selected for shallow experience.

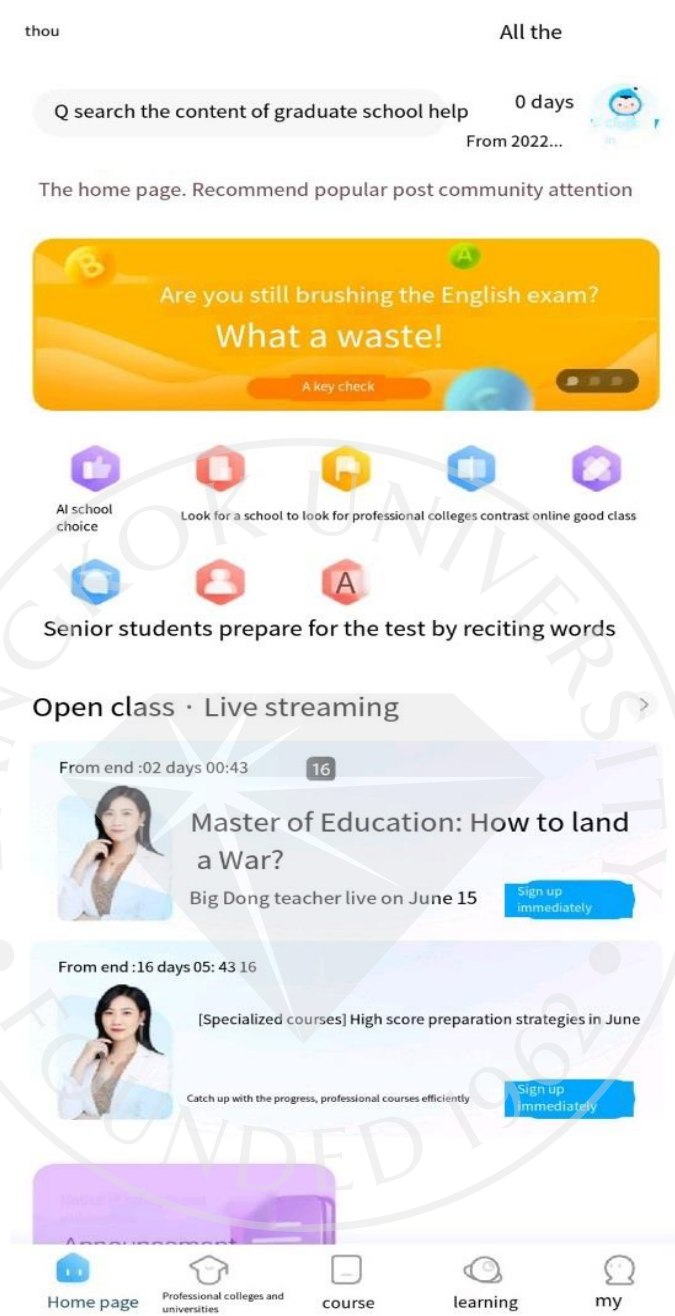
1) KAOYANBANG's software interface has a white background. The size of the buttons for software functions is appropriate, and the font is bold. Except for the graphics of the icon and the title of the training course, no graphics are used in other parts, and the overall design is simple. Moreover, due to its huge software volume, KAOYANBANG has relatively perfect functions.

The first is the core learning function of this kind of software. The learning function in this software has five sub-functions, namely, learning plan making and viewing; Recite English words; past test exercises; Academic journals related to the Graduate Entrance Examination; Help to develop the review knowledge framework. The second is the biggest profit point of this kind of commercial training software,

which is also the biggest common ground between online and offline training, namely the training course. According to the mode of broadcasting, the training course can be divided into online live broadcasting and recording. It can also be divided into free and paid. Generally, free courses are short in time and mainly play an enlightening and key guiding role. They are suitable for students with relatively strong learning ability or stable professional knowledge foundation. However, the paid courses are longer in length and involve many aspects, which are suitable for students with poor learning ability or weak professional knowledge base or cross-major exams.

The third is the introduction of relevant universities and majors. This function is mainly used in the beginning of students' graduate entrance examination review to help students determine the target university and major. There is also a function named "AI University Selection" on the home page of this software, which can recommend suitable universities for students according to their personal ability level and major choice after inputting students' relevant personal conditions. This feature is relatively rare in this kind of software, and its reliability may take time to verify.

The fourth big functions is social, the software for the students attending the PGEE and have passed this test provides an exchange between students online community, makes the senior to junior to provide more guidance from personal experience, to help us to review, also allows the user to increase viscosity. In addition, the APP provides links to social APP chat groups outside the APP's community, making it easier for potential and light users to communicate with others without logging into the APP.




2) The design style of QIANBIKAOYAN is similar to that of KAOYAN BANG, which is relatively simple. The buttons of the function are larger than KAOYANBANG's and the font is not bold.

Compared with KAOYANBANG, the function of QIANBIKAOYAN focuses on learning and training. The buttons in the middle of the home page correspond to the learning function.

That is ||

# 195 days countdown

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English ii Political Mathematics More and more


Camera overtake wins in the summer

**Summer postgraduate entrance examination system classes were launched**


\* Golden summer efficient assault senior lecturer directly to the test site.

Snapped up immediately







All questions,



A quick practice



Smart group volume



Memorizing words

day Test kits

Brush test questions


0 Advanced Mathematics \* 0/76


Zero linear algebra

Do \*\* 0/37


Probability theory and mathematical statistics

Do \* 0/37


 Test preparation package




practice



Special class



course



I

## Appendix B

### Interview Guideline

The list of regular questions used in the interviews is shown below:

- 1) How did you initially obtain information about your target university and master major?
- 2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?
- 3) What is your overall experience of taking the PGEE? How did your review plan go?
- 4) What is your attitude towards the PGEE Aid APPs?
- 5) What functions of an PGEE Aid APP do you think can improve your study effect for this exam?
- 6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?
- 7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APP?

#### Interviewer A

1) How did you initially obtain information about your target university and master major?

A: First of all, I determined the occupation and company I want to be engaged in in the future, and then chose the target major according to the job requirements (1.0.A.1). Then I chose my target university according to my ability and the comprehensive strength of the university among the universities offering such a master's major. My main sources of information were the official websites of universities (1.0.A.2) and articles on some social media accounts (1.0.A.3).

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

A: Keep practicing the past exams (2.0.A.1). If I found a question that I could not answer, I just found the tutorial material (2.0.A.2) and looked for a point related to the question and restudied it. In addition, mind mapping (2.0.A.3) was a great way to help frame my knowledge (2.0.A.4).

Besides, I think your question is a little ridiculous.

2.1) Why do you think the 2nd question is a little ridiculous?

A: Because learning methods are a very vague concepts (2.1.A.1), can only be understood and can hardly be expressed. They are difficult to describe in words, especially for this exam. All I can say is that it's always good to practice the past exams. If I could outline an accurate and effective learning method, I would have become a training teacher.

What is your overall experience of taking the PGEE? How did your review plan go?

A: I think the whole review process was very long; the early review was lack of purpose.

In my plan, I used to review English in the morning, math in the afternoon, and major-foundation course and major course in the evening. In the last month, I devoted half of my English review time to political theory (3.0.A.1).

Looking back now, I think my review plan was a little unreasonable (3.0.A.2).

3.1) Why do you think your review plan was now reasonable?

A: Because I allocated too little time to the major-Foundation course and the major course, the results of these two subjects' exams did not meet expectations (3.1.A.1). Although I passed in the end.

What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?



A: I used a software called Shell - Words to help me remember English words (4.0.A.1), but the results were mediocre. Because even if I remember the word in a normal situation, I might forget it in the context of an English reading comprehension question.

What functions of an PGEE Aid APP do you think can improve your study efforts for this exam?

A: I think after practicing past exams (5.0.A.1), the system would be able to provide me with analytical and logical ideas for answers (5.0.A.2). It is better to recommend similar topics based on similar knowledge points (5.0.A.3) for me to deepen my impression when I do reviewing with the APP. In addition, the database of the test paper must be comprehensive (5.0.A.4).

5.1) In addition to math, for example, in the major course, are there any questions that need to be calculated?

A: Of course, because my target major was information engineering. So questions like the complexity of the algorithm, the rate of information transfer, etc., were all computational questions (5.1.A.1).

5.2) So, if you want to practice these questions in a PGEE Aid APP, is it difficult to input special symbols?

A: Generally speaking, this is true. After all, according to the normal input logic, it is very inconvenient to use the input method to input special symbols. It takes me nearly enough time to use a pen to calculate a problem with software. However, it can be easily solved using special equation input software such as Mathtype or LaTeX. The prerequisite, of course, is that the PGEE Aid APP can access these software (5.2.A.1).

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

A: In my opinion, the software needs to be able to make associations based on the knowledge points I am learning and recommend other knowledge points that are



related to the knowledge are being learning. Thus, it can help me to build the knowledge framework (6.0.A.1). In addition, it should match and get references or materials that fit me (6.0.A.2).

In addition, I think the design of this software should be as concise as possible (6.0.A.3) we use it for serious study, not for play.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

A: I think the past examination database of the current PGEE Aid APPs are not comprehensive (7.0.A.1). I wanted to find the past exams of the major course of the university I signed up for, but it was hard to find them.

