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Factors Facilitating Chinese College Students to Adopt and Engage in Mobile Campus Service Apps

CHU Shanzhong

Doctor of Management

Supervisors:
PhD Bráulio Alturas, Associate Professor,
ISCTE University Institute of Lisbon
PhD FANG Jiaming, Professor,
University of Electronic Science and Technology of China

September, 2022

BUSINESS
SCHOOL

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**Declaration**

I declare that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university and that to the best of my knowledge it does not contain any material previously published or written by another person except where due reference is made in the text.

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# Abstract

Increasingly college students are using mobile campus service applications (mcs-Apps) for information and activities related to their campus. Therefore, college student adoption (initial adoption) and engagement (continuance usage and interaction) with mcs-App become extremely important for mcs-App-related companies and college management. However, there is little empirical research on what factors may drive college students' adoption and engagement in using mcs-App.

This research studies two stages of App usage. First, Base the TOE framework, this study proposes model A of mcs-App adoption. The study investigates the impacts of mcs-App's technological characteristics, personal characteristics, and environmental characteristics on students' attitudes, which in turn influence students' intention to adopt them. The results showed that perceived usefulness, perceived ease of use, personal motivation, self-efficacy, mass influence, and peer influence are critical determinants of students' attitudes, which can lead to students' adoption intentions.

Second, this study proposes model B, based on the S-O-R model, to explore how and to what extent two types of mobile app attributes (design and performance) stimulate mcs-App engagement. The results demonstrate that two app design features (privacy/security and user interface attractiveness) and four app performance attributes (compatibility, effort expectancy, interactivity, and time convenience) are important drivers of college students' behavioral engagement of mcs-Apps. Further, affective involvement and cognitive involvement serially mediate the relationships.

This study is based on a real mcs-App development project. The results can be used to improve the related mobile app adoption and engagement research and the mcs-App design.

**Keywords**: Mobile campus app; App attributes; Mobile user adoption; Mobile user engagement; Initial adoption; Continuance usage

**JEL**: M15; L86

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# Resumo

Cada vez mais estudantes universitários estão usando aplicações móveis de serviço de campus (mcs-Apps) para obter informações e participar em atividades relacionadas ao seu campus. Portanto, a adoção do estudante universitário (adoção inicial) e a sua fidelização (uso contínuo e interação) com as mcs-App tornam-se extremamente importantes para empresas que desenvolvem as mcs-App e para a gestão das universidades. No entanto, há pouca pesquisa empírica sobre quais os fatores que podem impulsionar a adoção e a fidelização dos estudantes universitários no uso de mcs-App.

Esta pesquisa estuda duas fases de uso da App. Em primeiro lugar, com base no framework TOE, este estudo propõe o modelo A de adoção de mcs-App. O estudo investiga os impactos das características tecnológicas, características pessoais e características ambientais das mcs-App nas atitudes dos alunos, que por sua vez influenciam a intenção dos alunos em as adotar. Os resultados mostraram que a utilidade percebida, a facilidade de uso percebida, a motivação pessoal, a autoeficácia, a influência de terceiros e a influência dos pares são determinantes críticos das atitudes dos alunos, o que pode levar à intenção de adoção dos alunos.

Em segundo lugar, este estudo propõe o modelo B, baseado no modelo S-O-R, para explorar como e em que medida dois tipos de atributos das aplicações móveis (design e desempenho) estimulam a fidelização às mcs-App. Os resultados demonstram que dois recursos de design da aplicação (privacidade/segurança e atratividade da interface do utilizador) e quatro atributos de desempenho da aplicação (compatibilidade, expectativa de esforço, interatividade e conveniência de tempo) são importantes impulsionadores do envolvimento comportamental dos estudantes universitários em relação às mcs-Apps. Além disso, o envolvimento afetivo e o envolvimento cognitivo mediam serialmente os relacionamentos.

Este estudo é baseado em um projeto real de desenvolvimento de mcs-App. Os resultados podem ser usados para melhorar a investigação em adoção e fidelização de aplicações móveis, bem como contribuir para o design de mcs-App.

**Palavras-chave**: Aplicações móveis do campus; Atributos da aplicação; Adoção de aplicações

móveis; Fidelização do utilizador; Adoção inicial; Uso de continuidade

**JEL**: M15; L86

# 摘　要

越来越多的大学生使用移动校园服务 App（mcs-Apps）来获取与校园相关的信息和活动。因此，大学生对 mcs-App 的采用（初次采纳）和融入（持续使用和互动）对于 mcs-App 相关公司和高校管理来说变得极其重要。然而，究竟是什么因素驱动了大学生对 mcs-App 的采用和融入，相关的实证研究还很少。

本文研究了 App 使用的两个阶段。首先，基于 TOE 框架，本文提出了 mcs-App 采用的模型 A。本研究考察了 mcs-App 的技术特征、个人特征和环境特征对学生态度的影响，进而影响学生使用 mcs-App 的意愿。研究结果表明，感知到的有用性、感知到的易用性、个人动机、自我效能、大众的影响力和同伴的影响力是学生态度的关键决定因素，可以导致学生的采用意愿。

其次，本研究提出了基于 S-O-R 模型的模型 B，以探索两种类型的 App 属性（App 设计和 App 性能）如何以及在多大程度上刺激 mcs-App 的融入。结果表明，两个 App 设计特性（隐私/安全性和用户界面吸引力）和四个 App 性能属性（相容性、努力预期、交互性和时间便利）是大学生对 mcs-Apps 行为融入的重要驱动因素。此外，情感卷入和认知卷入起到连续中介作用。

本研究基于一个真实的 mcs-App 开发项目。研究结果可用于改进相关的移动 App 采用和融入的研究以及 mcs-App 的设计。

**关键词**：移动校园 App；App 属性；移动用户采用；移动用户融入；初次采用；持续使用
**JEL**: M15; L86

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# Contents

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# List of Tables

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# List of Figures

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# Chapter 1: Introduction

## 1.1 Research background

In recent years, China's mobile Internet industry has achieved remarkable development. According to the statistical data, as of the end of March 2020, the number of smart phone users in China totaled 897 million. Previously, the figure was 79.92 million at the end of 2018. Among the netizens in China, the proportion of Internet access through smart phones has reached 99.3%, an increase of 0.7 percentage points from the previous period. Among the netizens in China, students account for the largest share of 26.9%. By December 2019, a number of apps monitored in the domestic market is 3.67 million (China Internet Network Information Center [CNNIC], 2020).

From the perspective of China's telecommunications industry development, by the end of December 2019, the number of 4G users totaled 1.28 billion, accounting for 80.1% of mobile phone users. In 2019, China's mobile Internet data consumption increase significantly (by 71.6%), with a total of 122 billion GB. In particular, the proportion of mobile Internet traffic in the total traffic is 99.2%, which has reached 121 billion GB, with an increase of 72.4% (Ministry of Industry and Information Technology of the People's Republic of China [MIIT], 2020).

From the perspective of China's smart phone popularity, according to International Data Corporation (IDC), the total sales volume of smart phones is about 421.47 million units in China in 2018 (IDC, 2019).

From the perspective of China's education development, according to Ministry of Education of the People's Republic of China (MOE), there are 2,688 colleges and universities of all kinds in China as of 2019, with about 40.02 million attending students (MOE, 2020).

From the perspective of China's mobile app development, China's mobile application field has achieved good development results. According to CNNIC, the total number of mobile IM users in China has increase rapidly. In March 2020, there were about 89,012 million users, and the proportion of Internet users was 99.2%. Among the netizens in China, the total number of mobile payment users is 765 million as of March 2020, accounting for 85.3% of all Internet users. In addition, the total number of mobile search users was 745 million,

accounting for 83.1% of Internet users, an increase of 91.4 million from December 2018. At the same time, the total number of mobile news users is about 726 million, accounting for 81.0% of Internet users, an increase of about 73.56 million over December 2018. In the same period, the total number of mobile shopping users was 707 million, accounting for 78.9% of Internet users, an increase of about 116 million from December 2018. Statistics show that the total number of mobile music users is 633 million, accounting for 70.5% of Internet users, an increase of about 79.78 million from December 2018. Compared with the total number of Internet users of 4.25 billion in 2018, the proportion of Internet users of literature increase by about 38.5%. The number of mobile game users is 529 million, accounting for 59.0% of Internet users, an increase of about 70.14 million over December 2018. In addition, the total number of mobile education users was 420 million, accounting for 46.9% of Internet users, an increase of about 226 million over December 2018. A total number of mobile takeout users has reached 397 million, accounting for 44.2% of the netizens (shown in Annex A, Table 1.1; CNNIC, 2020).

In summary, mobile Internet technology has an important impact on the lifestyle of college students and the way they access information. College students are increasingly inclined to use mobile apps as their primary means of accessing information and services. Among these apps, mobile campus service apps account for a large proportion.SHOU

With the advent of the "Internet +" era, data promotion and software development, more and more apps that assist the school's informatization and intelligent management have emerged, bringing great convenience to the lives and work of the teachers and students. But the "sudden popularity of campus apps" seems to have come too quickly, and the large number, poor quality, little effect, bombardment of commercials, information leakage, improper management, and other drawbacks have gradually driven the campus app management model away from its original intention (M. K. Wei & Li, 2019). MOE (2019a) clearly requires that the management and use of campus apps be comprehensively regulated, and that joint actions with network information departments be carried out to control the disorder of campus apps, with a focus on strengthening the standardized management of education apps and promoting the orderly and healthy development of mobile Internet. It can be seen that the research on the mobile campus service app is imminent and can provide a theoretical basis for school management and decision-making.

Mobile commerce is a further development and extension of e-commerce. It mainly forms a relatively independent channel and provides sufficient convenience to enable users to obtain the required value (Balasubraman et al., 2002). Based on provided mobile services,

consumers can obtain higher added value without being limited by time and space (Balasubraman et al., 2002; L. Chen & Nath, 2004). In addition, it can also provide some special customized products (Figge, 2004).

The study find that the use and acceptance of consumers are the main factors to realize mobile marketing. The main reason is that the effect of mobile marketing will be greatly affected by consumer response (Heinonen & Strandvik, 2007). Therefore, it is necessary to analyze in depth the relevant behaviors of users from PC to mobile application and analyze their main intentions. On the one hand, applications provide more convenience. On the other hand, it also brings more development potential to mobile commerce. Generally, mobile commerce is regarded as a different form of transaction, and we can use wireless telecommunications networks to obtain the corresponding monetary value (Barnes, 2002). Applications can provide a wealth of related services conducive to the development of mobile commerce. Users can effectively use mobile applications to deal with various conventional tasks efficiently. They can purchase, trade, or pay through applications, enjoy the convenience anytime, anywhere, and significantly promote the further development of mobile commerce (Roy, 2017). As mobile applications have a series of functional advantages, so they have gradually gained more applications in the business field. Users can use them to carry out brand publicity and promote their continuous development in the field of mobile commerce (D. G. Taylor et al., 2011). After using the mobile application, users can obtain the required product information through different channels to better judge the performance of the product. On this basis, users can timely adjust their choices according to their actual needs (J. Y. Lai et al., 2012). After the user uses the application, the time cost can be significantly reduced, so the work can be carried out conveniently without the limitation of time and space (that is, the user does not have to be present at a specific location). In addition, marketers can use mobile applications to interact with users more extensively, thus further reducing the cost of advertising and obtaining higher economic benefits (Gupta, 2013).

In the past period, due to the continuous development of mobile commerce, mobile service applications have obtained more applications.

Recently, due to the rapid development of communication technology, more attention has been paid to the R&D and application of mobile phone products (Hassan et al., 2014). With the continuous progress of science and technology, the development of new mobile devices has obtained better basic conditions (typically 4G / 5G technology and Wi-Fi). Because of this, the field of smart phones has made amazing development achievements (Middleton, 2010). Researchers have found that with the rapid growth of mobile phone use, the development

needs of various new mobile applications increase significantly (Middleton, 2010). Such programs are mini programs that can run on mobile devices and perform various tasks effectively (Middleton, 2010). It can better eliminate the confusion of the domain name server so that users can directly obtain the required content. In this process, users can obtain the required information without using a browser to connect (Johnson, 2010). Some researchers believe that mobile apps are applications that allow and encourage users to perform certain tasks. Usually, these tasks will be installed on portable devices such as tablets or smart phones (C. Z. Liu et al., 2015). After merchants have launched different forms of mobile applications one after another, users can get a variety of services. These services include tourism, information, banking, investments, shopping, and sports. Mobile applications also have rich entertainment functions such as music and social networking (Roy, 2017). A study by Accenture in 2012 points out that users can meet their relevant needs through applications (Accenture, 2015). In other words, all aspects are " applied " (Hassan et al., 2014). After the merchant launches the application, it will be able to provide customized services. It is more cost effective and user friendly than conventional desktop applications, and it is very easy to install and use (D. G. Taylor et al., 2011).

In the past few years, the use of mobile applications has become more extensive, and the adoption behavior on mobile platforms has attracted more attention (K. Peng et al., 2014). Some researchers have discussed this behavior, including mobile advertising service (Martí Parreño et al., 2013), mobile commerce (Liang et al., 2007), and mobile banking service (Ha et al., 2012). Among them, early researchers propose the technology acceptance model (TAM) and introduced some improved models (Ha et al., 2012; H. C. Yang, 2015). Some studies have explored the main influencing factors, including subjective norms, perceptual control, and ease of use. Some studies have also deeply analyzed its culture, perceived risk, and self-efficacy (Ha et al., 2012; H. C. Yang, 2015).

Generally, mobile services are mainly provided by mobile applications. To achieve the above goals, users need to adopt the mobile application (through a channel). In fact, the influencing factors related to application adoption have not been carefully discussed (Ha et al., 2012; H. C. Yang, 2015). It should be pointed out that this theory is largely based on the TAM model. They are fully combined with other basic theories and then developed. H. C. Yang (2015) mainly combines satisfaction and satisfaction theory and TAM, and on this basis, deeply discusses the mainstream opinions of young consumer groups in the United States on mobile applications. The results show that consumers' attitudes are greatly affected by factors such as ease of use, usefulness, and perceived enjoyment. Therefore, consumers' willingness

4

to use mobile apps will be affected by their attitudes and perceptions.

Fang et al. (2017) conduct in-depth research in this field. Based on the stimulus organism response (S-O-R) model, they propose a new research framework to analyze the impact of application attributes on users' participation in tourism applications. They find the effectiveness of the performance attributes of applications and then discuss the process and mechanism of consumers' participation in the behavior of applications. Their results show that the above relationship will be significantly affected by psychological participation and interest perception. Among them, these benefit perceptions mainly include social benefit, utilitarian benefit, and hedonic benefit.

According to CNNIC (2020), by March 2020, the number of online video users (including short-form video users) in China have reached 850 million, an increase of 126 million from the end of 2018, accounting for 94.1% of all Internet users in China. Among them, the number of short-form video (SFV) users was 773 million, up 125 million from the end of 2018, accounting for 85.6% of the total Internet users. At the beginning of 2020, the user scale and usage time of online video apps are significantly increased due to the impact of COVID-19 epidemic .

The rise of mobile SFVs app is only started a few years ago, but the sweeping trend is unstoppable. Looking back at the development trajectory of mobile SFVs in China, the earliest one should be Miaopai launched by Sina Weibo in 2013. Ge (2021) found the whole industry of SFVs expanded vigorously afterwards and a series of phenomenon mobile SFVs apps were launched successively, such as TikTok app and Kwai app (*Kuaishou or Kwai* is a SFV mobile app in China. Formerly known as "GIF Kuaishou", an app for making and sharing GIF images that was launched in 2011, it was transformed into a SFV community in 2012 and renamed Kuaishou in 2014.).