7.1) Is there a big difference in the Major Course test of the PGEE for the same master's major in different universities?

A: Of course, although the proposition is based on the PGEE outline, the difficulty of the proposition varies greatly among different universities (7.1.A.1). The better the university, the harder it's proposition is.

### **Interviewer B**

1) How did you initially obtain information about your target university and master major?

B: I mainly got relevant information through the web pages of some educational institutions (1.0.B.1) and the official websites of some universities (1.0.B.2).

What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

B: First of all, for English, I think the most important thing is vocabulary. If I didn't have a rich accumulation of words, it doesn't matter how many skills I learned since I didn't actually understand the questions. The way I solved this problem was to recite the words (2.0.B.1),

In terms of reading comprehension, I deepened my understanding of the logic of articles by watching online tutoring courses (2.0.B.2). Finally, writing, I recited some common templates and sentence patterns, and then use the templates to practice the writing questions of the past exams (2.0.B.3).

As for the major-Foundation course, there were only two textbooks (2.0.B.4) for this exam, so I reviewed it first according to the progress of online training, and then sorted out the knowledge framework and reviewed both sides by myself, then recited some possible nouns or definitions based on questions that have appeared in past exams. And finally, I practiced the calculations questions that come with the textbook.

Forget about math. I was terrible at it.

3) What is your overall experience of taking the PGEE? How did your review plan go?

B: I had a poor knowledge base of mathematics, and the process of reviewing mathematics is very painful.

English is not difficult for me; I just learn it step by step.

I started revising political theory around the end of August, and I was watching online training sessions and practicing on single choice questions. Then, a week before the test, the subjective questions were recited using paper references.

As for the major-Foundation course, I first roughly browsed all the exam points, and then recited the important ones.

At the beginning, I planned my review plan according to subjects and time schedule (3.0.B.1), but later, the review of mathematics took longer than I expected, which affected the review of other subjects more or less (3.0.B.2).

3.1) So. If your math review was good then, you are confident that you would have passed the written exam?

B: I could have passed math if I had not been screwed up. The final scores of the other three items were all in line with or very close to my expectations

(3.1.B.1).

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

B: I hadn't basically used the comprehensive PGEE Aid APPs (4.0.B.1).

But I have used some auxiliary software, such as Youdao Translation for correcting my English exercises (4.0.B.2), Notability for taking notes (4.0.B.3) during online tutoring, and mind mapping. Youdao also has online course (4.0.B.3) functionality that I have used. However, I rarely use any of the other features.

4.1) Why didn't you want to use the comprehensive PGEE Aid APPs?

B. First of all, using the phone or tablet to study online and take notes all the time was tiring for my eyes (4.1.D.1).

Then there was the matter of layout. Due to the size of the screen, questions were often only half displayed (4.1.D.2). With paper materials, I could easily scan the whole question.

Finally, I still think there are some uncertainties (4.1.D.3) in network products, if I rely entirely on this APP. If the operator suddenly goes bankrupt or the server fails, all my data stored in the cloud could disappear.

What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

B: As I said earlier, I have never used a comprehensive PGEE Aid APP. I have only used some apps or even web apps to learn online courses. I think there are some paid online courses that would be better if they were cheaper (5.0.B.1).

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

B: In my opinion, software pages should be as simple as possible (6.0.B.1). Too dense and exaggerated colors or pictures are not good for the eyes. In addition, the design of the page should not be too old-fashioned (6.0.B.2), after all, as a girl, I still value the appearance.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

B: I'll just use a couple of apps that I've used.

Although the English practice correction function in Youdao was useful on the whole, but it was realized by AI instead of real people, thus sometimes there will be wrong correction (7.0.B.1).

While the note-taking capability of the Notablity is great, but it will have to be paid for and it's a little bit expensive (7.0.B.2).

Finally, I also used an APP called MOMO-Recite-Words to memorize words. But there are some bugs (7.0.B.3) in this APP. For example, it often Repeat pushed words I had memorized rather than words I hadn't, so the experience was poor.

### **Interviewer C**

1) How did you initially obtain information about your target university and master major?

C: Through the undergraduate study, I have made clear my favorite major and my intention to continue studying. Then in daily life, I searched for relevant Internet information (1.0.C.1) and communicated with others on the Internet about major choosing (1.0.C.2) Finally, I also communicated with teachers and classmates (1.0.C.3) in daily life, and finally decided on the target university.

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

C: The method I prefer to use is associative memorization (2.0.C.1), which extends from one knowledge point to another until the entire knowledge framework is established and consolidated (2.0.C.2). However, there are still some knowledge points that need intensive recitation (2.0.C.3) to deepen my memory. I am now participating in the commercial tutoring training (2.0.C.4), so I will follow the

tutoring process for the first round of review. Of course, I will review again by myself later.

3) What is your overall experience of taking the PGEE? How did your review plan go?

C: As it is still in the review process, it is difficult for me to give a final conclusion (3.0.C.1). But now I will do reviewing whenever I have time. No pains, no gains.

Due to the time conflict between the PGEE's revision and my internship (3.0.C.2), I have to adapt to the situation. If I can't finish my review plan on someday, I have to finish the task of that day on the next day. However, it's very important to rest. I used to spend a whole week's free time reviewing, but in the last days of the week, I found that my review efficiency decreased significantly. At this time, I will rest for half a day in order to give myself some relaxation.

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

C: I'm using this kind of software. For me, when I was not too busy in my internship, I took some time to use the PGEE Aid APP to recite words (4.0.C.1) and practice the past exams (4.0.C.2). The overall feeling about this is good.

5) What functions of an PGEE Aid APP do you think can improve your study efforts for this exam?

C: I think the answer analysis function (5.0.C.2) is very necessary, that is, after I practice the past exams (5.0.C.1), the software can analyze the logic of the answer and the corresponding page number of the textbook corresponding to the relevant knowledge points, which is convenient for me to search in the textbook. After all, for students who are revising for the PGEE, time is at a premium.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

C: I think software still should have **statistic function** (6.0.C.1), namely statistic is aimed at this course character, what knowledge point is in recent years often be used at proposition. This will make my review more specific.

I also believe that **the software should run as smoothly as possible** (6.0.C.2) to save me as much time as possible.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

C: Let me talk a little bit about the current PGEE training. Some training's process is moving too fast, so it's not conducive to students to establish a deep understanding. However, the process of some other training move too slow, not concise, wasting students' time and easy to strengthen students' anxiety (7.0.C.1).

#### **Interviewer D**

1) How did you initially obtain information about your target university and master major?

D: First of all, I wanted to be a teacher. Secondly, I found that I could well adapt to my undergraduate major. Therefore, I chose a graduate major closely related to my undergraduate major.

In choosing a university, I also checked the relevant information on the official websites of some universities (1.0.D.1) and communicated online with some seniors (1.0.D.2). Finally, according to the location of the university I considered comprehensively.

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

D: I mostly used asking myself questions (2.0.D.1) to enhance my memory. At that time, I would design some questions according to the knowledge point, and then let myself answer them after a period of time or reviewing other subjects.

3) What is your overall experience of taking the PGEE? How did your review plan go?

D: Before December, I felt very relaxed and confident. After arriving in December, I felt like everything was bad. I even doubted I could even pass the PGEE (3.0.D.1).

At that time, I first planned the review plan by time (3.0.D.2), mainly with the help of textbooks and reference books. Complete the first review by the end of October, the second review by the end of November, and then the third review by mid-December. Then a week before the test, I practiced for the past exams.

However, according to the review situation of each subject, the review time of political theory I arranged was too short at that time, which resulted in some acceleration of the review process (3.0.D.3).

3.1) Why did you doubt yourself?

D: I did not finish reciting knowledge points, for knowledge points of memory are not so firm.

But after struggling (1.1.D.1) for the better part of the month, I finally calmed down before the exam.

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

D: At that time, I used this kind of software less, with the APP named MOMO-Recite-Words to recite words (4.0.D.1). In addition, according to the review progress, I have watched online courses (4.0.D.2) on some web pages.

In my opinion, the PGEE Aid APPs are still of some use. It enable me to memorize knowledge with fragmented time so that I can flexibly use my own time to review (4.0.D.3), which is of great help to prepare for the exam.

What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

D: In my opinion, the PGEE Aid APP should have a function to help students establish knowledge framework (5.0.D.1). In addition, it also needs to be able to remind students what knowledge points have been tested in the past exams (5.0.D.2) to help them review more efficiently.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

D: First of all, I think most of the functions of the PGEE Aid APP should be free (6.0.D.1). In addition, if the PGEE Aid APP can scan the knowledge points that students have reviewed, and it prompts the knowledge points that students have missed (6.0.D.2), then it will be great.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

D: Advantages of the current PGEE Aid APPs: the software are fully functional and detailed (7.0.D.1). For example, there are Settings to remind the review of the function, humanized to assist examinee preparation.

Disadvantages of the current PGEE Aid APPs: Most of the services of the software need to be charged (7.0.D.2), which is a large cost for students without independent income.

### **Interviewer E**

1) How did you initially obtain information about your target university and master major?

E: I mainly relied on the official website of each university (1.0.E.1) to understand each university and relevant major's information. Then the choice of the target major was mainly based on my own career planning, as well as the employment prospect and employment form of the counterpart. Employment prospects and employment forms were mainly understood through the Internet related media articles (1.0.E.2) and communication with friends (1.0.E.3).



2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

E: I used to choose to attend online training (2.0.E.1) to assist my revision. The review was planned according to the progress of the training.

3) What is your overall experience of taking the PGEE? How did your review plan go?

E: As for the previous PGEE, I don't want to talk about it in case my mood would be affected. For the review of this year, my plan is just to keep practicing.

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

E: I think there are too many services that these apps have to pay for (4.0.E.1). Operators should consider that most of us students do not have that much money and should release as many free features and content as possible.

5) What functions of an PGEE Aid APP do you think can improve your study efforts for this exam?

E: The most important function must be to practicing the past exam papers (5.0.E.1).

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

E: Let the software run smoothly (6.0.E.1). As for the other functions, I think they are not needed. After all, if I want entertainment, I might as well turn on TikTok.

6.1) So, for example, after practicing the past exams, you don't need something like answer parsing?

E: If these features are free (6.1.E.1), then I can accept it. But if I have to pay to use these features, then I'd rather it didn't exist.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

E: The advantage is that they are relatively full of features (7.0.E.1), the disadvantage is that most of these features have to be paid for (7.0.E.2).

### **Interviewer F**

1) How did you initially obtain information about your target university and master major?

F: The first channel was to learn about relevant information through relevant videos on the video platform (1.0.F.1).

The second channel was to get information through social media articles (1.0.F.2) and conversations with netizens (1.0.F.3).

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

F: I mainly used some guidance software (2.0.F.1) to help me strengthen the memory of knowledge points, so as to build knowledge framework (2.0.F.2).

3) What is your overall experience of taking the PGEE? How did your review plan go?

F: In terms of this year's review, my review plan is to divide different months into different stages so as to make different review plans for each month (3.0.F.1). So far the implementation of the plan is going well (3.0.F.2), and my overall feeling is very calm (3.0.F.3), after all, I have already experienced it once.

4) What is your attitude towards the PGEE AID APPs? Have you ever used this kind of APPs?

F: I use some of these right now. It's acceptable except that paid features and paid content are expensive (4.0.F.1).

5) What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

F: I think this kind of APP needs to be able to train students to use more efficient review methods (5.0.F.1). In addition, it should also be able to give some suggestions for students' review behavior (5.0.F.2).

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

F: In my opinion, there should be a review plan making function (6.0.F.1) in the software will be better.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

F: The advantage is that there are so many of them, and materials that I might not find in this one can be found in that one (7.0.F.1).

The downside is that the content is not properly priced (7.0.F.2).

### **Interviewer G**

1) How did you initially obtain information about your target university and master major?

G: I chose my master's major which is the same as my undergraduate major.

As for the choice of target university, I firstly made a preliminary understanding according to the interactive knowledge community such as Zhihu (1.0.G.1). Then I asked seniors who have passed the PGEE for relevant information (1.0.G.2). After that I would come up with three potential target universities.

Then I made the final selection according to the enrollment ratio, score line and difficulty of the examination of these three universities (1.0.G.3), thus obtaining the target university.

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

G: When reviewing the major-Foundation course, I chose the combination of computer and tablet. The computer was mainly used to watch online tutorial videos (2.0.G.1). The tablet was primarily used to quickly build mind maps (2.0.G.2).

As for the major course, I signed up for paid training (2.0.G.3) in local training institutions during the summer vacations. And because there are drawing questions in the part of exam, I basically practiced drawing every week to keep the inspiration and accuracy of drawing.

3) What is your overall experience of taking the PGEE? How did your review plan go?

G: From April to May last year, I used the textbooks of the major course for a quick skim of knowledge points, and then participated in the training from June to July. Then, in August and September, I took online courses on political theory and English. Then, IN October, I reviewed the major-Foundation course and major Course again. The review of English and political theory will continue according to the online course schedule. Between November and the exam. I participated in the training for the major course again and also recited the knowledge points of political theory. Besides, I also practiced the past exams of English subjects this month. However, due to the interference of normal undergraduate study and other matters, the review of the major course did not proceed as planned. The review of English and political theory was basically completed as planned (3.0.G.1). Overall, I feel tired (3.0.G.2).

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

G: I have watched free online courses (4.0.G.1) about English, political theory and Major course on the three PGEE Aid apps respectively. In the end, I chose

the APP named PRENTICE. In my opinion, what is more important is the quality of the training content. If the quality of the training content is good, the APP itself can be accepted even if it looks simple.

5) What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

G: I think these online training sessions should be reviewable (5.0.G.1). In addition, the teachers should release the exercises related to the lesson after each lesson (5.0.G.2).

In addition, as for the function of practicing past exam papers (5.0.G.3), the system should set up the function of correcting papers and providing resolution for the wrong answers (5.0.G.4).

5.1) What do you think about the function of past exams practicing?

G: In the online course, the side exercises were also from past exams, I did the exercise in deed. But if I were going to practice on a full exam paper, I prefer to practice on paper materials (5.1.G.1) out of habit.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

G: I think interaction is important, and students need to be well monitored by the software or the operators to prevent students from slacking off (6.0.G.1).

If anything else is important at the software level, it's probably how the software fits into different systems. If I do practice drawing in apps, I have to do it on a tablet, because the phone's screen is so small, and a lot of current apps for tablets aren't designed for tablets, but rather crudely copy the mobile UI onto the tablet version (6.0.G.2).

In addition, the current marketing and advertising campaigns for such software are more or less false claims (6.0.G.3).

6.1) What have you experienced about this kind of interaction?

G: After purchasing the online class that needs to be paid, the software

automatically pushed a reminder to me (6.1.G.1) according to the playing plan of the online class. In addition, I was invited to join a chat group where a tutor would regularly urge students (6.1.G.2) to review and ask about their progress. But in the later stages, that tutor rarely pushed us.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

G: As for my major, the main use of the PGEE Aid APPs is watching online courses. After all, for the drawing questions it's not meaningful to practice on the screen (7.0.G.1), and we still need to use pencils and rulers to draw pictures in the exam.

#### **Interviewer H**

1) How did you initially obtain information about your target university and master major?

H: I got information from social media articles (1.0.H.1) and the university's website (1.0.H.2).

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

H: I first learned about the test scope and the focus of the proposition from the PGEE outline (2.0.H.1), and then I did reviewing twice. For the first review, I mainly browsed all the knowledge points. The second review was targeted at the key points of the exam and doing practice of the past exams (2.0.H.2).

3) What is your overall experience of taking the PGEE? How did your review plan go?

H: I was breaking down the review plan by time period (3.0.H.1). The overall plan worked as I expected (3.0.H.2). In the end I felt calmed (3.0.H.3), after all I passed the PGEE.

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

H: I used two of these apps at the time, called MEDICAL EXAM HELPER and BLUE GENE. I used these two APPs to practice the past PGEE exam papers (4.0.H.1). And they worked well. I also watched online training courses (4.0.H.2) occasionally, but not very much.

4.1) For what exam subjects have you practiced past exams on the APP?

H: Of course, I practiced all the subjects (4.1.H.1) otherwise it would be difficult to pass the PGEE.

4.2) In the interview with other interviewees, they have mentioned that it is more difficult to practice on the APP than on paper materials for some questions that need to be solved by inputting special symbols. I would like to ask, have you ever had such difficulties with the subject of your major?

H: This kind of situation does not exist to the subject of my major. Because the major course test for my major was full of single and multiple choice questions (4.2.H.1).

4.3) As far as I know from my previous investigation, except for the PGEE of medical major, there are subjective questions in all major courses in the PGEE for other majors. What do you think accounts for the difference?

H: Because medical majors need more knowledge accumulation than other majors (4.3.H.1). Therefore, in my opinion, for undergraduate students, it is more important to test the integrity of knowledge structure than other aspects, and objective questions are more about this aspect. The subjective questions test students' application of knowledge and their understanding of knowledge, which is too early for undergraduate students.

5) What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

H: The most important function, of course, is to practice the past exams (5.0.H.1).

In addition, on the basis of this exercise function, the system must be able to record the questions I made wrong and give links to the location of the textbook for related knowledge points (5.0.H.2).

Finally, communication with other users (5.0.H.3) on the APP about revision is also important.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

H: I think it is very important to optimize the design and the operation of the PGEE Aid APP (6.0.H.1), so that I can review even if I can't bring the textbook.

6.1) For you, what is the situation where you can't bring your textbook and use your mobile phone? You mean during your internship on campus?

H: It's not a question of what the scene is, but of the thickness of our PGEE reference book, which is close to two thousand pages. It's not easy to carry around (6.1.H.1).

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

H: I think there's a dilemma with most of this software today. Apps with more features have more ads (7.0.H.1) and expensive paid content (7.0.H.2), and apps with less ads have fewer features



### Interviewer I

1) How did you initially obtain information about your target university and master major?

I: I mainly obtained relevant information through the official websites of some universities (1.0.I.1) and the introduction of counselors (1.0.I.2).

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

I: I used the textbook (2.0.I.1) to memorize the knowledge points, while carrying on the practice of the past exam (2.0.I.2) related to the knowledge points I was reviewing.

The order of my reviewing was according to the difficulty of knowledge points, from easy to difficult (2.0.I.3).

If I kept getting things wrong on past exams about some knowledge point, I would repeat past exams on this topic until I didn't make any more mistakes.