Although the popularity of SFVs is related to the rapid expansion of the market with its technical support, the adaptability and practicability of its target users are also closely related to its rapid expansion (X. L. Kang, 2020).

An increasing number of studies have focused on the phenomenon of SFVs in the recent years. In summary, the existing research has investigated the following areas.

(1) Research on the development status and future trend of mobile SFVs. S. Q. Fan (2021) summarizes and analyzes the development process and characteristics of SFVs, reviews the existing problems and attributions of the business model of the current SFVs platform, and provides suggestions and solutions as a reference for the healthy and sustainable development of the SFVs industry. Focusing on the connotation and characteristics of new media SFVs,

Tang (2020) summarizes the benefits and problems of SFVs, proposes several improvement measures, and point out that "in the era of new media, SFVs have changed the communication status of traditional media platforms and are an innovative act in the era of new media".

(2) Research on users' use of mobile SFVs. Based on the ECM-IT model, M. X. Jiang (2021) combines the characteristics of Tiktok app and adds three variables (perceived entertainment, product factors and social influence) to investigate the influence of these variables on users' continuous use intention. Guan and Chen (2021) analyze the reasons for the decline in user loyalty of "Tiktok" app and propose the following three improving strategies: making good use of new technologies, strengthening supervision, and expanding new functions.

(3) Research on the characteristics of mobile SFVs transmission. M. Huang (2020) points out that the spread of SFVs as the important form, with the natural advantage to win the majority of users welcome and recognition, but a SFVs also has some disadvantages, especially in the hot issues of public opinion in the fermentation, which requires the legal norms and policy guidance, to avoid the negative effects to the public and the society. J. Wen and Jin (2020) select the representative Tiktok app in the SFVs industry, take it as an example to study the development status and communication characteristics of the industry, and propose several suggestions on the future development of the SFVs industry in the new media era.

(4) Research on the marketing strategy of mobile SFVs. Based on the development status of mainstream media in the field of mobile SFVs and the actual case analysis of "CCTV News" Tiktok, You (2021) analyzes the innovation of the current mainstream media's mobile SFVs news communication strategy, and pointed out that "the mainstream media represented by CCTV should also adhere to the content of the king on the basis of adopt the communication voice suitable for the new media environment to carry out innovative communication, so as to adapt to the changes in the media environment, and achieve the integration of 'useful + interesting' ".

(5) Research on user perception of SFVs. Harris (2013) believes that SFVs not only have simple operation methods and rich and diverse contents, but also can give users a sense of being on the spot and meet their needs of reading news information, entertainment and cultivating sentiment. Therefore, his study offers the reasons why SFVs are popular with the majority of users.

The existing literature mainly studies apps in short-form videos, sports, shopping, maps, banking, news, tourism, social, and music. Therefore, this study will contribute to the

literature by filling the gaps in related theories.

## 1.2 Research problem and questions

According to CNNIC statistical data at the end of 2019, if divided by age group, the highest number of mobile apps per capita is people aged 15-19, reaching 84%. Followed by the group of 20-29-year-old netizens, this number is 65 (CNNIC, 2020). In this age range, a significant proportion of young people are college students, thus stressing the importance of having a mobile application that connects the student with the university, making this interaction more dynamic. From the application, the student can have integrated and real-time access to certain content, facilitating contacts and sharing information (Tavares & Alturas, 2018). With the development of mobile campus service apps, companies developing apps are facing the dilemma of increasingly fierce competition. Campus management has experienced the dilemma of how to manage and how to serve college students. College students are the main force of mobile app use, among which the campus service app provides students with services such as clothing, eating, accommodation, and transportation. Therefore, this thesis studies the factors facilitating Chinese college students to adopt and engage in mobile campus service apps. The purpose is to provide a theoretical guidance for college management teams and their decision-making process, and to fill the research gaps in the literature.

The main contents of this research include:

- What is the current status of campus service applications use?

- What factors make college students use an app (download, install, and use it) for the first time?

- What factors enable college students to continuously use the app and continue to interact with the app?

- What specific management strategies can be adopted to further improve its participation?

## 1.3 Research contents

### 1.3.1 Research methods

The research methods will be (shown in Annex B, Figure 1.1):

(1) Literature review.

(2) In-depth interview.

(3) Questionnaire survey.

(4) Structural equation model.

## 1.3.2  Research process

First, through literature review, this thesis identifies existing theories and relevant models on the main influencing factors of mobile app use. Second, this research constructs the main variables of the research model. Third, this research will conduct a comprehensive interview analysis on students' use behavior of the mobile campus service app. Fourth, this study determines the theoretical model of the study based on the interview findings. Fifth, based on the theoretical model, this work designs the corresponding questionnaires and scales and collects data following the method of investigation and research. Sixth, Using the survey data, this thesis estimates the model based on the structural equation modeling technique (including descriptive statistics, reliability assessment, validity assessment, and hypothesis testing). Finally, based on data analysis, the corresponding management strategies are proposed in a targeted manner (shown in Annex B, Figure 1.2).

The data are imported and analyzed with Amos 24. This research is conducted in P. R. China.

## 1.3.3  Research outline

This thesis studies factors facilitating Chinese college students to adopt and engage in mobile campus service apps. The thesis contains five chapters (shown in Annex B, Figure 1.3), and the research outline is as follows:

Chapter 1: Introduction. The introduction section, mainly analyzes the progress and main content of this research field, so as to pave the way for the follow-up analysis. This section contains the research background, existing research problem, and questions, followed by my research method and contribution.

Chapter 2: Literature Review. It mainly introduces related theories on user app adoption, and engagement, and the studies on mobile phone apps, all of which have laid a significant foundation for the subsequent research on mobile campus service apps.

Chapter 3: App Adoption. This chapter mainly includes data analysis, data collection, and research methods. Related research models, hypotheses, indicators, and questionnaires are first proposed. In the next section, research model and hypotheses, research models and

hypotheses are proposed. In the section of research methods, indicators, questionnaires, population and sample, sample size, and field research of this study are discussed. The section on data analysis describes descriptive statistics, reliability assessment, validity assessment, and hypothesis testing.

Chapter 4: App Engagement. This chapter mainly includes data analysis, data collection, and research methods. Related research models, hypotheses, indicators, and questionnaires are proposed in the first section. In the next section of research model and hypotheses, research models and hypotheses are proposed. In the section of research methods, indicators, questionnaires, population and sample, sample size, and field research of this study are introduced. The final section on data analysis describes descriptive statistics, reliability assessment, validity assessment, and hypothesis testing.

Chapter 5: Discussion and Conclusion. This chapter mainly discusses the managerial and theoretical implications, research limitations, future research, and summary.

## 1.4 Research implications

### 1.4.1 Practical implication

First, this research studies the behavior of college students on mobile campus service apps, provides a basis for product development strategies and directions for app developing companies, and solves the dilemma that these companies face in increasingly fierce competition.

Second, there are a large number of mobile campus service apps and fierce competition. The research in this research provides a basis for colleges to select apps.

Third, students' loyalty to mobile campus service app usage is relatively low. Mastery of students' use behavior of mobile campus service apps usage offers an important management reference value for universities. This research solves the dilemma of how universities manage and serve the majority of college students.

### 1.4.2 Theoretical implication

First, previous research work has paid less attention to the application of mobile campus apps. This study will fill the research gap in this field.

Second, this research studies the adoption and engagement of mobile campus service apps. The developing app adoption research model, app engagement research model, as well as

their relationship offer a framework and reference for future researchers who study the college mobile apps.

Third, college students are the main body of netizens and represent the future of this society. The study and research models in this research also have certain reference significance for app research in other industries.

# Chapter 2: Literature Review

## 2.1 Definitions of basic concepts

### 2.1.1 App related concepts

There are some different definitions of "app/App", "mobile phone", "smart phone", "tablet" and "education app/campus app" (shown in Table 2.1).

Table 2.1 Terms definitions on app

| Terms | Definitions | Author(s) and year |
|---|---|---|
| App | It is an application software downloaded by users to tablets or smartphones. Its functions include online games, information queries, and social communication. | Hornby, 2018 |
| | A piece of computer software that does a particular job (SYN application). | Pearson, 2019 |
| | Mobile App (Application) is a special application service developed for smartphones connected to the Internet business or wireless network business. Its popular name is mobile phone software. Its original purpose is to make up for functional defects of the original system of smartphones and to provide users with more personalized services. | Y. Zheng, 2019 |
| | Mobile App—It is application software used to perform certain tasks. In addition, it can run on different types of portable digital devices. | C. Z. Liu et al., 2015 |
| Mobile phone | It is a new type of telephone that works by radio. In addition, its use will not be limited by location (including cellular phone and cell phone). | Hornby, 2018 |
| | A telephone that you can carry with you and use any place(SYN cellular phone). | Pearson, 2019 |
| | In recent years, mobile phones have gradually developed into a new type of location "smart phones". In fact, it is equivalent to a computer with rich functions. At present, smart phones have good operating systems and processor and can use broadband to access the Internet. It usually has a very friendly user interface and can provide convenience in production and life, so it has significantly changed people's life | C. Z. Liu et al., 2015 |
| | After continuous development, the original mobile phone has gradually evolved into a new type of smart phone. If users need to access all kinds of information, they can get it anytime, and they can get it anywhere. | D. Wang et al., 2011 |
| Smartphone | It is a mobile phone with some functions of a computer. These functions include using the Internet or app. | Hornby, 2018 |
| | A MOBILE PHONE is also a small computer and can connect to the Internet. | Pearson, 2019 |
| Tablet | It is a portable computer. It has a relatively large touch screen. In some cases, it does not have a physical keyboard. | Hornby, 2018 |
| | (also tablet computer) A computer that you can carry with you which has a TOUCH SCREEN and does not have a separate KEYBOARD. | Pearson, 2019 |
| Education | Its users include school teachers, different types of students, related | MOE, 2019b |

| | | |
|---|---|---|
| app | family members and so on. Its application scenario is educational activities, and its main goal is to provide good services for students' life and teaching activities. On this basis, good interaction between schools and students' families can be realized | |
| Campus app | Campus app is a general term for a class of apps that can provide learning directory and resources, daily life convenience, learning service or skill training for teachers and students in campus life. | M. K. Wei & Li, 2019 |

Generalizing from the existing literature, this study will use the following definitions:

(1) *App* - It is a software that can be downloaded to users' tablets and smartphones through app stores (such as iOS, Google Play, and third-party Android in China). It has various functions.

(2) *Mobile phone* - It is a new type of telephone that works by radio. In addition, its use will not be limited by location (including cellular phone and cell phone).

(3) *Smartphone* - It is a mobile phone with some functions of a computer. These functions include using the Internet or app.

(4) *Tablet* - It is a portable computer. It has a relatively large touch screen. In some cases, it does not have a physical keyboard.

(5) *Mobile campus service app* - Its users include school teachers, different types of students, and related family members. Its application scenario is educational activities, and its main goal is to provide good services for students' life and teaching activities. On this basis, good interaction between schools and students' families can be realized (MOE, 2019b).

In recent years, communication technology has achieved remarkable development results, further promoting the continuous popularization and improvement of smart phones (Hassan et al., 2014). This study considers mobile phones and smartphones as the same.

### 2.1.2 Types of apps

As mentioned earlier, through continuous development, mobile phones have gradually evolved into smart phones with more functions. It has a high-performance operating system and processor, can connect to the Internet through broadband, and has efficient applications and a very friendly user interface. Therefore, it has good application potential (D. Wang et al., 2014). These possibilities are enhanced by the diversity of smartphone apps available today (Tavares & Alturas, 2018).

According to Seymour et al. (2014), mobile devices and platforms have increased in numbers very quickly, and technology has shifted at different levels. The applications mainly include hybrid apps, mobile web apps, and native apps.

### 2.1.2.1 Native App

Native applications (Native apps) are downloaded directly from online app stores and then installed. At present, some famous app stores include Apple app Store, Huawei AppGallery, and Google Play. These applications are installed on mobile devices (e.g., smartphones, tablets) and are accessed through an icon displayed on the screen. They are designed and developed for a particular platform/operating system (e.g., iOS and Android), but they have the advantage of exploiting hardware resources, like location-based service (LBS), microphone, camera, compass, gyroscope, and accelerometer. In addition, native apps can provide data from onboard applications. Its development mainly uses the integrated development environment (IDE). In fact, IDE is a rich toolbox. The tools it provides include deployment, release, version control, debugging, construction and compilation. Therefore, it has good function and availability. In particular, it can also provide an ideal mobile experience (2014).

### 2.1.2.2 Mobile Web App

Mobile Web applications (Web apps) looked like native apps but are not implemented as such. In fact, they are web pages and not applications. They run mainly through web browsers. Generally, they mainly use web technologies such as CSS and HTML5. In fact, web applications do not just apply to the underlying platform of deployment. The implementation of web technologies makes mobile web apps different from native apps. The "write-once-run-anywhere" of the HTML5 method has made the distribution and support for web apps easier than for native apps (Seymour et al., 2014).

### 2.1.2.3 Hybrid App

Hybrid apps are partially web and native applications. They come from the app store and can effectively take advantage of various available device functions, just like native applications. Similar to web applications, they depend on HTML being loaded into a browser that integrates into the application. Because they can carry out cross-platform development, they have attracted the attention of users. We can use the same HTML code components in various operating systems (e.g., iOS and Android), thus significantly reducing the development costs (Seymour et al., 2014).

### 2.1.2.4 Social media

In addition to the aforementioned three common types, a new campus mobile informatization construction mode has also emerged in recent years, that is, using social media as the carrier

of mobile app. Different from the hybrid application mode, social media itself usually does not involve the information business of colleges and universities, but acts more as a "channel/entrance" to build a communication "bridge" between users and applications (H. Liu & Zheng et al., 2017).

This type has many advantages. First of all, the application research and development cost is small and the threshold is low. Second, the channel has significant advantages, and the interaction between users and applications is frequent. After superimposing the campus information application, the message service can reach users quickly and effectively. Third, the application is lightweight. The service is downloaded only during use and disappears after closing. It does not reside in the storage and continuously occupies the resources of the mobile device. The fourth, advantage of this mode is that it has good compatibility on technology, and it will be very convenient to realize the transformation to other modes in the future. Last but not the least, behind the influential social media, there are usually some powerful Internet companies (such as Tencent Holdings Ltd. and Ant Group Co., Ltd.). Their mobile technology architecture can not only enable the informatization of colleges and universities to start from a relatively high starting point, but also improve the success rate of universities in the process of exploring mobile transformation by laying a good foundation for the sustainable development of mobile information services in universities. The main problem of this type is that in the development of colleges and universities function applied to a certain extent when is limited by the constraints of the external framework and, at the same time the user data will be exposed to social media, colleges and universities need to attach great importance to, detailed and comprehensive suitability of these media and security considerations, in order to ensure the information security of the school teachers and students.

### 2.1.2.5 Comparison of types

The evolution from native application to hybrid application and then to social media, to a certain extent, reflects the transformation of university informatization construction in the mobile Internet era. It has migrated from a large-scale, heavy and large input stage to a more lightweight, flexible and micro input stage. At present, many domestic colleges and universities have begun to put into practice and promote the mobile reform of schools with the help of social media mode. Some colleges and universities that have built hybrid applications have also begun to try the new mode (S. G. Zhong et al., 2016).

**2.1.3 Definitions of adoption and engagement**

In order to deeply analyze the participation of users in using applications, we should clearly distinguish the real meaning of the concepts of engagement behavior, continuous usage, and adoption, and grasp their specific differences (Fang et al., 2017). Definitions of the variables described by their developers in the existing literature (shown in Table 2.2).

Table 2.2 The definitions of variables

| Variables | Definitions | Author(s) and year |
|---|---|---|
| Technology adoption | *Technology adoption* mainly refers to the use of hardware and software technology to further improve processing speed, competitiveness, and productivity, and promote the availability of information at any time. | Davis et al., 1989 |
| | *Technology engagement and technology adoption* are quite different, the latter mainly refers to the adoption of technology as the starting point of participation. | Y. H. Kim et al., 2013 |
| App adoption | It mainly refers to the selection of mobile applications. | Pagani & Mirabello, 2011; Y. H. Kim et al., 2013 |
| Continuous usage | It mainly refers to the behavior that users will continue to use the product after the initial adoption" (Yoon & Rolland, 2015). "If it is analyzed from the perspective of basic concepts, it is actually a specific subset of behavior participation (Fang et al., 2017). | Pagani & Mirabello, 2011; Y. H. Kim et al., 2013 |
| Continuance behavior | Generally, it mainly focuses on the process of using a product by individuals. | Fang et al., 2017 |
| Engagement behavior | It is actually a special participation process, mainly including interactive participation and individual engagement. | Oh et al., 2017 |
| | It also includes continuous value-added social interaction, typical examples such as customer co-creation, good reputation, knowledge contribution. | Fang et al., 2017 |
| | It refers to the continuous interaction after the user has adopted the application. | Fang et al., 2017 |
| Personal engagement Interactive engagement | *Individual engagement* is actually individual participation activities (eg. Recommendation, continuous usage). In addition, *interactive engagement* mainly includes socialized community participation, such as problem-solving, content sharing, and discussion. | Fang et al., 2017 |
| Psychological engagement | In essence, *psychological engagement* involves the concepts of participation and flow. But there are some differences between them. The so-called flow refers to a high degree of concentration in the process of users' activities" (Mahnke et al. 2015). *Psychological engagement* is similar to "flow", which mainly means that individuals will fully invest in relevant activities, but it is different from heart flow. In general, *flow* is a very advanced experience. In contrast, psychological participation has higher persistence and stability (Hallberg & Schaufeli, 2006). If we need to enter the flow experience, we need to have the following aspects, including rapid feedback, clarity of purpose, and a full balance between challenges and skills (Buchanan & | Buchanan & Csikszentmihalyi, 1991; Cuny et al., 2015; Hallberg & Schaufeli, 2006; Mahnke et al., 2015 |

| | Csikszentmihalyi, 1991). People have deeply analyzed flow from different angles and levels (Cuny et al., 2015). *Psychological engagement* is actually a state in which individuals do not need to think too much about perceptual control. | |
|---|---|---|
| Adaptation | It mainly refers to the efforts that users must make in behavior and cognition in order to better deal with some major events. | Beaudry & Pinsonneault, 2005 |
| Involvement | It refers to the perceptual relevance of people to a specific object due to certain interests, values or needs. | Zaichkowsky, 1985 |
| | In fact, involvement belongs to a typical motivation construct. It has a certain dependence on individual needs and values. | Zaichkowsky, 1986 |
| | The so-called user *involvement* mainly refers to people's psychological identification with specific objects because they have certain interests and needs. | Schaufeli et al., 2002; Zaichkowsky, 1994 |

Based on the literature reviewed, this study uses the following definitions of adoption and engagement (shown in Annex B, Figure 2.1). Conceptually, engagement and adoption are different, engagement will not appear until adoption (namely first-time use).

(1) *Adoption* is defined as the initial use, including three actions of downloading the app, installing the app, and using the app. "Use" may be one or more times. Acceptance has the same definition as adoption.

(2) *Engagement* is defined as the continuance usage and involvement after the initial use, including two actions to interact with the app and to use the app. "Use" and "Interact" are continuously.

## 2.2  Mobile phone app

### 2.2.1  Adoption review

In the traditional concept, intelligent devices refer to those portable devices with mobile communication capability and a specific operating system. In addition, mobile apps refer to software programs that can be applied to smart devices. In recent years, due to the increasing use of mobile applications, people have gradually paid attention to the adoption of mobile platforms. Some achievements have been made in these researches, mainly discussing mobile advertising services (Martí Parreño et al., 2013), mobile technology commerce (Liang et al., 2007), and mobile banking services (Ha et al., 2012). It is found that mobile services are mainly realized by using various mobile applications. In order to obtain the required mobile services, users need to use the corresponding mobile apps (K. Peng et al., 2014).

The technology acceptance theory (TAM) is actually the corresponding adaptation of the

theory of reasoned action (TRA) in the information system (IS). TAM posits that personal intention to use the system will be affected by perceived ease of use and perceived usefulness. The related in-depth discussion is gradually carried out, and some phased research results have been achieved. Research in this field has gradually become a hot issue.

For TAM, the user's attitude towards a system will greatly affect whether the user will use it. It is found that users' use attitude is directly related to perceived ease of use and perceived usefulness. In addition, there is a certain causal relationship between the two (Davis, 1985). The related research usually explores the TAM model. Some researchers further combine TAM with relevant factors and then carry out in-depth discussion. H. C. Yang (2015) mainly integrate TAM into the use and satisfaction theory, comprehensively analyze the basic attitudes of young consumer groups in the process of using mobile apps, and study the key influencing factors. They find that consumers' attitudes are affected by factors such as ease of use, usefulness, and perceived enjoyment. On this basis, these researchers analyze the key influencing factors in the process of users using applications. They organize respondents to analyze and judge various mobile function lists and then discuss the basic value of mobile applications. The results show that these values mainly include five basic types. Some foreign researchers (Bellman et al., 2011) comprehensively analyze the impact of application use on consumers' purchase intention. They point out that when consumers use apps, they will have a stronger interest in choosing certain brands. In addition, C. K. Kim et al. (2013) also analyze the impact of consumers' dependence on applications on some brand support attitudes and then analyze the mechanism. They find that brand attachment, determined by self-connection and social-connection with mobile apps, positively impacted brand supportive behaviors. K. Peng et al. (2014) mainly discuss the issues of brand identification and brand attachment. They point out that for brand applications, users' consumption value plays a key role.

R. P. Wang (2014) investigates the adoption intention of travel-related apps. In this study, the perceived characteristics of the software quality model and technology acceptance model are mainly considered. On this basis, the analysis model is gradually constructed.

R.Y. Chen (2016) constructs a research model of mobile e-commerce app usage intention. His model draws the following conclusions: (a) The user experience and online trust of mobile e-commerce app are significantly and positively correlated with the Using intention. (b) Cognitive experience, emotional experience, ability dimension trust, and security dimension trust of mobile e-commerce apps significantly and positively predict consumers' willingness to use mobile e-commerce apps. (c) Ability dimension trust and security dimension trust partially mediate the relationship between affective experience and intention to use. (d)

Ability dimension trust partially mediates the relationship between cognitive experience and usage intention.

Based on the UTAUT (unified theory of acceptance and use of technology), G. Q. Zheng (2014) proposes the model of UTAUT-App by adding perceived value as a mediating variable. The measured variables of G. Q. Zheng's model include five perceived variables (ease of use, pleasure, price, risk, and usefulness) and a social influence variable. Through empirical research, he finds that among all measured variables, the hypothesis that only perceived risk negatively affects perceived value is not valid.

According to the technology acceptance theory, Z. M. Li (2018) analyzes the influence of personal relationship on consumers' download intention from three dimensions: emotion, human favor and face. His research suggests the following findings: (a) Emotion and face have a positive effect on behavioral willingness. (b) Three perceived variables (ease of use, usefulness, and risk ) mediate personal relationships and behavioral willingness. (c) There is no correlation between affection and dependent behavioral willingness.

Based on the technology acceptance model, D. H. Li and Zhang (2015) build an influencing factor model of tourism app download and use behavior. Their model suggests the following: (a) Perceived usefulness and experienced ease of use in the cognitive dimension of tourists have a significant impact on the behavioral dimension, and experienced ease of use significantly affects experienced usefulness. (b) The dimension of external variables indirectly affects the dimension of behavior by influencing the cognitive dimension, among which, the impact on experienced ease of use is the greatest. (c) The intensity of risk perceived by tourists in the cognitive dimension does not have a negative impact on their attitude and behavior.

Based on the perceptual desire theory, J. Wang (2015) explores the motivation and demand of SFVs audiences and investigates the willingness of SFVs app users to download. His study sorts out the relevant factors affecting the willingness of SFVs app users to download. The factors include cognitive factors, emotional (experiential) factors, attitudinal factors, personality factors, social factors, and technical factors. Among them, cognitive factors include perceived usefulness, perceived ease of use, perceived security, and perceived convenience, while emotional (experience) factors include perceived pleasure (number of advertisements), perceived entertainment, and perceived fun (S. T. Cai, 2019).

Starting from the UTAUT2 and combining the characteristics of tourism and trust attributes, Y. Chen (2017) constructs the initial trust model of booking tourism app users by adding three factors: perceived risk, trust tendency and business reputation. His results

suggest the following: (a) Utility expectation, social influence, low price trade-off and merchant reputation variables have positive effects on initial trust of booking travel app users. (b) Effort expectation and experienced risk variables have a negative impact on the initial trust of app users in booking travel, while the significance of trust tendency and habit variables does not meet the standard. (c) Utility expectation, effort expectation and social influence have no significant effect on the intention to use reservation travel app, which is completely mediated by initial trust, indicating that initial trust plays a very important role in the adoption to use reservation travel app.

Based on the TAM model and combining the characteristics of mobile applications and behaviorally targeted advertising, Y. Zheng (2019) makes appropriate adjustments and extensions to the traditional TAM and constructs a new ETAM to study the factors facilitating mobile app users' intention to accept behavioral targeted ads. His findings are as follows: (a) Users' subjective norms have positive effects on experienced usefulness and experienced accuracy, and indirectly affect acceptance intention through perceived usefulness. (b) Users' willingness to accept behaviorally targeted ads is directly affected by experienced usefulness, while experienced ease of use has no significant effect on willingness to accept them. (c) Perceived accuracy will positively affect perceived risk and the usefulness, while experienced risk will negatively affect the usefulness of advertising. (d) Advertising response time has a positive impact on experienced risk and experienced precision, and its effect on perceived precision is greater than that on perceived risk.

On the basis of the UTAUT model, S. Y. Zhong (2017) empirically analyzes the factors facilitating users' acceptance and adoption of mobile medical apps. His findings are as follows: (a) Contributory factors, individual innovation, effort expectation, and performance expectation have a positive impact on mobile medical app users' adoption. (b) Enabling factors, individual innovation, effort expectation, performance expectation, and use intention positively affect mobile medical app users' use behavior.

Based on the technology acceptance model, innovation diffusion model, and software quality model, Z. R. Zhao (2017) establishes a tourism app user intention model. The model includes the characteristics of the app, the process of user cognition and perception, and the user's willingness to use the new technology. He has the following findings: (a) Relative advantage positively affects involvement degree, compatibility positively affects involvement degree and attitude, complexity negatively affects involvement degree and attitude, social interaction positively affects involvement degree and attitude, and UI aesthetics positively affects involvement degree and attitude. (b) Involvement positively affects attitude and user

intention, and attitude positively affects user intention.

Based on the UTAUT model, and adding two factors of mobility and use context, S. F. Zhang (2017) constructs a user acceptance behavior model of mobile travel apps. His findings are as follows: (a) Performance expectation, social influence, hedonic motivation and use situation significantly affect tourists' behavioral willingness to accept travel-related apps and their usage behavior. (b) Mobility has a significant impact on the use context and a significant impact on the behavioral intention and use behavior of tourists to accept mobile tourism app through the use context. (c) The effect of effort expectation, facilitators and low price trade-off on behavioral intention is not statistically significant.

Based on the TAM model and the characteristics of mobile SFVs app, Fu (2017) introduces the innovation diffusion theory (IDT, individual innovation) and the social capital theory to construct the influencing factor model of user acceptance behavior of mobile SFVs app. Fu's model has the following findings: (a) Individual innovativeness significantly affects users' experienced usefulness and experienced ease of use of mobile SFVs app; (b) Structural social capital has a significant impact on the engagement in mobile SFVs app; (c) Cognitive social capital significantly facilitates users' adoption in SFVs app, and cognitive social capital has a significant impact on users' perceived usefulness; (d) Mobile users' experienced usefulness of SFVs app significantly affects users' engagement in mobile SFVs app, mobile users' experienced ease of use of SFVs app significantly affect users' intention to use, which confirms the positive effect of perceived ease of use on perceived usefulness. (e) The willingness to use mobile SFVs app has a significant positive impact on the acceptance behavior of mobile SFVs app users.

On the basis of the UTAUT model, Y. Zhang (2018) adds three core variables: entertainment expectation, risk perception, and individual innovation. Education level is used as a control variable to construct the acceptance behavior model suitable for video app users. His work shows that effort expectation, facilitators and individual innovativeness significantly affect the usage willingness, and that the control variables (gender and education level) are significantly different.

Based on the decomposed of the TPB theory, X. J. Zhong (2017) builds a user acceptance behavior model of travel apps. Through empirical research, he finds the following conclusions: (a) Perceived pleasure has a positive effect on attitude, which proves that tourists have both utility needs and pleasure needs for tourism app. (b) External influence also has a positive effect on subjective norms, and its influence on the subjective norms of tourists' use behavior is greater than that of peer influence. (c) The negative effect of perceived risk variables on

attitudes is not supported by data, indicating that tourists' risk perception of tourism app use behavior does not directly affect their attitudes.

Taking the TAM model as starting point, Wang (2015) combines the characteristics of mobile payment services and integrates the TPB theory, the TRA theory, and the IDT theory. He proposes a model of mobile social users' app acceptance behavior by adding variables such as perceived risk, perceived entertainment, social influence and consumer innovation, and proposes hypotheses affecting mobile social users' app acceptance behavior from different dimensions. His model suggests the following findings: (a) Behavioral intention has a significant impact on usage behavior. (b) Consumer innovativeness has significant influence on experienced usefulness and behavioral intention. (c) Experienced usefulness has a significant influence on behavioral intention and usage behavior. (d) Experienced ease of use has significant influence on perceived usefulness and perceived entertainment. (e) Perceived entertainment has a significant impact on behavioral intention; (f) Experienced risk has no significant effect on behavioral intention (g) Mass influence has a significant influence on experienced usefulness and behavioral intention.

Bian (2017) extends the UTAUT model and constructs a user acceptance behavior model of shared tourism app by adding three factors: individual innovation, perceived trust and perceived security. His results suggest the following: (a) Performance expectation, effort expectation, social influence, experienced security and experienced trust have significant effects on users' willingness to use shared travel apps. (b) Facilitators influence not only user behavior but also user effort expectations to use the shared travel app. (c) Individual innovation positively affects effort expectation and perceived trust, but has no significant effect on performance expectation. (d) The effect of effort expectation on performance expectation is not significant. (e) Perceived security positively affects perceived trust, and intention to use has a significant impact on usage behavior.

Based on the TAM model, J. Chen (2017) constructs a theoretical model of college students' information acceptance behavior based on WeChat. His results are as follows: (a) Experienced entertainment, experienced ease of use, and experienced usefulness positively affect information reception behavior of college students. (b) Perceived risk negatively affects information acceptance behavior of college students.

According to TAM model and uses and gratifications theory (UGT), Qiao (2016) investigates the user acceptance behavior of we-media of colleges and universities. He points out that user acceptance behaviors include the following areas: (a) User subscription and unfollowing behaviors. (b) Users' reading, forwarding and sharing behaviors. (c) Use behavior

of platform related functions. (d) Participation in online and offline activities. (e) Interaction with WeChat we-media. (f) Acceptance behavior of college WeChat we-media users toward advertisements.