3) What is your overall experience of taking the PGEE? How did your review plan go?

I: My review plan was divided into two rounds. The first round was to browse the whole test points, and the second round was to review the key points and difficult test points again (3.0.I.1). The implementation of the second round of review was not good. In the end, the overall review experience was just so (3.0.I.2).

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

I: I have used XMind, Chinese University MOOC and Tomato Todo. I think these software is indeed helpful for preparing for the PGEE, but the most important thing is my perseverance and patience, as well as daily knowledge accumulation, which is the biggest reason for my success in passing the PGEE (4.0.I.1).

5) What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?

I: The most important thing is information screening and practicing the past exams. The software should be able to find popular test points (5.0.I.1) in recent years so that students can target their revision. Then, in the practice of the past exam (5.0.I.2), the order of the questions should not be the same as the exam at that time, but should be shuffled or even generate different questions according to the same test points (5.0.I.3).

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

I: It is also very important for students to know the PGEE situation of that year as soon as possible through the information query of adjustment over the years and the release of hot information about the PGEE (6.0.I.1).

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

I: I used to watch online courses on a PGEE Aid APP called CHENGLA. The APP also offered help with customizing review plans and one-on-one online tutoring with teachers (7.0.I.1). However, since such one-to-one tutoring is conducted online, it was difficult to guarantee the authenticity of teachers' qualifications (7.0.I.2).

I also used videos uploaded by others to help with my revision on bilibili, a video site. The software was friendly and interactive, and I could also find many like-minded people on it to review and exchange experience. However, the defect of this software was that it is a video website APP and does not focus on PGEE, so its content is not professional enough (7.0.I.3).

### **Interviewer J**

1) How did you initially obtain information about your target university and master major?

J: I mainly obtained the basic information of the university through communication with seniors (1.0.J.1), and then selected the final targeted university based on the rankings of each university and the admission rate of each university in the Secondary examination. These data are released by some educational institutions(1.0.J.2). As for my major, I chose a graduate major in the same discipline classification as my undergraduate major.

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

J: First of all, I took review notes (2.0.J.1) for each test point. Secondly, after reviewing a certain test point, I immediately looked up the past exams (2.0.J.2) related to this test point for practice. Finally, I will review by watching online courses (2.0.J.3) when I was tired.

To sum up, when I was full of experience, I usually reviewed the new test points or practice the past exams. When I was tired, I reviewed the online courses in a slightly less intense way.

3) What is your overall experience of taking the PGEE? How did your review plan go?

J: My review lasted four months in total. Over the course of four months, it was divided into three phases. In the first stage, I reviewed the knowledge points mainly through textbooks and reference books. In the second stage, I mainly strengthened my memory by practicing past exams. In the last stage, I crossed the review behaviors of the first two stages to maximize my understanding of the test points (3.0.J.1).

I kept a diary to record my daily review, and optimized my review behavior through weekly or monthly periodic summaries (3.0.J.2).

In the end, I think the completion of my review plan at that time was about 70 percent (3.0.J.3). Since I paid more attention to the mediation of psychological pressure, the overall review experience was relatively relaxed (3.0.J.4).

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

J: I mainly used software to help me memorize English words (4.0.J.1) and obtain relevant information of PGEE (4.0.J.2), which mainly played a supporting role.

The software allowed me to use fragmented time for revision (4.0.J.3). In addition, I also communicated with like-minded partners (4.0.J.4) and so on.

5) What functions of an PGEE Aid APP do you think can improve your study efforts for this exam?

J: I think an important function is to help students make review plans and urge students to complete the review according to the plan (5.0.J.1).

Secondly, the software must consider how to keep students' attention on it (5.0.J.2). After all, this kind of software is mostly operated on smart terminals such as mobile phones, and most of us use smart terminals for social and entertainment purposes. If this kind of Aid APP cannot attract students' attention continuously, students will naturally start to use other entertainment apps, which will be detrimental to students' review.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

J: I think it is also very important to establish a communication platform (6.0.J.1) for students in the software, so that students can learn from each other and encourage each other. This is very important for students who are reviewing under high psychological pressure. In addition, such software should be able to provide students with as much peripheral information about PGEE (6.0.J.2) as possible to save time for students to search for such information.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

J: I think this kind of software provides relatively complete review materials (7.0.J.1), in addition to this kind of learning method is relatively new (7.0.J.2) so that students can learn at any time, which is good.

But such APPs don't necessarily hold students' attention consistently (7.0.J.3). Students may pause their revision because of a message on social software.

### **Interviewer K**

1) How did you initially obtain information about your target university and master major?

K: I have already determined the master's major and university I wanted to apply for during my undergraduate study. Finally, I made up my mind by contacting the seniors who had passed the exam (1.0.K.1) to learn about the employment prospects.

2) What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?

K: Since I thought I was stupid, I actually had no effective learning methods that could be described. What I did at that time was to recite (2.0.K.1) to strengthen my memory about the test points as much as possible in my spare time. All the review was carried out strictly according to the review plan. The only tool I used more than my textbook was tutorial videos on the Internet.

3) What is your overall experience of taking the PGEE? How did your review plan go?

K: My review plan is divided into four stages according to the schedule. In the first and second stages, I mainly browse and memorize knowledge points. In the third stage, I started practicing for the past exams. In the last stage, I will review the knowledge points related to the mistakes made in the third stage again (3.0.K.1).

4) What is your attitude towards the PGEE Aid APPs? Have you ever used this kind of APPs?

K: I prefer to use the textbook for revision. I only use my phone or computer to watch tutorial videos (4.0.K.1). I hadn't used this kind of software (4.0.K.2).

5) What functions of an PGEE Aid APP do you think can improve your study efforts for this exam?

K: From my perspective, I think these apps should provide tutorial videos (5.0.K.1) that students can study over and over again.

6) In addition, what other characteristics do you think a successful PGEE Aid APP should have?

K: There's nothing else I can say.

7) In your opinion, what are the advantages and disadvantages of the current commercial PGEE Aid APPs?

K: Same answer as the previous question..

**Appendix C****Interview Coding**

Interviewee A	Pass the PGEE
Interviewee B	Preparing now
Interviewee C	Failed
Interviewee D	Pass the PGEE
Interviewee E	Failed/Preparing again
Interviewee F	Failed/Preparing again
Interviewee G	Failed
Interviewee H	Pass the PGEE
Interviewee I	Failed
Interviewee J	Pass the PGEE
Interviewee K	Pass the PGEE
Interviewee L	

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q1.0 How did you initially obtain information about your target university and master major?						
1.0.A.1 Recruitment needs for ideal jobs	1.0.B.1 Web pages of some educational institutions	1.0.C.1 Search engine 1.0.C.2. Net friend	1.0.D.1 The official website of the relevant university	1.0.E.1 The official website of the relevant university	1.0.F.1 Online video platform 1.0.F.2 Articles on some social media accounts	1.0.G.1 Interactive knowledge community
1.0.A.2 The official website of the relevant university	1.0.B.2 The official website of the relevant university	1.0.C.3 His own teachers and classmates	1.0.D.2 Net friend	1.0.E.2 Recruitment needs for ideal jobs	1.0.F.3 Net friend	1.0.G.2 Seniors who have passed PGEE
1.0.A.3 Articles on some social media accounts				1.0.E.3 His own friends and classmates		1.0.G.3 Web pages of some educational institutions



Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q1.0 How did you initially obtain information about your target university and master major?						
1.0.H.1 The official website of the relevant university 1.0.H.2 Articles on some social media accounts	1.0.I.1 The official website of the relevant university 1.0.I.2 His own teachers	1.0.J.1 Seniors who have passed PGEE 1.0.J.2 Web pages of some educational institutions	1.0.K.1 Seniors who have passed PGEE	Recruitment needs for ideal jobs (A, E) The official website of the relevant university (A, B, D, E, H, I) Articles on some social media accounts (A, F, H) Web pages of some educational institutions (B, G, J)	Network Information provision (IV6) Communication PLATFORM (IV4)	1. Students prefer to get official information about the PGEE from the Internet. In an efficient PGEE Aid APP, links pointing to the official websites of universities and educational institutions can be added to help students

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q1.0 How did you initially obtain information about your target university and master major?						
						<p>better obtain information.</p> <p>2. Add an interactive communication community in an efficient PGEE Aid APP, so that students who are preparing for the PGEE can communicate with each other about college choices,</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q1.0 How did you initially obtain information about your target university and master major?						
				Net friend (C, D, F) Teachers (C, I) Friends and classmates (C, E) Seniors who have passed PGEE (G, J, K) Search engine (C) Online video platform (F) Interactive knowledge community (G)		and they can ask successful experiences of students who have already passed the PGEE, etc.