Based on the UTAUT2 model and adding two factors of mobility and usage situation, T. Y. Sun (2015) constructs a user acceptance behavior model of mobile travel booking. He has the following findings: (a) The variables in the model have direct or indirect effects on the use intention and behavior of mobile travel booking. The influence degree from large to small is as follows: ease-of-use expectation, mobility, hedonic motivation, social influence, low price trade-off and performance expectation. (b) Hedonic motivation, social influence and performance expectation significantly and positively affect behavioral willingness of mobile travel booking. (c) Low price trade-off and ease of use expectation do not significantly affect behavioral willingness. (d) Mobility influences behavioral intentions through its influence on the context of use.

On the basis of the theory of perceived value, Y. N. Sun (2021) constructs a theoretical model of membership purchase intention of sports and fitness app users. Y. N. Sun proposes that the factors affecting the membership purchase intention of sports and fitness app users should include perceived value, experienced usefulness, experienced ease of use, experienced cost, health awareness, subjective norms, and personal payment awareness. He also introduces consumption experience as a moderating variable. His model offers the following conclusions: (a) perceived value and personal payment consciousness have significant positive effects on purchase willingness. (b) Experienced usefulness, health awareness and subjective norm have significant positive effects on experienced value. (c) Experienced cost has a significant negative impact on perceived value. (d) Experienced value plays a significant mediating role in the relationship between experienced usefulness, health awareness, subjective norms, perceived cost and purchase intention. (e) For groups with consumption experience, experienced value has a greater impact on the purchase intention of members of sports and fitness apps.

## 2.2.2 Engagement review

At present, the concept of participation has received significant attention. The related research has been carried out gradually, and some results have been achieved. Some researchers have analyzed the role and mechanism of engagement in exploring employees' work experience (Maslach et al., 2001; Schaufeli & Bakker, 2004). Some people mainly discuss the academic issues related to information systems (IS) (Jacques et al., 1995). Some studies have pointed

out that participation is actually a very pleasant experience (Jacques et al., 1995; Webster & Ahuja, 2006; Webster & Ho, 1997). Other research results show that its basic characteristics mainly include interest, attention, and curiosity (Jacques et al., 1995; Webster & Ahuja, 2006; Webster & Ho, 1997). Later, some studies find that these features also include novelty, feedback, and control (Jacques et al., 1995; Webster & Ahuja, 2006; Webster & Ho, 1997). If consumers can actively participate in the process when using the product, they will get a better experience than expected (Chou & Conley, 2009). A study shows that if users actively interact with smartphones in-depth, they will be able to feel the powerful functions and beauty of the product better (Chou & Conley, 2009). On this basis, consumers will be able to interact actively with those applications smoothly, and then fully understand the external environmental conditions (O'Brien & Toms, 2008).

Some researchers compare it with the flow experience (Csikszentmihalyi, 1990), and find that there is a strong correlation between participation and perceptual characteristics. On this basis, users will form a positive attitude and obtain good results (Webster et al., 1993). Some studies have pointed out that technical functions help to improve the participation experience. The former is considered to be a very key motivation (Y. H. Kim et al., 2013). In fact, if a system has a good user interface, ease of use, and flexibility, it will help to improve the user experience in the interaction process and finally bring better use results (Peters et al., 2016).

Previously, Ipsos and Google (2015) have launched a special investigation and research work. The results show that nearly 40% of users are likely to give up using the application after downloading and purchasing it. In other words, we need to explore the characteristics of users' adoption behavior of applications, and on this basis, we should also analyze their participation behavior (Fang et al., 2017). Only in this way can we have a more comprehensive understanding of this issue.

Some researchers mainly discuss the internal relationship between consumer participation and sales growth, word-of-mouth, and loyalty (Cheung et al., 2015; Oh et al., 2017; Ray et al., 2014; Y. H. Kim et al., 2013). It is found that user participation is a very important condition for the success of the system (Cheung et al., 2015; Oh et al., 2017; Ray et al., 2014; Y. H. Kim et al., 2013).

Bhattacherjee and Lin (2014) put forward some academic viewpoints in a comprehensive study and constructed an analytical model based on factors such as habitual response, empirical response, and rational action.

Peters et al. (2016) show that if users have higher participation due to some external

factors, it will help further improve the utilization rate. In addition, they analyze the important role of engagement in this process.

Fang et al. (2017) develop a new research framework based on the stimulus-organism-response (S-O-R) model. The main purpose is to analyze the impact of different application attributes on the participation of tourism applications. On this basis, they also analyze the mechanism. These researchers point out that the performance attributes and design of applications will have their effectiveness. User behavior participation will be significantly affected by the performance attributes and design characteristics of the app. These two factors play a certain driving role.

To investigate mobile health app users' continued subscription intention, Ying and Li (2017) look at the information system and behavior of health app users by constructing an integrated model based on IS success theory and expectation confirmation theory. They find satisfaction and perceived usefulness are the main factors contributing to users' continued subscription intention.

Based on TAM model and the basic characteristics of mobile SFVs platform, H. C. Qiu and Chen (2020) replace usefulness with perceived entertainment and social value, and increase perceived risk to build a research model. Using the Tiktok app as their research object, they have the following findings: (a) Perceived entertainment and social value significantly and positively affect continuous engage purpose. (b) Experienced ease of use is positively, but not significantly, associated with continued use willingness. (c) Perceived risk has little effect on goals to continue engage.

Based on the UGT theory, Tao and Zhu (2020) take user motivation, use behavior and satisfaction as the pre-factors of users' continuous use intention to conduct empirical research. Their main research findings are as follows: (a) Users' social needs, cognitive needs and self-presentation all positively affect users' use behavior. (b) Users' usage behavior significantly affects users' satisfaction, which in turn significantly affects the intention to continue using. (c) However, entertainment demand only significantly affects content consumption behavior, but not content production behavior.

Based on D&M model (D&M IS success model and updated D&M IS success model) and valence framework theory, Cui (2019) develops a research model on cross-border e-commerce mobile buyers. His study finds that the perceived distance, social distance, communication quality, speculative behavior, satisfaction, amount of investment and relationship benefits of mobile e-commerce affect the continuous use intention of cross-border e-commerce through individual buyer trust and buyer belonging.

Based on the expectation confirmation theory (ECT), TAM and the expectation-confirmation model of IS continuance (ECM-ISC), S. Yang (2020) selects five perceived variables (ease of use, entertainment, interactivity, similarity, and usefulness), expected confirmation, and satisfaction. S. Yang constructs a research model affecting the willingness of post-90s mobile SFVs app users to continue using and makes hypotheses. His study obtains the following conclusions: (a) Gender and occupational characteristics have no significant difference in the continuous use purpose of mobile SFVs app users born in the 1990s, while education level has significant difference in their continuous use intention. (b) Experienced usefulness, experienced ease of use, expected confirmation, experienced entertainment, experienced interactivity, and satisfaction all have positive effects on users' continuous use intention. Among them, experienced ease of use and expected confirmation have significant positive effects on users' experienced usefulness when using mobile SFVs platform. However, the perceived similarity has no significant effect on the continuous use intention of the post-90s mobile SFVs app users. (c) The perceived variables (ease of use, entertainment, interactivity, and usefulness) and expected confirmation all positively affect the satisfaction of mobile SFVs users. Among them, perceived entertainment and perceived interaction significantly directly affect user satisfaction and thus affect the goals of continuous usage.

Based on the ECT theory, value acceptance model and D&M IS success model, J. H. Chang (2021) proposes a research model of users' continuous use purpose of social reading apps. J. H. Chang has the following conclusions: (a) Personalized service, experienced entertainment and experienced usefulness are the three variables that have the greatest impact on continuous use intention. (b) Personalized service, platform resource quality and perceived social interaction are directly and significantly positively correlated with experienced usefulness and experienced ease of use. (c) Experienced social interaction and personalized service significantly and positively affect perceived switching costs. (d) Satisfaction is directly affected by experienced cost, experienced entertainment, experienced usefulness and experienced ease of use. (e) Experienced cost)has a direct negative impact on continuous use goals. (f) Experienced entertainment, experienced switching cost, experienced usefulness and experienced ease of use have direct positive effects on continuous use intention. (g) Privacy security has no significant effect on continuous use meaning. (h) There is a significant positive correlation between satisfaction and continuous use purpose.

By integrating the ECM-ISC model and D&M IS success model, C. Zhang (2020a) explores the factors facilitating users to continue using SFVs app. His empirical research has

the following findings: (a) Information quality, expected confirmation, PE (perceived entertainment), and service quality have significant positive effects on users' experienced usefulness, while system quality has no significant effect. (b) System quality, information quality and service quality have significant positive effects on perceived entertainment, and the order of influence (from most to least significant) is service quality, information quality and system quality. (c) Expectation validation, experienced usefulness and perceived entertainment have significant positive effects on satisfaction. (d) Experienced usefulness, experienced entertainment, satisfaction and social influence have significant positive effects on continuous use willingness.

Based on the stimuli-organism-response (S-O-R) theory, S. Jiang (2021) analyzes the influence mechanism of users' purpose to use third-party mobile payment apps from the perspective of user experience and social influence. His main conclusions are as follows: (a) The functional experience and service experience of third-party mobile payment apps have a positive impact on user satisfaction, while the preferential experience has no significant positive impact on user satisfaction. (b) The functional experience and preferential experience of the third-party mobile payment app have a positive effect on the user's perceived value, while the service experience has no significant positive effect on the user's perceived value. (c) Social influence has a positive impact on the perceived value of third-party mobile payment app users. (d) The perceived value of third-party mobile payment app users will have a positive impact on their satisfaction. (e) There is a positive correlation between the satisfaction of third-party mobile payment app users and their willingness to use it. (f) The experienced value of third-party mobile payment app users has a positive impact on their goals to use it.

Based on the TAM model and self-determination theory (SDT), G. Zheng (2020) proposes the intention model of keeping users to continue using, which includes four influencing factors: external influence, perceived usefulness, experienced ease of use and exercise self-efficacy. His main research findings are as follows: (a) User habits, experienced usefulness and experienced ease of use have direct and significant positive effects on continuous adopt purpose. (b) Professional trust has significant positive effects on experienced usefulness and experienced ease of use. (c) app quality has significant positive effects on experienced usefulness and experienced ease of use. (d) Social contact significantly negatively affects user perception. (e) Experienced usefulness and experienced ease of use play a mediating role in users' continuous engagement. (f) Exercise self-efficacy moderates the relationship between experienced usefulness and sustained adoption.

Based on the TAM model, W. R. Gao (2021) identifies the influencing factors that affect users' perceived risks and satisfaction with app advertisements, and develops a user acceptance willingness model for mobile app advertisements. He has the following findings: (a) Users' perceived risk of app download advertising has a negative impact on app use purpose. (b) Users' satisfaction with app download advertisements has a positive impact on app use intention. (c) High clarity of app download advertisements will reduce users' perceived risks and increase users' willingness to use. (d) High clarity of app download advertisements will increase users' satisfaction and increase users' willingness to use.

By refining six variables (experienced usefulness, experienced ease of use, corporate reputation, social influence, perceived risk, and trust), C. Gong (2020) proposes a research model of the factors facilitating mobile tourism app users' intention to adopt. His study suggests the following findings: (a) Social influence, corporate reputation, experienced risk, experienced usefulness and experienced ease of use all influence users' purpose to use mobile travel apps through influencing trust. (b) Social influence and trust positively influence intention to use.

Using the TikTok app and Kwai app as research objects, J. H. Qiu (2020) develops a theoretical model of mobile SFVs app users' continuous use behavior. His model is mainly based on EECM-ISC model and affective theory, adding variable medium attachment and including cognitive and affective paths. His empirical research offers the following findins: (a) Cognitive path and emotional path positively affect users' continuous use purpose. (b) Experienced usefulness, media attachment and satisfaction directly affect users' continuous use goals, while expectation confirmation indirectly affects users' continuous use behavior, among which satisfaction has the greatest impact. (c) Continuous use behavior is influenced by the convenient conditions.

J. P. Wei (2020) studies the case of personalized service of Ctrip app. J. P. Wei's model is based on the TAM model and includes use attitude, continuous use intention, continuous use behavior, experienced usefulness, experienced ease of use, as well as personalized service. He has the following findings: (a) Personalized service can significantly affect users' app continuous use behavior. (b) The impact of personalized service on users' continuous use behavior is smaller than that of experienced usefulness and experienced ease of use. (c) Users' evaluation of Ctrip app's personalized service is positive.

Different from other scholars who have studied the method of building the behavior of continuous use of apps, Su (2020) studies the related comments of mobile fitness apps through text mining technology from an external perspective. Through cluster analysis of

feature words, Su proposes that seven factors, that is, experienced usefulness, experienced ease of use, experienced sociability, service quality, system quality, information quality, and satisfaction, would play a role in users' continuous use purpose. 7 factors developed by Su based on the ECM model, D&M IS success model, and TAM model.

Y. H. Huang (2019) proposes to take information system quality as a second-order construct while information quality, system quality, and service quality as first-order constructs. His study focuses on the continuous use behavior of users (taking booking travel apps as an example). Y. H. Huang has the following findings: (a) Information, system and service quality constitute second-order information system quality in the process of user use. (b) Information system quality has a positive impact on user satisfaction, and also has a positive impact on users' intention to continue using. (c) Expectation confirmation has a positive impact on continuous use purpose through satisfaction and perceived usefulness. (d) Continuous use intention and contributing factors jointly and positively influence the continuous use behavior. (e) Self-efficacy has no effect on continuous use intention.

Y. X. Liu (2019) studies mobile learning apps and analyzes in detail the correlation between the following sets of variables in this research model: (a) New media characteristics and confirmation. (b) Confirmation and experienced usefulness and satisfaction. (c) Experienced usefulness, experienced ease of use and satisfaction, attitude. (d) Satisfaction, attitude and intention of continuous use. (e) Mass influence, self-efficacy and continuous use intention. (f) Perceived risk, perceived cost, and intention to continue use.

C. X. Yang (2018) develops a research model from ECM Model, Customer Satisfaction Index Model (ACSI), and EECM model. His study focuses on travel booking apps and includes the following variables: perceived quality, perceived trust, switching cost, and user habits. He also selects perceived usefulness, confirmation degree, satisfaction, continuous use purpose, and continuous use behavior. C. X. Yang's main findings are as follows: (a) Perceived usefulness is positively and significantly affected by the degree of confirmation. (b) Satisfaction is positively and significantly influenced by recognition degree, perceived quality and switching cost. (c) Continuous use intention is positively and significantly affected by perceived usefulness, satisfaction and perceived trust. (d) Continuous use behavior is positively and significantly influenced by continuous use intention and user habits. (e) Satisfaction and intention of continuous use are the potential variables with full mediating effect.

One topic that needs our attention is that the factors related to the participation and adoption of mobile applications have not been fully explored and discussed in depth. The

increasing use of mobile applications has further promoted the research, development, and popularization of mcs-Apps.

## 2.3 Mobile campus service app

### 2.3.1 Top 10 universities in China

Quacquarelli Symonds (QS, 2020) has recognized the top 10 universities from "QS UNIVERSITY RANKINGS 2020" in China. They include Tsinghua University (THU), Peking University (PKU), Fudan University (FDU), University of Science and Technology of China (USTC), Zhejiang University (ZJU), Shanghai Jiao Tong University (SJTU), Nanjing University (NJU), Sun Yat-sen University (SYSU), Wuhan University (WHU), and Harbin Institute of Technology (HIT). This thesis has searched the apps from App stores (e.g., iOS, Google Play, domestic third-party Android market; as of March 2020), then installed, followed, and analyzed the apps of the top 10 universities in China. The result is shown in Annex A, Table 2.3.

According to the statistical results in Table 2-3, the following findings are found after analysis.

(1) Among the top 10 universities in China, THU has the largest number of apps (13 in total), with 2 of its their own apps, 10 WeChat subscription accounts and 1 WeChat mini program. In contrast, the USTC has the least number of apps (5), including 1 WeChat service account and 4 WeChat subscription accounts. In addition, the USTC is the only university in the top 10 that does not have its official app.

(2) Among China's top 10 universities, all provide WeChat subscription accounts. In particular, THU provides the most (10) WeChat subscription accounts, while USTC, SJTU, and HIT each have provide 4 WeChat subscription accounts.

(3) Among the top 10 universities in China, all universities but USTC offer WeChat mini programs. USTC, SJTU, NJU, and SYU provide WeChat service accounts, of which SJTU provides 2 WeChat service accounts of its own.

(4) From the official websites of China's top 10 universities, we analyze the social media apps provided by these universities (as of July 2022). The apps include Kwai, TikTok, Weibo, WeChat subscription account, WeChat mini program, and WeChat channel provide services for teachers and students in China (see Table 2.4 in Appendix A). The top10 universities in China use Facebook, Instagram, Twitter, YouTube and LinkedIn, Bilibili, Weibo, TikTok and

WeChat Service Account provide services for foreign teachers and students. Among them, USTC does not rely on any social media, HIT only provides a WeChat subscription account and WHU does not provide any social media in English version. These universities mainly rely on Weibo and WeChat subscription accounts as the Chinese version of social media, while they utilize Facebook, Instagram, and WeChat Service accounts as the English version of social media. (See Table 2.4 and Table 2.5 in Annex A).

It can be seen that the social media app has become a popular new medium for university propaganda, management, teaching, and daily services. At the same time, however, too many available apps will cause a certain degree of confusion for individual students. For example, Tsinghua University has 13 applications (as shown in Figure 2.2 in Annex B).

Taking Tsinghua University as typical example, we discuss the characteristics of all apps offered by the university in detail.

Tsinghua University has 13 apps, including 2 apps (in Tsinghua and Employment), 1 WeChat mini program (Tsinghua University), 10 WeChat subscription accounts (i.e., Tsinghua University Law School, Tsinghua University Institute of National Conditions, Tsinghua University School of Economics and Management, Tsinghua University Library, Tsinghua University Student Union, Tsinghua University Academy of Fine Arts, Tsinghua University Graduate Education and Tsinghua University Admissions Office).

The Tsinghua app include the following functions: (a) Classroom recommendation; (b) Wifi login; (c) Network school; (d) The library; (e) Station visit; (f) My class schedule; (g) Tsinghua mailbox; (h) Mobile info; (i) Tsinghua performance; (j) My position; (k) Tsinghua news; (l) Home website; (m) Tsinghua university calendar; (n) Campus buses; (o) My push; (p) EasyIPv6; (q) Off-campus visits; (r) Off-line maps; (s) Wireless meteorology; (t) Air quality; (u) Time capsule (see Figure 2.3 in Annex B).

### 2.3.2 Functions of mcs-App in China

According to the analysis of the top 10 universities in China, the functions of the mcs-App can be summarized as identification, information acquisition, resource acquisition, learning assistance, and mobile payment.

*Identity authentication* - Wi-Fi access authentication, one-stop access to campus sites.

*Access to information* - campus news, announcements, help/user guides.

*Resource acquisition* - library appointments, self-study room appointment application services.

*Study assistance* - schedules checking, credits checking, exam results checking, online

registration.

*Mobile payment* - online payment, scan code payment (Quick Pay and QR Code Payment).

### 2.3.3 Business model of mcs-App in China

MOE (Tencent, 2020) summarized the business model of campus apps into three categories: (1) market competition to provide, independently chosen by teachers and students; (2) school-enterprise cooperation to develop, school organization to apply; and (3) independently developed by the school and deployed for teachers and students in the school.

This classification links the operation mode with the promotion mode for campus apps together. Most Chinese campus apps cooperate with a third party to utilize its platform for operation and management. Chinese colleges have not paid enough attention to the independent research and development of apps suitable for college teaching, learning, and campus life (M. K. Wei & Li, 2019).

### 2.3.4 Prominent apps in China

At present, there are well-known, national-level apps in China, such as WeChat and Alipay. There are also apps with a high market share in colleges and universities, such as Campushoy, Wanxiao, and eCampus.

### 2.3.4.1 WeChat

Tencent provides the Weixin Official Accounts Platform (i.e., Service account, Subscription account, Mini program, and WeChat work) and WeChat Pay (WeChat pay open platform).

*Service account application* is defined as *"When enterprises use the WeChat service account, they will further enhance their user management and business service capabilities. In addition, they can also improve the quality and efficiency of services". Subscription account application* is defined as *"When individuals and media use it, they can effectively publish their own information and innovate new content as needed". Mini program* is defined as *"Its main feature is that it can use very convenient development and has a good user experience. On this basis, enterprises and developers can use WeChat to further improve services and products". Work application* origianlly named "Enterprise Account application". It is conducive to better management and operation of enterprises so that users can get a good communication experience and perfect office functions.

In addition, it also provides good interoperability related to WeChat Pay and Mini

Programs.

At present, WeChat Pay has reached about 800 million active users worldwide including 49 countries and regions. It supports a total of 16 currencies, including the Hong Kong dollar, US dollar, British pound, Japanese yen, Canadian dollar, Australian dollar, Euro, New Zealand dollar, Korean won, Thai baht, Singapore dollar, Ruble, Danish krona, Swedish krona, Swiss franc, Norwegian krona (Tencent & Tenpay, 2020; shown in Annex B, Figure 2.4). *WeChat Pay* includes Quick Pay, QR Code Payment, Mini Program Payment, Official Account Payment, in-App Payment, Web Payment. *Quick Pay* is defined as "The user shows his/her own payment code, and then the merchant completes the code scanning payment". *QR Code Payment* is defined as "The payer turns on the WeChat code scanning function and then confirms the amount. When the user passes the security check, he/she can pay". *Mini Program Payment* is defined as "Users can use it to pay for services and goods". *Official Account Payment* is defined as "Users can use it to buy the services or goods they need". *In-App Payment* is defined as "Users can use it to purchase required products or services through merchant apps". *Web Payment* is defined as "Users can use the 'Scan' function to complete the payment".

According to China Academy of Information and Communications Technology (CAICT, 2020), as of the first quarter of 2020, WeChat has built a stunning 1,202.5 billion WeChat users base as a typical digital economy product. It has covered more than 800 million monthly active WeChat pay users, more than 1 million mini programs, 20 million public accounts, and more than 400 million daily active users of WeChat mini program. WeChat has become the largest industrial application of mobile Internet, covering 68.04% of mobile intelligent terminals. The proportion of active users and monthly opening time rank the top among all mobile applications (Iimedia, 2020). The Weixin official account platform is widely used in Chinese colleges and universities. Many universities focus on the communication function of Weixin official account platform to improve its impact on the study and life of teachers and students. There are also many universities using Weixin official account platform for department-level information release, and publicity, as well as to carry out simple functions.

H. Liu and Zheng et al. (2017) take the East China Normal University as an example, which uses WeChat to build a university mobile information platform. From the perspective of the basic framework of university mobile information, they analyze the target objects and functional positioning of typical social media platforms and products, such as WeChat and its related subscription account, service account, WeChat work, WeChat card packages, and mini programs. They also design a mobile information framework to provide information services

for different user groups. B. Liu and Sun (2017) take the Changchun Normal University as an example, which uses the Weixin official account platform to build the university information service system. This strategy indicates how colleges and universities can broaden their ways to publicize school information and promote the information exchange among different colleges and universities. Using Peking University as an example, Long et al. (2017) develop a campus mobile information service construction scheme based on Weixin official account platform, which solves the technical difficulties such as user binding, web page authorization, notification push, and WeChat payment through the advanced service interface of Weixin official account platform. J. Jiang et al. (2018) conduct a statistical study on the construction of Weixin official account platforms of financial departments from 76 Chinese universities directly under the Ministry of Education. They suggest that financial departments of universities should focus on the following three aspects: fully understanding the importance of WeChat public platforms, strengthening early planning, and maintenance. M. G. Cai and Li (2020) propose a solution to construct a multi-entry mobile application platform relying on WeChat work, WeChat service account, WeChat mini program and WeChat campus card based on the practice of a university using various WeChat products to build a mobile application platform. Pei (2021) points out that universities can establish their own WeChat service account platform to solve the problem of poor communication in the process of charging fees. Students and parents can pay attention to the school's WeChat service account. They can consult and leave messages via the WeChat service account. Universities can designate special management personnel to answer questions, and students and parents can be informed via their service accounts by the school finance department manager about fees, arrears, refunds, and other information.

At present, WeChat Work (formerly "Enterprise Account") has become a separate app. The application research content of WeChat Work in universities is relatively rich. Using Tianjin University of Science and Technology as an example, R. R. Xue and Yan (2021) rely on the functions and characteristics of WeChat Work and investigate the basic functions and advantages of the mobile service platform in colleges and universities. They also introduce the app's specific functions and roles in colleges and universities through an application example. Similarly, Song et al. (2016) take South China University of Technology as an example and implement the shared management platform of university instruments by using WeChat Work. The shared management platform includes the query of shared instrument, the query of instrument reservation, the query of instrument reservation status, the query of instrument usage status and the remote control of instrument. Using the functional

characteristics of WeChat Work, L. Yang and Zhang (2018) adopt HTML5 technology to develop the mobile college service platform from the aspects of overall architecture and functional architecture. They combine the overall planning of college informatization, gradually realized the servitization, openness, and intelligence, and further promote the construction of smart campus of colleges and universities. S. Q. Li and Ma (2018) design and implement a college mobile office platform using WeChat work in North China University of Technology. The platform includes official documents, announcements, to-do lists, meeting management, and other modules. In addition, by using the callback mode, message response and management interface of WeChat Work, the docking between mobile office platform and WeChat Work is completed, and the main functional modules of collaborative office system are displayed in WeChat Work.

Tencent company reveals in the "2018GES Future Education Conference", with the advantage of WeChat platform, "Tencent iWeSchool" through the campus service account number and mini program, teaching, research, management and campus life depth integration. "Tencent iWeSchool" is a digital campus service platform based on WeChat ecology, and a digital campus solution with WeChat campus card and Tencent campus code as the core. "Tencent iWeSchool" has connected more than 130,000 university public accounts, covering more than 2,800 universities, and processing user requests up to 400 million times per month (TechWeb, 2018).

The core of the digital campus scheme of Tencent iWeSchool is the WeChat campus card and the WeChat campus code. The WeChat campus card combines with the WeChat service account realizes the unified entrance of various online and offline applications in the university, and the WeChat campus code is the application scenario connecting the offline.

Taking East China Normal University as an example, H. Liu and Liu et al. (2017) introduce the design and development of the WeChat campus card system. It realizes the functions of dining hall consumption, library entry, campus card balance inquiry, campus card recharge, consumption inquiry, library borrowing inquiry, and campus announcement inquiry.

X. J. Wang et al. (2017) take Beijing Normal University as an example to explore and analyze the application of virtual campus card in colleges and universities. They conduct an in-depth analysis on the transaction process, application scenario, relationship with physical card, security and other aspects of WeChat campus card.

Using China University of Petroleum (East China) as an example, L. Y. Xia et al. (2017) design the identity identification scheme of library gate machine by using a WeChat campus card. During the process of implementations, the passage mechanism of the library gate

machine which needs QR code scanning technology and WeChat campus cards is revised and developed twice, so that college students and teachers can pass the library gate scanning the built-in QR code of their WeChat campus cards.

With the increasing enrichment and individuation of users demands for mobile applications, the development of mobile applications in colleges and universities is also diversified among varying portals, such as WeChat, Weibo, campus official app. However, it is difficult to keep consistent pages and functional applications accessed through different portals, which can lead to user confusion. Although the mobile terminal entrance is diversified, the current domestic research on the integration and docking of mobile application platforms is not specific or systematic.

Pei (2021) points out that WeChat and Alipay jointly have a high penetration rate in the population, and that WeChat and Alipay payments are relatively practical ways to collect fees. Colleges and universities can use this method to collect, fees from students, as well as to enable scanning code payment methods when students are with their mobile phones.

S. H. Wen (2021) reports that Hunan University has encouraged freshmen to use WeChat service accounts, WeChat or other online payment since 2019. While the initial use rate was less than 10%, in 2020 students use of such payment jumped to more than 90%. WeChat and other payment platforms have been rapidly popularized, and the payment mode has changed from the passive mode to the active mode.

Ou (2020) points out that WeChat, as a social communication software, has already been an integral part of everyday life. It has a huge user base and powerful functions such as information resource transmission, mini program and service account. The digital campus ecosystem based on WeChat can complete the organic integration of college business and resources through service number, mini program, WeChat pay and other functions and ways, which facilitates the overall planning and unified deployment of campus resources and campus activities, thus providing one-stop services for students. In the process of building a digital campus ecosystem based on WeChat, our work should be guided by the actual needs of campus education to prevent the occurrence of content duplication, division of departments, information islands and other situations. Our work should unify the underlying development interface and model, unify the identity authentication service, operate the wechat service platform well, and build a perfect mobile campus ecological chain.

W. W. Cai (2020) conducts a questionnaire survey among college students from 5 universities located in Fujian Province, China. He finds that the payment methods of college students' consumption include cash, WeChat pay, Alipay, credit card, telecom wing, and

campus card payment. Among these payment methods, Wechat Pay accounts for the highest proportion of 93.58%, followed by Alipay (87.16%), cash payment (27.41%), campus card (5.56%), credit card (3.46%), and wing pay (1.98%). It is apparent that WeChat, Alipay, and other mobile payment have become a common way of payment for college students' daily consumption.

G. Q. Li et al. (2020) study the "campus wallet" of Tongji University in China and reports that the "campus wallet" is connected with three payment channels -- Alipay, WeChat, and China Merchants Bank's "All in One Net". It can support five online payment scenarios -- one-card recharge, dormitory electricity purchase, self-printing of student status certificate fee, teacher apartment rental deposit, and rent payment. The product also has the potential to expand to all (three aforementioned) payment channels and to cover all mobile online payment scenarios, which include one-card recharge, dormitory electricity purchase, self-printing of student status certificate fee, teacher apartment rental deposit, and rent payment.

### 2.3.4.2 AliPay

Ant Group (A Chinese internet financial services company) develops the Alipay app for free download to users. In recent years, AliPay has become a leader and pioneer in the field of payment and lifestyle applications, with 450 million users worldwide. The product highlights of the Alipay app are shown in Annex B, Figure 2.5. The current version of Alipay has ten fearurs, namely Shopping, Mobile Phone Top Up, Pay Utility Bills, Travel, Bill Split, Takeout, Didi Taxi, Red Packet, E-Invoice, and Alipay Love.

Meng (2022) points out that higher education institutions in Jiangsu province can provide a unique interlibrary card mobile service based on WeChat service accounts and Alipay mobile terminals. This service can help improve the user experiences via mobile phones and optimize the management process. The adoption of the brand-new service procedures can further optimize the library entrance and the handling of interlibrary loans,　 expand the user base, respond to the mass reading campaign, improve the service management mechanism, and promote the long-term development of cross regional alliance services.