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
2.0.A.1 Practice the past exams	2.0.B.1 Recitation	2.0.C.1 Associative memorization	2.0.D.1 Ask myself questions	2.0.E.1 Participate in the commercial tutoring training	2.0.F.1 Use some guidance software	2.0.G.1 Watch live tutorial and MOOCs
2.0.A.2 Learn from tutorial materials and textbooks	2.0.B.2 Watch live tutorial and MOOCs	2.0.C.2 Build the knowledge framework			2.0.F.2 Build the knowledge framework	2.0.G.2 Mind mapping
2.0.A.3 Mind mapping	2.0.B.3 Learn from tutorial materials and textbooks	2.0.C.3 recitation				2.0.G.3 Participate in the commercial tutoring training
2.0.A.4 Build the knowledge framework		2.0.C.4 Participate in the commercial tutoring training				

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
2.0.H.1 Learn about the test scope and the focus of the proposition from PGEE outline 2.0.H.2 Practice the past exams	2.0.I.1 Learn from tutorial materials and textbooks 2.0.I.2 Practice the past exams 2.0.I.3 review from easy to difficult	2.0.J.1 Take review notes 2.0.J.2 Practice the past exams 2.0.J.3 Watch live tutorial and MOOCs	2.0.K.1 Recitation	Practice the past exams (A, H, I, J) Learn from tutorial materials and textbooks (A, B, I) Mind mapping (A, G) Build the knowledge framework (A, C, F)	Practice the past exams (IV2) Live tutorial and MOOCs (IV2) Building the knowledge framework (IV2) Provide the PGEE outline, virtual tutorial materials and	1. The learning function is a PGEE Aid APP's core. 2. In an efficient PGEE Aid APP, the learning function is mainly realized in four directions.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
				Watch live tutorial and MOOCs (B, G, J) Recitation (B, K) Participate in the commercial tutoring training (C, E, G) Associative memorization (C) Ask myself questions (D) Use some guidance software (F)	Textbooks (IV2)	The first is the practice of past exams. The second direction is to provide Live tutorials and MOOCs. The third direction is to help students or build knowledge framework for students.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
				<p>Learn about the test scope and the focus of the proposition from PGEE outline (H)</p> <p>review from easy to difficult (I)</p> <p>Take review notes (J)</p>		<p>The fourth direction is to provide PGEE outline, tutoring materials, and electronic textbooks.</p> <p>3. There is no clear and precise learning method that can guide the review of PGEE for all master's majors.</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
Learning methods are metaphysical (2.1.A.1)				Learning methods are metaphysical (A)	Learning methods (IV5)	Ausubel's theory is only an ideal state and a general guideline. In practice, the review of PGEE still requires students to spend a lot of time, and there is no shortcut.



Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
3.0.A.1 Make different review plans according to different time stages or examination subjects	3.0.B.1 Make different review plans according to different time stages or examination subjects	3.0.C.1 Difficult to generalise for now 3.0.C.2 time conflict between PGEE's review work and the internship	3.0.D.1 Once doubted herself 3.0.D.2 Make different review plans according to different time stages or examination subjects 3.0.D.3 The implementation of the review plan did not achieve the expected results	The interviewee didn't want to talk about it	3.0.F.1 Make different review plans according to different time stages or examination subjects 3.0.F.2 The implementation of the review plan is going well 3.0.F.3 feeling calmed.	3.0.G.1 Make different review plans according to different time stages or examination subjects 3.0.G.2 Felt tired

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
3.1.A.1 During the review, each item was assigned unreasonably, resulting in the result not reaching the expectation	3.1.B.1 felt only because math		3.1.D.1 vexed that the review did not go as planned.			

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
4.0.A.1 Help recitation	4.0.B.1 Hadn't basically used the comprehensive PGEE Aid APPs 4.0.B.2 Correct my English exercises 4.0.B.3 Taking notes 4.0.B.4 Watch live tutorial and MOOCs	4.0.C.1 Help recitation 4.0.C.2 Practice the past exams	4.0.D.1 Helping recitation 4.0.D.2 Watch live tutorial and MOOCs 4.0.D.3 Help using fragmented time for revision	4.0.E.1 Too many features have to be paid for	4.0.F.1 paid features and paid content are expensive	4.0.G.1 Watch live tutorial and MOOCs

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
3.0.H.1 Make different review plans according to different time stages or examination subjects	3.0.I.1 Make different review plans according to different time stages or examination subjects	3.0.J.1 Make different review plans according to different time stages or examination subjects	3.0.K.1 Make different review plans according to different time stages or examination subjects	Make different review plans according to different time stages or examination subjects (A, B, D, F, G ,H,I, J, K)	Help to develop and optimize the review plan(IV5) psychological counselling (IV6)	1. The APP should be able to help students make review plans for time or subjects in the APP. 2. If the APP can help students optimize their review plan in real time
3.0.H.2 The implementation of the review plan was going well	3.0.I.2 The implementation of the review plan did not achieve the expected results	3.0.J.2 monitor and optimize the review plan in real time		The implementation of the review plan did not achieve the expected results (A, B, D, I)		

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
3.0.H.3 felt calmed.		3.0.J.3 The implementation of the review plan was going well 3.0.J.4 felt calmed.		The implementation of the review plan is /was going well (F, H, J) feeling /felt calmed.(F, H J) Once doubted herself (D) Difficult to generalise for now (C)		according to their own situation, students' review experience and review will be better. 3. Students may have psychological problems in the review process.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
				time conflict between PGEE's review work and the internship (C)		If the APP can provide psychological counseling,
				During the review, each item was assigned unreasonably, resulting in the result not reaching the expectation (A) felt only because math (B)	The review plan (IV5) The psychological counselling (IV6)	students' psychological pressure can be reduced.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
				vexed that the review did not go as planned. (D)		
4.0.H.1 Practice the past exams 4.0.H.2 Watch live tutorial and MOOCs	4.0.I.1 Helpful but not the most important	4.0.J.1 Help recitation 4.0.J.2 Help obtaining relevant information of PGEE 4.0.J.3 Help using fragmented time for revision	4.0.K.1 Watch live tutorial and MOOCs 4.0.K.2 Hadn't used this kind of software	Help recitation (A, C, J) Watch live tutorial and MOOCs (B, D, G, H, K) Too many features have to be paid for/ paid features and paid content are expensive (E, F)	Help recitation (IV2) Live tutorial and MOOCs (IV2) Practice the past exams (IV2)	1. One of the biggest advantages of such software over traditional paper materials is portability. The biggest use of this kind of software for students is to assist in reciting knowledge points,

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
		4.0.J.4 Communicated with like-minded partners		Help using fragmented time for revision (D, J) Practice the past exams (H) Taking notes (B) Correct my English exercises (B) Help obtaining relevant information of PGEE (J)	Use an Incentive mechanism instead of a payout system (IV3) Mobility (IV1) Communication (IV4) Network Information provision (IV6)	represented by English words. 2. Due to the mobility of software, developers and content providers must consider how to divide knowledge into small parts for students to review in spare time



Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
				<p>Communicated with like-minded partners (J)</p> <p>Helpful but not the most important (I)</p> <p>Hadn't basically used the comprehensive PGEE Aid APPs/</p> <p>Hadn't used this kind of software (B ,K)</p>		<p>during the implementation of the above functions.</p> <p>3. As students are sensitive to the pricing of paid content, they can be attracted to use some content that needs to be paid for by converting it into free</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
						<p>exchange through certain user behaviors.</p> <p>4. As students revise for the PGEE, It takes a lot of time every day. The designer must ensure that the user's eyes are comfortable while using the PGEE Aid APP.</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
						<p>5. In the stage of overall software design and server erection, the designer must consider how to ensure the stability of the data link between the user and the background server when using the APP and the security of the data in the server.</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q2.0 What kind of study method did you adopt for the exam? How do you improve your memorization and understanding of knowledge points?						
						6. Compared with other majors, the busy undergraduate internship schedule and the uniqueness of the PGEE may make medical students prefer to use the PGEE Aid APP for revision.

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee.G
Q4.1 (D) Why didn't you want to use the comprehensive PGEE Aid APPs?						
Q4.1 (H) For what exam subjects have you practiced past exams on the APP?						
			4.1.D.1 Tiring for my eyes 4.1.D.2 Problem with the page layout of the content 4.1.D.3 Cloud data at risk of loss			

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q4.1 (D) Why didn't you want to use the comprehensive PGEE Aid APPs?						
Q4.1 (H) For what exam subjects have you practiced past exams on the APP?						
4.1.H.1 Practice for all the subjects				Tiring for my eyes (D) Problem with the page layout of the content (D) Cloud data at risk of loss (D) Practice for all the subjects (H)	Page design (IV1) Software design and server erection (IV1) Practice for all the subjects (IV2)	

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q4.2 (H) In the interview with other interviewees, they have mentioned that it is more difficult to practice on the APP than on paper materials for some questions that need to be solved by inputting special symbols. I would like to ask, have you ever had such difficulties with the subject of your major?						
4.2.H.1 No,the major course test was full of single and multiple choice questions				The major course test was full of single and multiple choice questions (H)	Practice for all the subjects (IV2)	

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q4.3 (H) As far as I know from my previous investigation, except for PGEE of medical major, there are subjective questions in all major courses of PGEE of other majors. What do you think accounts for the difference?						
-	-	-	-	-	-	-
Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q4.3 (H) As far as I know from my previous investigation, except for PGEE of medical major, there are subjective questions in all major courses of PGEE of other majors. What do you think accounts for the difference?						
4.3.H.1 Medical majors need more knowledge accumulation than other majors (4.0.H.3)				Medical majors need more knowledge accumulation than other majors (H)	Practice for all the subjects (IV2)	



Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q5.0 What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?						
5.0.A.1 Practice the past exams 5.0.A.2 Give answer analysis after practicing past exams 5.0.A.3 Similar knowledge points review recommendation 5.0.A.4 Complete database of pass exam papers	5.0.B.1 Reasonable pricing of premium content	5.0.C.1 Practice the past exams 5.0.C.2 Give answer analysis after practicing past exams	5.0.D.1 Knowledge framework building function 5.0.D.2 Statistics of popular test points in past exams	5.0.E.1. Practice the past exams	5.0.F.1 Optimize the student's review methods 5.0.F.2 Monitor and optimize the review plan in real time	5.0.G.1 Reviewable MOOCs 5.0.G.2 Exercises that come with MOOCs 5.0.G.3 Practice the past exams 5.0.G.4 Give answer analysis after practicing past exams

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q5.0 What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?						
5.0.H.1 Practice the past exams 5.0.H.2 Record the wrong answers and link the relevant knowledge points after practicing the past exam 5.0.H.3 communicate with other pals on the APP	5.0.I.1 Statistics of popular test points in past exams 5.0.I.2 Practice the past exams 5.0.I.3 Re-optimized past exam papers	5.0.J.1 Help to make a review plan and remind students to finish it on time 5.0.J.2 Stay attractive	5.0.K.1 Reviewable MOOCs	Practice the past exams (A, C, E, G, H, I, J) Re-optimized past exam papers (I) Give answer analysis after practicing past exams (A, C, G) 5.0.A.4 Complete database of pass exam papers (A)	Practice the past exams and the follow-up functions(IV2) Knowledge framework building (IV2) Live tutorial and MOOCs (IV2) Help students to optimize review methods and review plans and supervise	1. Error analysis and error statistics can be added to the past test exercises of the software to help students review better. 2. Collecting statistics of popular exam topics over the years in the software can

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q5.0 What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?						
				<p>Record the wrong answers and link the relevant knowledge points after practicing the past exam (H)</p> <p>Reviewable MOOCs (G, K)</p> <p>Statistics of popular test points in past exams (D, D)</p>	<p>students to complete the review (IV5)</p> <p>Keep students focused on using the software (IV1)</p>	<p>guide students to revise more effectively</p> <p>3. Designers should consider how to keep the software engaging so that students don't stop learning when, for example, they receive messages from social software,</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q5.0 What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?						
				<p>Similar knowledge points review recommendation/ Knowledge framework building function (A, D)</p> <p>Optimize student's review methods and plan/ Remind students to finish review on time (F, J)</p>		<p>4. Since students majoring in science and engineering will face a large number of calculation problems in the PGEE, The PGEE Aid APP must have access to input tools for special symbols</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q5.0 What functions of a PGEE Aid APP do you think can improve your study efforts for this exam?						
				Reasonable pricing of premium content (B) communicate with other pals on the APP (H) Stay attractive (J)		so that students can easily and quickly input special mathematical symbols when they use the PGEE Aid APP for revision.

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q5.1 (A) In addition to math, for example, in the major course, is there any questions that need to be calculated?						
Q.5.1 (G) What do you think about the function of past exams practicing?						
5.1.A.1 A lot of calculation questions in the test of major course						5.1.G.1 prefer to practice on paper materials
Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
				A lot of calculation questions in the test of major course (A) prefer to practice on paper materials (G)	practice the past exams (IV2)	

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q5.1 (A) So, if you want to practice these questions in a PGEE aid APP, is it difficult to input special symbols						
5.2.A.1 Yes but it can be easily solved using special equation input software such as Mathtype or LaTexe						

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q5.1 (A) So, if you want to practice these questions in a PGEE aid APP, is it difficult to input special symbols						
				It can be easily solved using special equation input software such as Mathtype or LaTeX (A)	Software compatibility problems (IV1)	



Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee.G
Q6.0 In addition, what other characteristics do you think a successful PGEE aid app should have						
<p>6.0.A.1 Knowledge framework building function</p> <p>6.0.A.2 Provide suitable references or materials</p> <p>6.0.A.3 Concise UI</p>	<p>6.0.B.1 simple UI and contents</p> <p>6.0.B.2 UI design can't go out of style</p>	<p>6.0.C.1 Statistics of popular test sites in past exams</p> <p>6.0.C.2 Smooth operation of the APP</p>	<p>6.0.D.1 Most of the functions are free to use</p> <p>6.0.D.2 Prompts the knowledge points that students have missed to review</p>	<p>6.0.E.1 Smooth operation of the APP</p>	<p>6.0.F.1 Let students make the review plan in the APP</p>	<p>6.0.G.1 Remind and monitor students to finish the review plan on time</p> <p>6.0.G.2 Targeted software optimization according to the characteristics of different equipment and systems</p> <p>6.0.G.3 Marketing based on real data</p>

Interviewee.H	Interviewee.I	Interviewee.J	Interviewee.K	Coding round 1	Coding cycle 2	Evaluate
Q6.0 In addition, what other characteristics do you think a successful PGEE aid app should have						
6.0.H.1 optimize the design and the operation of the APP	6.0.I.1 Provide relevant information of PGEE	6.0.J.1 establish a communication platform in the APP 6.0.J.2 Provide relevant information of PGEE	None	Knowledge framework building function (A) Provide suitable references or materials (A) 6.0.A.3 Concise/simple UI (A, B) UI design can't go out of style (B) Statistics of popular test sites in past exams (C)	Knowledge framework building (IV2) Provide suitable references (IV2) UI design (IV1) Software optimization (IV1)	1. Since students who are reviewing for PGEE are very sensitive to the time spent, designers must consider optimizing the loading time and network response time of the PGEE Aid APP to improve students' use experience as much as possible.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q6.0 In addition, what other characteristics do you think a successful PGEE aid app should have						
				Smooth operation of the APP/ Optimize the design and the operation of the APP (C, E, G, H) Most of the functions are free to use (D) Prompts the knowledge points that students have missed to review	The cost of using the APP (IV3) Help students to make and optimize the review plan and urge students to complete the review plan (IV5) Communication platform (IV4)	Otherwise, students will waste meaningless time due to the excessively long loading and software lag. This will reduce students' favorable impression of the APP,

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q6.0 In addition, what other characteristics do you think a successful PGEE aid app should have						
				<p>(D)            Let students make the review plan in the APP/            Monitor students finish the plan on time (F, G)            Provide relevant information of PGEE (I, J)            establish a communication platform in the APP (J)</p>		<p>2. It's relatively easy to help students make or optimize review plans,But how to urge students to complete the review according to the plan needs to be considered.            3. If a communication platform can be established within the software, it is an important</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q6.0 In addition, what other characteristics do you think a successful PGEE aid app should have						
				Marketing based on real data (G)		<p>supplement to the content of the software, because students have other sources of information, and mutual communication can spread some information that is not covered by other parts of the software. This is also helpful in improving user engagement.</p>

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
<p>Q6.1 (E) So, for example, after practicing the past exams, you don't need something like answer parsing?</p> <p>Q6.1 (G) What have you experienced about this kind of interaction?</p> <p>Q6.1 (H) For you, what is the situation where you can't bring your textbook and use your mobile phone? You mean during your internship on campus?</p>						
				6.1.E.1 If it is free then I will accept it		<p>6.1.G.1 Push reminders</p> <p>6.1.G.2 Supervise students to finish the review manually</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
<p>Q6.1 (E) So, for example, after practicing the past exams, you don't need something like answer parsing?</p> <p>Q6.1 (G) What have you experienced about this kind of interaction?</p> <p>Q6.1 (H) For you, what is the situation where you can't bring your textbook and use your mobile phone? You mean during your internship on campus?</p>						
6.1.H.1 Textbooks don't have the portability of cell phones				<p>If the service is free then I will accept it (E)</p> <p>Push reminders (G)</p> <p>Supervise students to finish the review manually (G)</p> <p>Textbooks don't have the portability of cell phones (H)</p>	<p>The cost of using the APP (IV3)</p> <p>Urge students to complete the review plan (IV5)</p>	

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee G
Q7.1 In your opinion, what are the advantages and disadvantages of the current commercial PGEE aid apps?						
7.0.A.1 The database of the current PGEE Aid APP is not comprehensive	7.0.B.1 The exercise correction in the software is completed by AI, and the accuracy rate is not high. 7.0.B.2 Some software services are too expensive 7.0.B.3 BUG	7.0.C.1 The training schedule of PGEE does not meet the requirements of students	7.0.D.1 fully functional and detailed 7.0.D.2 Services of the software need to be charged	7.0.E.1 fully functional and detailed 7.0.E.2 Services of the software need to be charged	7.0.F.1 fully functional and detailed 7.0.F.2 Some software services are too expensive	7.0.G.1 Not meaningful to practice on the screen for my major



Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q7.1 In your opinion, what are the advantages and disadvantages of the current commercial PGEE aid apps?						
7.0.H.1 Advertisements	7.0.I.1 fully functional and detailed	7.0.J.1 fully functional and detailed	None	fully functional and detailed (D, E, F, I, J)	Function and content (IV2, IV4, IV5, IV6)	1. In order to ensure the use experience of the software,
7.0.H.2 Services of the software need to be charged	7.0.I.2 No guarantee of the training capacity of the one-to-one trainer	7.0.J.2 Relatively new learning method		Some software services are too expensive/ Services of the software need to be charged (B, D, E, F, H)	The cost of using the APP (IV3) Factors that may cause students to lower their interest in this APP include advertisements, BUG and so on (IV1)	designers should ensure that there are as few bugs in the software as possible, and keep communication with users to ensure that

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q7.1 In your opinion, what are the advantages and disadvantages of the current commercial PGEE aid apps?						
	7.0.I.3 For non-professional video platforms, although it was friendly and interactive, I can also find peers on it to exchange review experience, but the video content is uneven.	7.0.J.3 Students may be distracted when using the software		The database of the current PGEE Aid APP is not comprehensive (A)  The exercise correction in the software is completed by AI, and the accuracy rate is not high (B)	Professionalism of content (IV2, IV4, IV5, IV6)	feedback on bugs can be received in a timely manner.  Operators also need to consider how to reduce advertising damage to the user experience.