X. H. Wu et al. (2020) investigate the frequency of contemporary college students using Alipay and WeChat Pay through survey data. According to their survey results, 65.64 percent of college students prefer WeChat when making payments, while only 32.65 percent use Alipay. The reason two-thirds of college students prefer to use WeChat pay is that they often have WeChat as their current mobile phone page and can pay directly with WeChat without

switching pages. In addition, WeChat's page is relatively simple. On the other hand, one third of college students still use Alipay because they are able to withdraw money without handling fees, to transfer money directly to their accounts after confirming the other party's information, where the transfer itself never expires. At the same time, the Ant Forest and preferential red envelopes features also attract the use of Alipay..

K. T. Zhang (2020) argues that the innovation of modern college management fees can change the inconvenient situation of payment in the past and transform the cash era into the digital currency era. Students and parents can make payments through WeChat, Alipay, and other third-party payment platforms, which can greatly improve the convenience of payment.

Han et al. (2020) point out that among many third-party payment platforms such Alipay and WeChat Pay are the most commonly used mobile payment platforms by college students. WeChat Pay and Alipay have become national app mobile payment methods in China, leading the booming development of China's mobile payment industry.

Tuo (2020) finds that the application of WeChat and Alipay in colleges and universities can basically cover almost all campus daily acitivities. Alipay and WeChat can be used for small payments, such as buying meals at canteens, recharging at campus supermarkets and renewing Internet fees. They can also be used for large payments such as tuition fees and on-campus dormitory fees. For the security of large funds, the university has established cooperation agreements with Alipay and WeChat to guarantee the smooth implementation of campus mobile payment at the technical level. This helps prevent fraudulent transfers or online crimes, and enables students to pay for their daily spendings through mobile phones instead of paper money.

Using Alipay as the example, S. Y. Zhu (2019) develops a third-party mobile platform user loyalty model and conducts an empirical analysis. He has the following findings: (1) The core competitiveness of Alipay for "platform relevance", "profitable", and "platform borrowing" can directly affect a third party mobile payment platform. They are the important factors of customer loyalty. (2) "User relevance", "social value", "added value", and other factors can not directly have a great impact on user loyalty, but indirectly affect loyalty by affecting the satisfaction of the platform.

Under the influence of Alipay, Dingtalk app, also under Alibaba Group, became popular with the epidemic. DingTalk is an enterprise version instant messaging mobile application software launched by China Alibaba Group.

Xiong et al. (2022) investigate Dingtalk and point out the following four functions of the app: (a) information release and timely and accurate personal reception. (b) participation

functions in key meetings; (c) resource sharing ; and (d) mail release function. They propose that the corporate directory, office phone, notification message, conference call, video conference, etc. in Dingtalk app can be received by phone or SMS, regardless of whether there is a network or installed Dingtalk, and the information will be accessible. During the pandemic, the app is widely used in online teaching for college students. It is considered relatively stable, and has features of screen, file, and basic information sharing and recording. In both chat and group messages, users can view the status of messages after they are sent, such as read or unread, which facilitates targeted notifications. The use of Dingtalk can improve the efficiency of campus management, make the teaching and student management tasks simpler and more effective, and promote fair educational resources sharing for all colleges and universities.

Using Beihua University as a case study, Y. Wang et al. (2022) investigate the platform of Dingtalk online course, which includes check-in, lecture duration, playback times, practice and answering times, test scores, and interaction frequency in the teaching process. During the mass online teaching process during the 2020 pandemic, Dingtalk topped the list of App store downloads.

Y. X. Liu et al. (2022) study the case of Henan Agricultural University. They discover that teachers can learn about students' pre-class preparation through the results of preview tests and focus on teaching the knowledge points that students do not master well, with the help of Dingtalk online class to conduct live lectures. At the same time, students can interact with the teacher and peers through questions and discussions during the live broadcast to gain a better learning experience. In addition, the teacher can post the knowledge point examination questions in class, including single choice, multiple choice, vote, and other forms of questions, and students are required to complete the answers within a limited time. After class, teachers can post homework assignments, group tasks, theme reports, and chapter tests through the learning platform to further students understanding and improve their interest in learning.

H. C. Gao and Li (2022) investigate the case of Shanxi University of Communication, Shanxi province in using online learning platforms. They find that in the practice of the hybrid teaching mode of "Dingtalk Live + online learning platform", the connected microphone function and screen interaction function of Dingtalk live teaching platform are used. Students can be reminded to pay attention to the lecture, and the online teaching platform can offer all the organizational functions in teaching, such as attendance check, experimental courses, pre-class preview, homework, MOOC videos, mid-term examination, and final examination, thus improving the online learning experience of the students.

He (2021) studies the case of Beijing City University in offering Dingtalk online classes. He finds that based on the interactive real-time performance data, students can interact with peers in real time and discuss various questions raised by others through Dingtalk live broadcast or Dingtalk online conference function. This feature can help solve the problem of poor interactions faced by of other online learning systems on the market. Nailing on small-class, online classes can also be more focused on the class, the blackboard, courseware import and more real-time interactive features, the teacher can in courseware and real-time picture on the blackboard, students and teachers can realize face to face, real-time video interaction, at the same time offering online classroom recording, playback, raise your hand, and incentives such as all kinds of offline required functionality.

Using Zhengzhou Shuqing Medical College as a study case, Y. L. Liu (2020) builds the "Teachers and students back to school system" based on Dingtalk and the university information management system through the same system. The examination and approval form and process are created in Dingtalk, and the daily health information statistics, epidemiological history survey, return plan, and approved return time of returning teachers and students during holidays are automatically pushed. The system and manual review ensure strict entrance to the school, and real-time statistics of personnel and information. During the execution phase, the number of students and teachers returning to school in each batch should return, the actual number of students returning to school, the list of people who do not return to school and the reasons are analyzed.

### 2.3.4.3 Campushoy

The Campushoy app is provided by Wiscom Education Information Technology Co., Ltd. It is a platform with a smartphone app as an important carrier. In addition, its model is a student growth system. Campushoy app effectively aggregates the application of the Internet and "high-quality" content in and out of school and provides high-quality services for college students in all aspects, such as study, life, and employment. (shown in Annex B, Figure 2.6).

M. G. Cai and Li (2020) reports that Yanbian University adopts the unified management mode of the Campushoy app, WeChat Work, WeChat service account, and WeChat campus card in the entrance of mobile terminal.

Y. W. Huang and Ren (2022) study the application of the Campushoy app in Yunnan University of Finance and Economics. They analyze the opportunities and challenges brought by new media in the case of student management and propose a feasible path for university student management to fully utilize the new media in the post-pandemic era.

According to the study by Kaliwal and Feng (2020), Yangming College of Ningbo University has more than 3,000 students from 29 provinces and autonomous regions, including more than 20 students from Hong Kong, Macao and Taiwan, and more than 10 international students. In order to enhance the rapid and accurate screening of student information, the "tutoring cat" in the big data platform "Campushoy" plays a unique role in promoting the overall pandemic prevention and control work.

S. H. Cao (2020) shows that since Yanbian University made great efforts to build the intelligent student-engineering system in 2019, the "tutoring cats" function in the Campushoy app has been gradually integrated to every link and corner of student work. The access rate of students to the Campushoy app reached 90.01 percent, and that of counselors reached 97.9 percent. In 2020, returning students back to school status, new students report and body temperature three times a day, the check-in function has been fully applied. In 2020 alone, the number of check-in tasks at all levels and of all kinds reached 12,446 times, and the cumulative number of check-in people exceeded 910,000.

### 2.3.4.4 Wanmei

The Wanmei app is developed by Newcapec Electronic Co., Ltd. Inspired by the concept of "Internet + education", the Wanmei app relies on the intelligent campus platform and focuses on on-campus services. With college students' quality portrait, the app is capable of providing precision internship, employment, training and growth planning services, campus inclusive financial services, and campus big data services. Wanmei is created with Chinese colleges together to help college students reach an "easy life, happy growth" (shown in Annex B, Figure 2.7).

According F. Wang (2019), Zhejiang SCI-Tech University (with 26,000 enrolled students) uses the Wanmei app, which has solved the problems of payment difficulty, a long time and complex process on campus. For example, students can pay for CET-4 and CET-6 exams and medical insurance through the Wanmei app.

### 2.3.4.5 eCampus

The eCampus app is developed by Zhejiang Zhihui Science&Technology Co., Ltd. eCampus provides college students with campus card online service, campus logistics service, teaching service, and on-campus payment service, making college life easier. At the same time, it provides college students with employment guidance and recommendation, online training and study, overseas study guidance, social practice, and other content and activities to enrich college students' campus life and make campus life more meaningful. (shown in Annex B,

Figure 2.8).

### 2.3.5 Top 10 universities in the world

U.S. News & World Report (2022) has recognized the top 10 global universities from "2022 Best University in the World". They include Harvard University (HU), Massachusetts Institute of Technology (MIT), Stanford University (SU), University of California--Berkeley (UCB), University of Oxford (UOX), Columbia University (CU), University of Washington (UW), University of Cambridge (UC), California Institute of Technology (CIT), and Johns Hopkins University (JHU). By comparing the social media apps provided on the university's official website with the apps of the above universities in Apple AppStore, the application situation of these university's campus apps is summarized as follows (shown Table 2.6 in Annex A).

(1) Among the global top 10 universities, 8 universities are located in the United States, that is, HU, MIT, SU, UCB, CU, UW, CIT and JHU. The other two universities are located in the United Kingdom, namely UOX and UC.

(2) Among the TOP ten universities in the world, seven (HU, MIT, SU, UCB, CU, UW, and JHU.) provide an official app (that is, the app is named after the full or short name of the school, and the provider is the same school). In particular, MIT offers the most campus apps in number (18), while UOX and UC offer the fewest (2 each). The other three universities (UOX, UC, and CIT) do not offer an official school app .

(3) Among the TOP 10 universities in the world, all attach more importance to sports, and some have set up a column of "sports", and some have developed independent sports apps, such as HU (CrimZone) and SU (Stanford Athletics), UCB (California Golden Bears), and CU (Columbia Athletics).

(4) From the perspective of social media exposure, all the ten universities use Facebook, Instagram, Twitter, and YouTube as social media platforms. The universities also use other channels including Apple Podcasts (iTunes U), Medium, LinkedIn, Weibo, Pinterest, TikTok, Coursera, and Edx. Through these apps, users can interact with teachers and students, make campus services closer to user needs, and enrich user experience (see Table 2.7 in Annex A).

(5) Among the world top 10 universities, SU was the first to launch its official app in 2009 (J. F. Zheng et al., 2018).

(6) In terms of app user types, users include students, faculty and staff, alumni, and even visitors.

(7) In terms of app functions, they can be categorized into campus news, shuttle bus, map, calendar (e.g., events, exhibitions, holidays, and academic), library, emergency/safety,

catering/food, and sports.

Using MIT as an example, we hereby explain in detail the characteristics of all apps offered by the university.

We analyze a total of 18 MIT apps from the App Store (as of June 2022, see Tables 2.5 in Annex A). We identify these apps by searching in the store and then download and install each app. The MIT apps are as follows: MIT Forum 219, MIT Orbit, Learner Credential Wallet, MIT App Inventor, MIT Atlas, MIT Coin, MIT Mobile, MIT Tim Tickets, NICS Mobile, Tablet.2008x, MIT Recreation, CPW 2021, HackMIT, MIT CPW 2020, MIT CPW 2022, MIT Ori 2021, Private Kit, and MIT Voice App (see Table 2.8 in Annex A). The official MIT Mobile app (Apple, 2022) brings many essential college services to iOS/Android users: (a) News; (b) Shuttles; (c) Map; (d) Events; (e) People Directory; (f) Libraries; (g) Dining; (h) Building services; (i) QR Reader; (j) Emergency; (k) Tours; (l) Student support; (m) Links; (n) About MIT; (o) Feedback; (p) Messages; (q) Customize my navigation. (see Figure 2.9 in Annex B).

MIT relies on four social media apps: Facebook, Instagram, Twitter and YouTube.

### 2.3.6 Comparison of mcs-App at home and abroad

The comparison between domestic and foreign campus apps is as follows:

(1) From the perspective of the types of apps provided by universities, most of the world top 10 universities have their own official school apps. The TOP 10 domestic universities also have their own apps, but most of them rely on third-party apps such as WeChat service account, WeChat subscription, WeChat work, Alipay, and Campushoy app. Among them, the proportion of school-owned apps is not high, while the proportion of third-party apps is relatively high.

(2) From the perspective of social media, top foreign universities mainly rely on Facebook, Instagram, Twitter, and YouTube. In contrast, the top universities in China mainly rely on Chinese social media such as WeChat (subscription and mini program) and Weibo to provide service to Chinese citizens. At the same time, they also provide services to international faculty and students via Facebook, Instagram, Twitter, and YouTube. Another noteworthy feature is that these Chinese universities use the TikTok app to serve domestic teachers and students (THU, FDU and ZJU), as well as international teachers and students (THU, PKU, FDU, STJU and SYSU). It can be seen that the application of SFVs has been relatively common in domestic universities, and SFVs is also a more intuitive and convenient service (media) trend.

(3) Stanford university was the first one to introduce an official school app (in year 2009) among the top foreign universities. Two years later, Fudan University launched its official school app "i 复旦" in 2011, becoming the first domestic higher education institute to introduce an official app (J. F. Zheng et al., 2018).

(4) Compared with domestic universities, their foreign peers pay more attention to sports and alumni networking.

(5) Both domestic and foreign top universities provide mobile payment services via their official apps.

(6) An obvious feature of China's TOP 10 universities is the widespread use of WeChat Service account and WeChat subscription account developed by third-party companies to provide services.

### 2.3.7 Research on mcs-App

L. Fan (2013) develop a new analytical model based on the so-called expectation confirmation model. Then, they analyze the main factors affecting users' use of WeChat and carried out a series of empirical research. The results show that perceived usefulness, perceived entertainment, satisfaction, and perceived performance could all contribute to sustainable willingness to use with a direct positive impact. In the field of mobile library apps, Based on ECM-ISC model and TTF theory, Guo (Guo, 2014) develops a research model of users' continuous use intention to study the behavior of university library users and finds that task-technology fit is a key factor affecting user perception of usefulness and satisfaction. In addition, Deng and Yang (2014) study the continuous use of a mobile library app by college students from the perspective of user factors. The results show that the influencing factors of college students' use of mobile libraries include service quality, system quality, information quality, and user factors. They have all exerted varying degrees of influence.

When college students use applications, the main influencing factors include social needs, perceived ease of use and perceived usefulness. For developers, effective measures should be taken to further improve the quality and fun of content. In addition, developers should also actively use various latest technical means to enhance the functions and user interface of smart phones and better attract potential users (Hassan et al., 2014). To improve the technology acceptance model, L. Liu (2015) includes the perceived risk and external effects as new variables and studies the factors on college students of mobile phone app use intention of shopping websites in Tianjin University of Finance and Economics.

Based on the two-factor theory, H. P. Zhao et al. (2015) use various factors (i.e. perceived ease of use, ads aggression, perceived risk, satisfaction, and loyalty) to deeply analyze continuous usage intention and discuss users' unloading behavior.

M. Chen (2016) finds that from the perspective of the external environment, network externalities and software design characteristics, the perception of social mobility significantly affects the perceived ease of use. From the perspective of information technology, perceived ease of use, and perceived usefulness have a significant impact on social class mobile phone app use intention. From the perspective of social psychology, compatibility, perceived entertainment, and perceived price positively influence the social class mobile phone app use intention, while the perceived risk hypothesis is rejected. From the perspective of consumer psychology, use intention positively influences actual usage, At the same time, the actual usage positively influences customer satisfaction.