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q7.1 In your opinion, what are the advantages and disadvantages of the current commercial PGEE aid apps?						
				<p>BUG (B)</p> <p>The training schedule of PGEE does not meet the requirements of students (C)</p> <p>Not meaningful to practice on the screen for my major (G)</p> <p>ADs (H)</p> <p>No guarantee of the training capacity of the one-to-one trainer (I)</p>		<p>2. To ensure the professionalism of software, designers and operators should ensure the validity and authority of the content source as much as possible.</p> <p>3. In the PGEE, except for English, political theory and mathematics,</p>

Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q7.1 In your opinion, what are the advantages and disadvantages of the current commercial PGEE aid apps?						
				<p>For non- professional video platforms, although it was friendly and interactive, I can also find peers on it to exchange review experience, but the video content is uneven (I) Relatively new learning method (J) Students may be distracted when using the software (J)</p>		<p>the rest of the subjects are set by universities themselves. So if operator could collect as many past exams as we could from every subject in every university, It will attract more students to use the APP for revision.</p>

Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F	Interviewee.G
Q7.1 (A) Is there a big difference in PGEE Major Course test for the same master's major in different universities?						
7.1.A.1 the difficulty of the proposition varies greatly among different universities						
Interviewee H	Interviewee I	Interviewee J	Interviewee K	Coding round 1	Coding cycle 2	Evaluate
Q7.1 (A) Is there a big difference in PGEE Major Course test for the same master's major in different universities?						
				the difficulty of the proposition varies greatly among different universities (A)	Content and database integrity (IV2)	

## Appendix D

### Persona & Empathy Map

#### Persona: Mike



Mike is a first-year master's student. Although he is no longer the target customer of PGEE Aid App, his experience in reviewing PGEE is obviously richer than that of students who are reviewing for PGEE. Through his experience, some enlightenment can be brought to the development of PGEE Aid App.

<p>Name: Mike Age: 22 Status: Have pass the PGEE</p>	<p><b>Characteristics</b></p> <ol style="list-style-type: none"> <li>1. Mike decided to pursue a master's degree after making his own career plans as an undergraduate</li> <li>2. He has a strong ability to resist pressure. Although his mood fluctuates slightly during the review, he can still keep a good attitude</li> <li>3. strong learning ability and material searching ability,</li> </ol>	<p><b>Pain Points</b></p> <ol style="list-style-type: none"> <li>1. It takes time to search for the reference material he need.</li> <li>2. There are many paid functions and advertisements in the tutoring software.</li> <li>3. When conducting PGEE review with software, it is easy to be attracted by other entertainment software.</li> </ol>
<p>Compressive ability</p> <p>_____ ♥ _____</p>	<p><b>Needs</b></p> <ol style="list-style-type: none"> <li>1. Need memorize as many knowledge points as possible in such a short review time and form knowledge points into knowledge framework.</li> <li>2. Practice past exams as much as possible</li> <li>3. need to keep track of hot information about PGEE.</li> </ol>	<p><b>the Ideal PGEE Aid APP's Features</b></p> <ol style="list-style-type: none"> <li>1. Comprehensive review materials and reference books.</li> <li>2. Practice the functions of past exams and provide follow-up functions such as answer analysis and error recording after practice</li> <li>3. Systematic learning.</li> <li>3. Help students to make review plans and supervise them to complete the review.</li> <li>4. Fewer ads and paid features.</li> </ol>
<p>Motivation to learn</p> <p>_____ ♥ _____</p> <p>Lo The ability to learn Hi w gh</p>		

## EMPATHY MAP

- SAYS**
1. How can I finish the review in such a short time?
  2. Where can I find materials for review?
  3. How can I build my knowledge framework?
  4. How can I balance the review and the daily study?

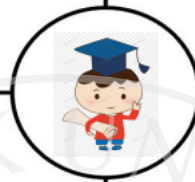
- THINKS**
1. I want to pass PGEE so that I can find my ideal job in the future.
  2. The process may be painful, but I will definitely pass PGEE.
  3. The review plan needs to be modified often.

**SAYS**

**THINKS**

**DOES**

**FEELS**



- DOES**
1. Devote all his free time to reviewing
  2. Through all channels to get suitable review materials
  3. Recite knowledge points
  4. Practice the pass exams

- FEELS**
1. Busy
  2. Doesn't feel confident sometimes

- DOES**
1. Devote all his free time to reviewing
  2. Through all channels to get suitable review materials
  3. Recite knowledge points
  4. Practice the pass exams

- FEELS**
1. Busy
  2. Doesn't feel confident sometimes

## Appendix E

### Supplementary Questionnaire

Hello, everyone. Here is a questionnaire survey aiming at the design and function of the PGEE Aid APP. The purpose of this questionnaire is to collect relevant opinions from students who are revising for the PGEE or who have had experience about the PGEE, so as to explore the possibility of designing an efficient and popular PGEE Aid APP. You may need 15 to 20 minutes to answer these questions, please choose carefully, all your answers will be kept confidential, your help and cooperation will be appreciated.

#### Part I: Basic information

Have you decided to take the postgraduate entrance examination or have you ever taken the postgraduate entrance examination [single choice] \*?

- a. I'm preparing for it
- b. I have passed the exam
- c. I did not pass the exam

Your gender

- a. Male
- b. Female



**Part II: Requirements for specific functions of the APP for postgraduate entrance examination**

	Strongly disagree	Disagree	Agree	Strongly agree
1. I think the Review Reminder function in the APP can be helpful to enhance my review efforts.				
2. I think the Countdown of PGE Exam function in APP can help enhance my review.				
3. I think the function of making review plan according to time shaft and test subject can enhance my review efforts.				
4. I think that, when I complete a certain stage of review according to the review plan and get certain material or spiritual rewards, I can improve my experience of using this APP.				
5. I think I can get some material or spiritual rewards when I share some high-quality contents of the software with my friends, which can improve my experience of using this APP.				

	Strongly disagree	Disagree	Agree	Strongly agree
6. I think that, adding the function of combing knowledge points or constructing knowledge framework for specific subjects into the APP can improve my review efforts.				
7. I think the function of the previous exam practice or the mock exam can enhance my review efforts.				
8. I think the functions of error analysis related knowledge link and error statistics after simulated exams on the APP can improve my review efforts.				
9. I think that, if I can obtain the PGEE outline, the E-book of each course and other teaching auxiliary materials on the APP, it can improve my review efforts.				
10. I think obtaining the live tutorial and MOOCs about the PGEE on the APP can improve my review efforts.				

	Strongly disagree	Disagree	Agree	Strongly agree
11. I think an interactive community can help me better choose the target university, obtain examination materials or communicate with seniors, so as to enhance my review efforts.				
12. I think functions like short jokes can make me have a rest when I review, so that I can review better. It would be better if the jokes were relevant.				
13. I think the function of psychological counseling can reduce my psychological pressure during review, so that I can review better.				
14. I think adding relevant information of the target university (enrollment phone number, direct link of the official website, navigation of the geographical location of the university, comprehensive strength analysis, historical admission rate, etc.) in the APP can enhance my experience of using this APP.				

	Strongly disagree	Disagree	Agree	Strongly agree
15. I think adding relevant information about the target major (employment prospect of the major, ranking of universities with the major, etc.) in the APP can enhance my experience of using this APP.				
16. I think the direct link function of the PGEE registration in the APP can enhance my experience of using this APP.				
17. I think if this APP can provide the surrounding information of PGEE exam site (map navigation, nearby accommodation, etc.), it will enhance my experience.				
18. I think the interface pattern and color arrangement of this APP should take into account the protection of users' eyes, so that my eyes will not get tired too fast when I use this APP for review.				

	Strongly disagree	Disagree	Agree	Strongly agree
19. I think the design style of this APP should be rigorous and simple but attractive, so that I can better focus on PGEE revision.				
20. I think the operation logic of this APP must be friendly, and the storage space and memory space of the software should not be too large.				
21. I think when I have achieved a good review efforts by using this APP, I will be more willing to continue using this APP or recommend it to others.				
22. I think if this APP gives me good experience, it will also help me enhance my review effect from the side.				

Thank you.

## Appendix F

### Prototype of the PGEE Aid App Based on This Study



The whole software is designed with flat design language, in line with the design concept of Android and IOS software in recent years. The whole page is based on light green to better protect students' eyes.

The far left screen is the login screen. Students can log in with their mobile phone numbers, or directly log in with social accounts such as QQ and Wechat, thus saving time for students to register.

The page to the left of center is the main page of the APP.

In the top left corner of the page is the user's avatar. Students can access the profile page by touching the profile picture.