Taking Alipay and WeChat as examples and based on value-based adoption model (VAM), H. D. Liu (2018) establishes a model for use intention of third-party mobile payment and add network externalities and usage scenarios richness as new variables for the model. T. S. Zhang (2018) discusses the factors that affect college students' mobile news app sustainability and intends to model and develop marketing awareness as a new variable. Q. Yang (2017), L. X. Ge (2018), and C. R. Sun (2019) study the factors facilitating the users' willingness to continuously use sports apps.

Tavares and Alturas (2018) mainly analyze how mobile applications affect Portuguese college students from the perspective of students. They comprehensively discuss the problems of user experience and content quality for some application software in this country. On this basis, they have designed a questionnaire, constructed an evaluation model, and then obtained the data related to satisfaction. The results show that under the action of an independent variable, there will be a certain effect between the dependent variable and the independent variable. Specifically, the use quality of application software will be affected by the content quality and product quality. They made a comprehensive analysis of the mechanism.

H. H. Xia (2019) constructs the third party loyalty model of mobile payment according to characteristics of the third party mobile payment. He selects nine latent variables (the service quality, perceived value and perceived risk, customer trust, context factors, satisfaction, loyalty, switching cost, and alternative attractiveness) and proposes 15 hypotheses. H. H. Xia builds a structural equation model through the relationship between these variables

Based on two-factor theory (TFT) and integrating ATM model and task-technology fit model (TTF), S. L. Peng (2018) proposes system quality, content quality, interactivity,

perceived ease of use, and experienced usefulness, and established a theoretical model that affects the continuous adoption and uninstallation willingness of foreign language app users. Her research has the following findings: (a) College students' experienced usefulness and experienced ease of use of foreign language software have a positive and significant impact on their intention to continue using, and experienced usefulness has the greatest impact. (b) The system and content quality of foreign language apps indirectly affect college students' purpose to continue using them, and the impact of the content quality of foreign language apps is greater than that of the system quality. (c) The interactivity and experienced usefulness of foreign language apps negatively affect college students' willingness to uninstall, and the effect of interactivity on willingness to uninstall is greater than that of perceived usefulness.

Y. M. Zhu (2019) develops a research model and proposes the variables affecting college students' sustainable use of health apps. The dependent variable is willingness to adopt continuously. The independent variables are experienced usefulness, experienced ease of use, quality variables (i.e., information, service, and system), health literacy, personal traits, switching costs and objective factors. The intermediate variables are experienced usefulness and experienced ease of use. The control variables are gender, education level, and type of the health app.

Based on the perceived value model (VAM) and introducing the variable subjective norm in the TPB, S. L. Cheng (2019) divides the product characteristics of sports apps into five aspects: perceived usefulness, perceived entertainment, perceived cost, technical features, and subjective norm. Based on the theory of perceived value, he proposes a model of factors facilitating college students to use sports apps, with five characteristics as independent variables, perceived value as a mediating variable, and willingness to use as the dependent variable of the model.

Y. M. Wang (2020) proposes five factors affecting mobile sports live streaming apps, namely app product brand, app operation experience, app audiovisual experience, app content experience and app interactive service.

T. T. Wang (2020) finds that sharing behavior is influenced by sharing intention, sharing attitude and perceived behavioral control. Acceptance behavior is influenced by acceptance intention, knowledge usefulness and perceived usefulness.

C. Zhang (2020b) finds that factors to influence the willingness of Xiaohongshu app (An online shopping and social networking platform in China, was established in June 2013.) users include (from highest influence to the least) the perceived interactivity, network externality, satisfaction, perceived risk and perceived ease of use. Among the factors affecting

the willingness of Xiaohongshu app users to continue to engage, the perceived interaction has the greatest impact. Xiaohongshu app users' perceived interactivity scored lowest among all variables.

An empirical analysis by L. Y. Zhou (2020) indicates that college students' willingness to use recruitment apps is significantly and positively correlated with their major, work experience, and understanding level. Two latent variables, convenience and information content, have the largest total effect on user satisfaction, followed by perceived value, stability, carefulness, and security.

H. C. Li (2021) points out that college students' willingness to use sports apps can better determine the direction and predict physical exercise adherence, and that self-efficacy plays a partial mediating role in the willingness to use sports apps and physical exercise adherence. College students' intention of using sports apps can affect the persistence and persistence of physical exercise through the mediating effect of self-efficacy.

X. H. Huang & Tan (2020) integrate the technology acceptance model (TAM) with operant conditioning in behavioral psychology to construct a structural equation model of college students' continuous usage behavior of SFVs app. Their work shows that the perceived ease of use based on the TAM model has basically no effect on the college students' intention to continue using, and that user engagement has the greatest positive effect on the continuous adoption behavior of college students on the shorters app platform. Operant conditioning has significant positive effects on experienced usefulness, experienced ease of use, and user engagement. Social isolation motivation has a significant positive effect on operant conditioning and achievement needs.

Xiao & Ma (2020) take ctrip app as an example to extend the ECM-ISC model and conduct an empirical analysis through college students. Their research shows that the perceived usefulness, subjective norm and satisfaction among college students have an impact on the intention of continuous adoption, while the experienced risk and experienced ease of use have no significant impact.

Based on online trust theory, TAM model and text analysis of user comments of Xinli001 app (A psychological service platform), N.Y. Cao et al. (2020) constructs an influencing factor model of psychological app users' continuous use intention. Factor analysis and multiple linear regression analysis are conducted to analyze the data from the questionnaire survey of the community group of Xinli001 app, and to explore the main factors facilitating the purpose of psychological app users to continue to use. Their results show that satisfaction factor, channel factor, benefit factor, and motivation factor have great influence on users' continuous

use intention.

G. A. Wu and Wu (2020) propose a model of college students' expectation confirmation and purpose to continue using TikTok app. Their empirical study shows that expectation confirmation has a significant positive impact on experienced usefulness and experienced entertainment expectation confirmation, while experienced usefulness and perceived entertainment have significant positive effects on satisfaction. Satisfaction, experienced usefulness, and social influence have significant positive effects on continuous use goals.

Combined with the technology acceptance model, expectation-confirmation model, extended expectation-confirmation model and customer satisfaction index model, J. Hu (2020) selects eight variables (expectation confirmation, perceived benefit, perceived pleasure, perceived trust, switching cost, satisfaction, intention to continue using and behavior to continue using) puts forward hypotheses, and constructs a research model on the behavior of college students using mobile music apps. His work shows that:(a) Expectation confirmation has a positive and significant impact on the perceived benefits of mobile music app users. (b) Perceived benefits, perceived pleasure, and perceived trust have a positive and significant impact on the continuous use intention through their satisfaction. (c) Perceived benefits, perceived pleasure, switching costs and satisfaction have positive and significant effects on the continuous use intention of mobile music apps, and finally positively and significantly affect the continuous use behavior of college students.

Integrating the TAM model, the Task-Technology Fit (TTF) model, and the integrated TAM/TTF Model, Yuan (2020) analyzes the factors facilitating students to use sports apps in higher vocational colleges in Henan Province from a more comprehensive perspective. Yuan finds that the five factors (experienced usefulness, experienced ease of use, experienced interest, task characteristics, technical characteristics, and task-technology matching degree) have positive correlation, but the index of each dimension of perceived interest is relatively low.

Based on the extended expectation confirmation model (EECM), Chai et al. (2020) introduce three influencing factors of sustainable use behavior: search effort, user habits, and switching costs. They construct an influencing factor model of sustainable use behavior of college students sharing tourism app users. Their main findings are as follows: (a) The degree of confirmation has a significant impact on experienced usefulness. (b) The degree of confirmation and search effort have significant influence on satisfaction. (c) Satisfaction and search effort have significant influence on continuous use willingness. (d) Continuous use intention, search effort and user habit have significant influence on continuous use behavior.

Combined with the ECM-ISC model, on the basis of the original four variables of the theory (perceived usefulness, expectation confirmation, satisfaction, and continuous adoption purpose), and based on the characteristics of the Tiktok app itself, M. X. Jiang (2021) adds three variables (product factor, perceived entertainment, and social influence), and proposes a research concept model. Her research shows that in addition to the three new variables, satisfaction and perceived usefulness are also positively correlated with user engagement with the app, and that this correlation is significant.

Based on the perspective of user experience and combined with the context of booking travel apps, X. Wang (2021) divides the context characteristics of travel apps into four dimensions: immediacy, convenience, personalization, and socialization. According to the "stimulus-organism-response" theory, X. Wang (2021) constructs the research model, taking the characteristics of travel app as the independent variable, flow experience as the mediating variable, and purpose to continue adopting as the dependent variable. His work has the following findings: (a) The four dimensions of tourism app characteristics can positively influence users' flow experience. (b) The four dimensions of tourism app characteristics all have positive effects on users' goals to adopt continuously. (c) Flow experience positively impact on users' continuous usage willingness. (d) Flow experience has a partial mediating effect between immediacy, convenience, personalization, socialization and users' intention to continue using.

X. X. Gong and Shen (2021) propose six independent variables, namely normative belief, behavioral variables (i.e., attitude and intention), subjective norm, experienced variables (i.e., behavioral control and ease of use), and the dependent variable actual behavior. Their finding are as follows: (a) Experienced ease of use of Alipay app by college students in Chongqing positively affects behavioral intention. (b) Users' behavioral willingness to use Alipay app directly leads to the final behavior.

Based on the ECM-ISC model and combined with the characteristics and attributes of news app, Jia (2022) conducts an empirical study on the factors facilitating the purpose of users to continue adopting news apps among college students. The research shows that perceived usefulness, expected confirmation, perceived authority, perceived interest and other factors directly or indirectly affect the user satisfaction and adoption to continue using news apps in different degrees.

From the two dimensions of pseudo-companionship and platform content, M. Zhang et al. (2021) propose a research model based on the D&M IS success model and the attachment theory. They have the following findings: (a) Mimicry relationship commitment and platform

emotional attachment positively affect users' continuous use intention. (b) Mimicry relationship commitment is positively affected by social usefulness and mimicry relationship demand satisfaction. (c) Platform emotional attachment is positively affected by functional usefulness and content quality requirements.

Based on the ECM-ISC model and combining with flow theory and the characteristics of knowledge-paid apps, Y. J. Xue et al. (2021) construct a model of users' continuous use intention of knowledge-paid apps. Their results are as follows: (a) Perceived usefulness, satisfaction, subjective norm, experienced behavioral control and experienced privacy risk have significant effects on continuous use purpose. (b) Although flow experience has no significant effect on continuous adopt goals, it has a significant effect on experienced usefulness and satisfaction.

Based on the expectation confirmation model, N. N. Zhang (2021) develops an ensemble model by integrating the expectation confirmation model, moderating focus theory, and social comparison theory. She uses user self-regulation focus and social comparison as moderating variables. She explores how perceived health outcomes, validation of expectations, perceived usefulness, and satisfaction affect continued use intention under different regulatory focus and social comparison tendencies. Her results are as follows. (a) Expectation confirmation, perceived health outcomes and perceived usefulness in mobile health management services have positive effects on individual satisfaction. (b) Perceived health outcomes, perceived usefulness, and individual satisfaction also all directly influence intention to continue use. (c) Among users' moderating focus and social comparison tendencies, facilitating focus positively moderates expectation confirmation and perceived usefulness in mobile health management. (d) Prevention focus negatively moderates expectation validation and perceived usefulness in mobile health management. (e) Social comparison positively moderates expectation confirmation and satisfaction with health management services.

Integrating the ECT theory and the TAM model, P. Wang (2021) studies the factors facilitating users' adoption in continue using dance sports apps. He uses the following five variables in his model: perceived entertainment, perceived trust, perceived cost, user habits, and subjective norms are newly introduced. His results are as follows: (a) Experienced ease of use and expected confirmation positively and significantly affect experienced usefulness. (b) Expected confirmation, experienced ease of use, experienced usefulness, experienced trust, and experienced entertainment positively and significantly affect user satisfaction. (c) Experienced ease of use, experienced usefulness, satisfaction, experienced entertainment, experienced cost and subjective norm positively and significantly affect users' intention to

continue using. (d) Perceived trust and user habits have no significant impact on continuous use intention. (e) Experienced usefulness, satisfaction and goals to adopt continuously play a mediating role.

Based on S-O-R theory, self-determination theory, perceived value theory, and continuous use model of information system, Q. Wang (2021) constructs the influence model of gamification elements on users' continuous use intention of mobile reading app. His main conclusions are as follows: (a) Gamification leaderboards positively influence users' perceived spontaneity and perceived autonomy. (b) Gamification teams positively influence users' perceived relevance and perceived autonomy. (c) Gamified avatars positively influence perceived autonomy. (d) Gamified rewards negatively affect user perception. (e) Perceived spontaneity, perceived autonomy, and perceived usefulness positively affect users' intention of continuous use. (f) Perceived propriety negatively affects users' adoption of continuous use, while perceived relevance has no significant effect on users' goals of continuous adoption.

Extending the theoretical basis of the TAM model, the ECM-ISC model, the D&M IS success model and updated D&M IS success model, Gui (2016) constructs a tourism app user sustainable use model and proposed theoretical hypotheses. His model suggests the following results: (a) Experienced usefulness, experienced ease of use, and experienced entertainment have significant positive effects on users' satisfaction and intention of continuous use. (b) System quality (SYQ) and service quality (SEQ) in information system performance have significant positive effects on satisfaction and adoption to continuous use. (c) Satisfaction has a significant impact on attitude and intention to continue adopting, and attitude also has a significant impact on intention to continue adopting.

Taking health goal as the main line, based on goal-setting theory, and combining the status quo deviation theory, self-determination theory and environmental behavior relationship theory, A. S. Li (2019) conducts three empirical studies on the use behavior of exercise and fitness app users in different stages. A. S. Li's empirical study offers the following findings: (a) In the initial acceptance stage, inertia negatively affects the exploratory use intention of exercise and fitness app. Since inertia negatively affects the perceived demand, it reduces the exploratory use intention of exercise and fitness app. (b) In the continuous use stage, the health goal influences the users' continuous use of exercise and fitness app through three ways: conscious self-management, unconscious habits, and conversion from awareness to unconsciousness, so as to achieve the health goal.

In recent years, the SFVs industry has developed rapidly, and many scholars have studied the willingness of college students to use SFVs.

Based on the uses and gratifications theory, X. Ge (2021) analyzes the correlation and influence relationship between user viscosity and Li Jia-qi trill SFVs student users (Hebei province in China) from five aspects: user motivation, perceived short video quality, influence of social interaction, user satisfaction and user willingness to continue using, and thus summarized the influencing factors of user viscosity.

Integrating the TAM model, and ECT theory, and the sense of virtual community theory, Xiang (2020) conducts an in-depth study on the status quo of college students' (five universities of Nanchang in China) using shorters and the factors affecting their continuous use. His main findings are as follows: (a) Three variables used for the first time (experienced ease of use, experienced usefulness, and experienced fun) positively affect satisfaction (b) Primary use has a positive effect on secondary use through mediating variable satisfaction. (c) The influence of satisfaction on mediating variables, immersion, personal relationship and emotional connection positively affect the intention of TikTok continuous use of college students. (d) Social influences have significant positive effects on college students' willingness to contact TikTok for the first time and their purpose to adopt TikTok continuously. (d) Experienced ease of use has no significant effect on college students' goals to adopt TikTok continuously, while experienced usefulness and experienced fun have significant positive effects on college students' willingness to adopt Tiktok continuously.