In the upper middle area of the page, there is an encouraging tip, review reminder information and the PGEE countdown to remind students to review. Students can directly enter the corresponding content of the review plan through the review reminder information.

Further down is a search box that allows students to search for information about any university or major, as well as relevant ranking information and direct links to the university's official website.

The deep yellow button in the center of the page shows the review subject options selected by students. Students can enter different review modules by touching different options. The light yellow button is the review material acquisition function, through which students can get the corresponding electronic textbook or other reference books.

The lower area in the middle of the page is the popular training or MOOC recommendation. Students can quickly join in by touching this message. Below this area are some decorative learning-related images to enhance the aesthetic of the main page.

At the bottom is the APP's navigation bar. Other important features are listed here, in order: training course module, review plan module, online forum module, and user care module.

The center-right page is the result of a student's college and major search. The page on the far right is the official website of the university (take Tsinghua University as an example).



This is a review page for students, using English and math as examples. The page on the far left is the English review module. In the English review module, students can memorize words and long difficult sentences, practice past exams or take

mock exams or practice for a particular type of question.

The left-center page is for Short composition targeted exercises.

The page to the right of center is the math review module. The layout of modules in most courses is the same as that of modules in mathematics. In the mathematics review module, students can memorize knowledge points and build knowledge framework in the first half of the area for higher mathematics, linear algebra, probability theory and mathematical statistics.

Practice past exams and practice exams in the middle and lower part.

The page on the far right is the page for past exams in math. After a complete past exam, students will get an answer analysis and index of the relevant knowledge points, so that students can directly go back to the knowledge points in the upper part of the module for another review.



By touching the second button on the navigation bar, students can access the training and courses module. This module consists of three sub-modules, namely paid area, free area, and user subscribed content. Students can directly attend free training



and courses for free, and they can also get higher quality paid courses by paying for them.

Of course, according to the research results of this paper, students can also get some tokens by sharing and completing the review to exchange part of the paid courses. This part will be described later.



Here, the diagram on the left shows the details of the review plan that has been drawn up.

Students can enter by touching the corresponding button in the navigation bar or by touching the review reminder on the home page. At the top of the page is a statement encouraging students to review. The main area is the details and completion of the plan.

Students can jump to the appropriate review page by touching the Continue button. They can also modify the review plan to enter the plan modification page on

the right.

The dialogue bubble at the bottom is about the completion of the review plan and the expected rewards to encourage students to continue with the review plan.

The page on the right is the revision page of the review plan. Here, students can make or modify their review plan by plan or subject. The system will also push the corresponding review plan recommendation according to the major students choose.



This page is the online forum module of the APP. Users can search for topics about the PGEE they are interested in in different partitions or publish their own posts. According to the idea of this paper, if a student's post is liked by many other students, he can also get some tokens.



In here, the leftmost figure is the assistant interface. Students can access this module by touching the button on the far right of the navigation bar.

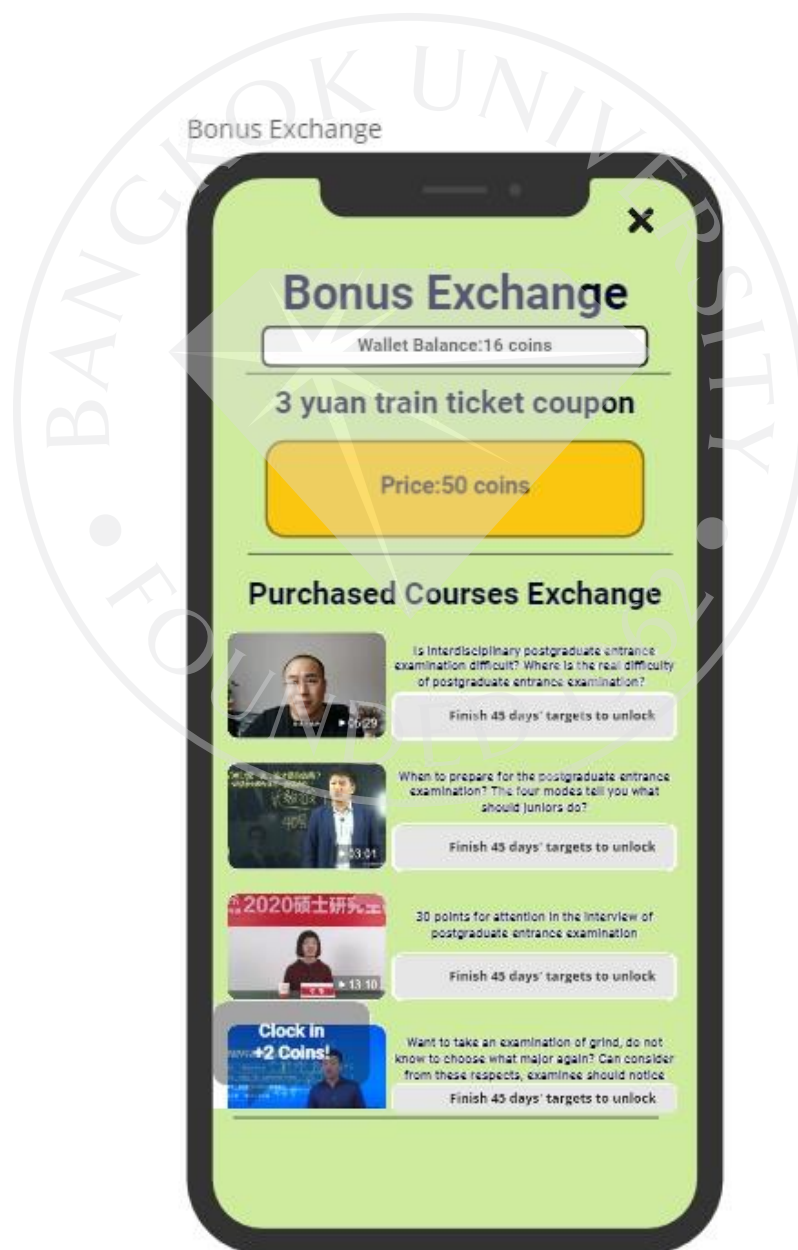
First of all, students can enter the provincial admission examination institute to register for the PGEE by setting their own location.

Secondly, by setting the student's current location and test site information, students can obtain transportation information from their location to the test site, and can easily book accommodation around the test site.

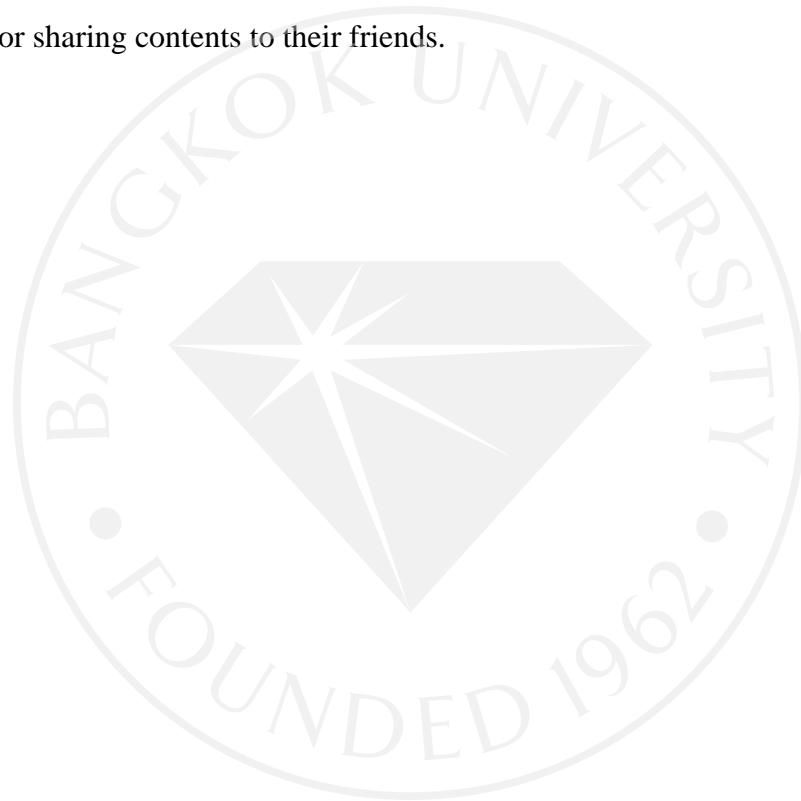
In addition, due to the rampant COVID-19, the APP will also push relevant regulations on epidemic prevention and control and safety in the cities where the test site is located at the bottom.

The middle page is a personal page, and students can access this module by touching the avatar on any page. In this module, students can access the reward exchange module and the stress relief module by touching the corresponding button.

The page on the right is for the stress relief module. In the upper part of the page, the symptoms and solutions of common psychological problems during the PGEE revision period are listed. The bottom half of the page is filled with jokes for students to relax during the revision break.



This page is the Bonus Exchange module of the software, the implementation of the Incentive Mechanism described in this article. This module can be accessed by touching the dialog bubble in the review plan or the corresponding button in the personal interface. In this module, students need to perform two kinds of behaviors to obtain rewards. First, they must complete a certain period of review, the effectiveness of which is determined by the system, in order to unlock the reward. Second, students need to earn tokens to redeem rewards by completing the review, posting on the forum, or sharing contents to their friends.



**BIODATA**

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