By integrating the extended model of TAM and use and the theory of perceived risk, Q. Y. Cheng (2019) constructs an influencing factor model of users' SFVs app use behavior. Taking college students in Hongshan District of Wuhan as his research subject, Q. Y. Cheng (2019) has the following findings: (a) Users' hedonic motivation and habits have a great positive impact on users' using behavior. Interest is the main reason for users to use SFVs and users have strong stickiness. (b) Perceived risk has a significant negative impact on user behavior, indicating that the concerns about time risk and privacy risk are the main reasons for user loss. (c) User's performance expectation and effort expectation have no significant influence on user's use behavior, while other variables have significant influence on user's use behavior, but the influence is small.

Some scholars have also studied non-continuous usage intention. Using the expectation disconfirmation theory and the stressors-strain-outcomes framework as their theoretical model, T. Sun and Xia (2021) conduct a survey on the influencing factors of users' willingness to not continue adopting the social reading app (Weixint Weread) for book reading. They find that negative perceived performance, dissatisfaction and use burnout all have significant positive effects on users' purpose of non-continuous adoption. Functional overload, social overload,

and information overload have effects on users' dissatisfaction, and intention of non-continuous use through use burnout. As a mediating variable between negative perceived performance, use burnout and intention of noncontinuous use, dissatisfaction has a significant mediating effect.

In the case of health apps use, S. Liu and Xie (2021) find that personalized recommendation system has a direct and significant impact on users' non-continuous adoption purpose. They also find that personalized recommendation system has at least two following adverse effects: (a) It has direct positive effects on privacy concerns. (b) It has a direct positive effect on users' perception of visual field stenosis. Their main findings are as follows: (a) Perceived visual field stenosis had an indirect positive effect on the intention of non-continuous adoption of health apps, which is induced by psychological reactance. (b) Psychological reactance has a direct positive impact on users' non-continuous adoption of app.

Taking SFVs as the research object and based on the stress-strain-outcome theory, M. M. Zhang et al. (2021) construct a social media burnout model of SFVs, taking information overload, low-quality information perception, social overload and upward social comparison as stressors. Their model discusses the factors affecting SFVs social media burnout and its influence on non-continuous use behavior. study suggests the following findings: (a) Information overload, low-quality information perception and upward social comparison positively affected SFVs social media burnout, and social media burnout positively affect non-continuous use behavior. (b) SFVs social media burnout plays a mediating role between information overload, low quality information perception and upward social comparison and noncontinuous use behavior. (c) Social overload does not affect SFVs social media burnout.

The extant literature mainly focuses on use intention (or use behavior) on mobile sports app (L. X. Ge, 2018; Luo, 2017; P. Wang, 2021; C. R. Sun, 2019; Q. Yang, 2017; M. X. Zhang & Liao, 2018), social apps (M. Chen, 2016), shopping app (M. Chen, 2016), news app (T. S. Zhang, 2018), payment app (H. D. Liu, 2018), SFVs app (M. X. Jiang, 2021; M. Zhang et al., 2021), and library app (Deng & Yang, 2014; Guo, 2014) in college. However, previous studies mainly discuss some special cases (H. P. Zhao et al., 2015), but the factors related to application participation and adoption have not been fully and deeply explored. The study of this problem is of great significance. Only a few studies use the technology acceptance model to analyze the problem of sustainable use, no other research has clearly distinguished the stages of app usage (i.e., adoption stage and engagement stage), clearly defined the adoption and engagement for campus apps, or attempted a theory that links both stages together. This

thesis will contribute to the existing studies by investigating the aforementioned fields.

## 2.4 Theories on user adoption

In this section we comprehensively review the research progress of new technology adoption and user acceptance and focus on the main research models. These theories have been evolving and under development for a long time, and they are closely related to each other. In terms of the chronical order of the theory development, researchers first put forward the theory of reasoned action (abbreviated as TRA), then put forward the planned behavior theory (abbreviated as TPB), and then develop it into the decomposed theory of planned behavior theory (abbreviated as DTPB). The continuous development of information systems promotes the proposal and development of the technology acceptance model (TAM), followed by the TAM2 model and TAM3 model, which are further developed through TRA. Later, some combined models have been developed, such as the C-TAM-TPB model, UTAUT model, and UTAUT2 model. This section also reviews the coping model of user adaptation (CMUA) and the personal involvement inventory (PII).

### 2.4.1 TRA (1975)

Rational action theory (TRA) is not designed for specific technologies and behaviors. It belongs to the general model. This theory mainly discusses human-related behavior. Ajzen and Fishbein's model as a result of a research program that started in the late 1950s on the persuasion models of psychology (Momani & Jamous, 2017). Ajzen and Fishbein (1980) mainly develop a basic theoretical system that can reasonably predict human behavior. At the same time, they also point out that the theory is mainly affected by attitudes towards subjective norms and behaviors (see Annex B, Figure 2.10).

### 2.4.2 TPBs

#### 2.4.2.1 TPB (1985)

Ajzen (1985) further extends TRA and proposes the theory of planned behavior (abbreviated as TPB). In this theory, perceptual behavior control is mainly added to expand (See Annex B, Figure 2.10). From the perspective of basic theory, we can find that it is an important influencing factor of behavior and intention. As of this writing, people have used TPB to analyze individuals' use and acceptance of technology. In addition, Ajzen (1985) discusses its

influencing factors. Alturas (2021) indicates that the TPB is the most cited model (see Annex B, Figure 2.11).

### 2.4.2.2 DTPB(1995)

S. Taylor and Todd (1995a, 1995b) discuss DTPB in great depth. In their research, they mainly analyze three aspects: perceived behavior control, subjective norms, and behavior attitude, which form a multi-dimensional belief construct. The theory is further enhanced by TRA. It uses innovation diffusion theory (abbreviated as IDT) to expand TPB. In this study, the factors involved include complexity, compatibility, and comparative advantage. It should be pointed out that the latter two factors jointly affect perceived behavior control. Relevant mechanism research is of great significance (S. Taylor & Todd, 1995). In addition, S. Taylor and Todd (1995a) also comprehensively analyze three models: DTPB, TPB, and TRA. Their results show that first model can better explain human behavior, while the latter two also have their advantages (see Annex B, Figure 2.12).

S. Taylor and Todd (1995) also comprehensively compare TAM, DTPB, and TPB models to achieve a better application of DTPB. Also, it exchanges the relative advantage factor from IDT with the perceived usefulness factor from TAM. Knowing that these factors are related to the same characteristics, the authors do not change the use of the construct "attitude". Ease of use is opposite to complexity, and perceived usefulness is similar to relative advantage. In the DTPB model, it first decomposes the belief construct, and then further adds the basic factors of TAM, so it can accurately predict the usage behavior. In this process, the model decomposes the subjective norms and obtains two aspects: Supervisor influence and peer influence. Then, it adds perceived behavior control to technical factors and finally realizes the relevant process.

### 2.4.3 TAMs

### 2.4.3.1 TAM (1985)

Davis (1985) further proposes the technology acceptance model (abbreviated as TAM) based on TRA. This model effectively replaces TRA's attitude towards behavior through perceived ease of use and perceived usefulness. The construct of TAM does not include subjective norms related to TRA. TAM is gradually developed based on information technology. In addition, TPB and TRA models are mainly proposed based on psychological research institutes. In the view of many researchers, TPB and TRA models have better universality than the TAM model (1985). In the evolution of TAM, the first stage is the adoption stage,

then the verification stage, and finally the expansion stage. The adoption phase mainly uses relevant applications to adopt and test. For the verification phase, the model will be implemented through the measurement of user acceptance behavior. For the validation phase, these studies introduce other variables to further expand the model. According to Alturas (2021), the TAM is the most cited model (see Annex B, Figure 2.13).

### 2.4.3.2  TAM2 (2000)

The development of TAM2 comes from the further expansion of TAM, which mainly focuses on the related fields of information technology (V. Venkatesh & Davis, 2000). TAM2 focuses on the issues of perceived ease of use and perceived usefulness from the perspective of cognitive tools and social impact. Among them, the process of social influence involves three factors: image, voluntariness, and subjective norms. In addition, the cognitive tool process mainly involves perceived ease of use, output quality, and job relevance. Starting from the TPB and TRA models, these researchers have carried out in-depth discussions with subjective norms as the required additional construct. The study finds that the user intention and perceived usefulness will significantly affect the subjective norms. It is pointed out that the user experience needs to play a very important role in this process. At the same time, the relationship between user experience and use intention is mainly affected by two factors: voluntariness of use and user experience. On this basis, they further extend TAM and propose the TAM2 model. In this new model, they include some other regulatory factors, which further enhance the basic performance of the model itself. Typically, because the experience regulator is added, it clearly shows that the user's experience of technology will gradually improve. In other words, users' acceptance of technology will fluctuate greatly (see Annex B, Figure 2.14).

### 2.4.3.3  TAM3 (2008)

Based on TAM2, V. Venkatesh and Bala (2008) further develop TAM3. These researchers add anchors and adjustments to ease of user perception. Anchor is the general belief in the computer field, mainly including computer gameplay, computer anxiety, and external control perception. In addition, adjustment is a belief based on practical experience, which mainly involves objective availability and perceived enjoyment. Therefore, it contains a lot of relevant information about the difficulty of using the system (see Annex B, Figure 2.15).

**2.4.4 C-TAM-TPB (1995)**

S. Taylor and Todd (1995a) fully combine the two models of TPB and TAM and propose a new research model to effectively improve the utilization of the TPB model in the field of technology acceptance. In this model, the perceived usefulness of TAM and the predictive variables of TPB are further integrated, and then a hybrid model is formed (S. Taylor & Todd, 1995a). Through their analysis, we can find that the TPB and TAM models mainly assume that the behavior is affected by intention. In addition, the intention should be affected by the attitude of behavior. They point out that the constructs of TAM could not reflect the impact of environmental factors and user acceptance. In the late 1980s, Davis (1989) has discussed that when carrying out academic research on technology acceptance, people should focus on the impact of other variables. These researchers have proposed an important hypothesis that perceived usefulness will be positively affected by perceived ease of use. In addition, attitudes are positively influenced by perceived ease of use and perceived usefulness. In other words, users' use behavior will be greatly affected by three aspects: perceived behavior control, subjective norms, and attitudes (see Annex B, Figure 2.16).

**2.4.5 UTAUTs**

**2.4.5.1 UTAUT (2003)**

We can find that UTAUT mainly includes four moderators and four constructs that affect its use and intention of IT. In addition, its decisive factors include promotion conditions, social impact, effort expectation, and performance expectation. The results show that the regulatory construct related to use intention includes four aspects: voluntary use, personal experience, age, and gender (V. Venkatesh et al., 2003; H. Wang & Yang, 2005). At present, this model has been used to deeply explore the acceptance of technology (Baltaci-Goktalay & Ozdilek, 2010; see Annex B, Figure 2.17).

**2.4.5.2 UTAUT2 (2012)**

V. Venkatesh et al. (2012) further propose the UTAUT2 model. The new model adds price value, habits, and hedonic motivation to the existing UTAUT model. The researchers argue that there is a big difference between consumer use and organizational use. So they add the price value to the model. They point out that in general, consumers will bear the cost of using technology, but employees do not need to bear the economic cost. V. Venkatesh et al. (2012) show that the process of users using technology is significantly affected by price and cost (see

Annex B, Figure 2.18).

In conclusion, we can use four factors (convenience, social impact, effort expectation, and performance expectation) to dynamically explain the use of information technology (W. Li, 2010).

### 2.4.6 MISSs

### 2.4.6.1 MISS (1992)

Because the quality of IS is considered to have a significant impact on the function of information systems, an information system success model (abbreviated as MISS) is proposed by DeLone and McLean (1992). In MISS, IS quality plays a very important role. DeLone and McLean (1992) define IS as a construct that includes different aspects. Their model includes performance results (ie., individual impact and organizational impact), attitude results (ie., user satisfaction and use), and quality measurement (ie., system quality and information quality; see Annex B, Figure 2.19).

### 2.4.6.2 UMISS (2003)

About 20 years ago, DeLone and McLean (2003) develop a new IS success model which incorporate the factors of service quality. Because IT will have a great impact on society, consumers, industries, organizations, and working groups, they adopt the "net benefits" construct and finally formed this model. Within this framework, they conduct an in-depth and comprehensive discussion on relevant issues (see Annex B, Figure 2.20).

### 2.4.7 PII (1985)

The Personal Participation Inventory (PII) is a bipolar adjective scale. Its main function is to clearly describe the concept of product involvement (2003; see Annex B, Figure 2.21).

PII includes a total of 20 bipolar adjectives which they are used to describe the involvement construct. The items are analyzed and scored on a seven-point bipolar scale. The total score is between 20 and 140. In addition, the derived average value of the product is equal to 90. If the score exceeds 90, we can consider it highly related to the product category (Zaichkowsky, 1987).

Some researchers (Bloch & Richins, 1983; Zaichkowsky, 1986) have pointed out that participation has some antecedents. These factors are related to the characteristics of people, stimulation, situation, and factors. If these factors are related to purchase (Clarke & Belk,

1979), advertising (Krugman, 1965, 1966), and products (Hupfer & Gardner, 1971), they will have a certain impact on the degree of stimulus participation. In fact, for the above aspects, there is no significant difference in the basic concept of participation (Clarke & Belk, 1979; Petty & Cacioppo, 1981). The main reason is that it is usually related to the stimulus object. On this basis, Greenwald and Leavitt (1984) further conceptualize its four levels, mainly elaboration, comprehension, focal attention, and preattention.

Park and McClung (1986) have comprehensively defined the concept of participation as follows: (1) cognitive involvement: it is mainly based on the correlation degree of the relevant information content of brand function performance; (2) affective involvement: it is mainly based on the relevance of aesthetic or emotional information, and then the motivation of self-image expressed to the outside world. The interaction between people and stimuli will significantly affect the motivation of value expression and the stimulation of utilitarianism. Some people believe that they will occur simultaneously in some cases (Zaichkowsky, 1994). On this basis, Zaichkowsky (1994) reduces the PII scale in half. Its reliability in application research still reaches 0.9.

## 2.4.8 CMCA (2005)

For the coping model of user adaptation (abbreviated as CMUA), it has the following assumptions: the first is the user's primary assessment, specifically the user's analysis and assessment of the consequences of relevant it events; and then the user's secondary assessment, specifically the user's reasonable control of the situation. The model includes a series of adaptation strategies, including self-protection strategy, interference handling strategy, benefit satisfaction strategy, and benefit maximization strategy. The model further assumes that the above strategies will produce corresponding results. Some researchers have conducted in-depth and comprehensive research on this and obtained some results (1994; see Annex B, Figure 2.22).

## 2.4.9 TRGP (2019)

Some researchers have developed the theory of planned behavior (abbreviated as TPB; Ajzen, 1991, 2012) to predict human-related behavior. The core of this theory is human behavior. It argues that behavioral intention is an important precursor of certain behaviors. The main influencing factors include the perceived control of behavior, the subjective norms of behavior, and the attitude towards behavior. In contrast, Kruglanski et al. (2002) have proposed a goal

systems theory (abbreviated as GST) which assume a target as the core of their theory. In their theory, behavior is considered to be an important means to achieve goals. Ajzen and Kruglanski (2019) further integrate the above theories and then develop the rational goal pursuit theory (its abbreviation is TRGP). In TRGP, the application scope and prediction ability of TPB have been effectively expanded. The model indicates that the motivation and personal goals of executive behavior play an important role in the formation of behavioral intention (see Annex B, Figure 2.23).

Unlike other earlier models, TRGP comprehensively integrates some motivation and target systems into TPB in the following aspects: (a) The motivation to engage in behavior will be affected by subjective norms and attitudes. In addition, motivation is also an important reason for intention. (b) Perceived behavior control can effectively reduce the effect of motivation on intention. (c) Behavior and normative beliefs will be greatly affected by approval objectives and positive purchase behavior. (d) The same time, the approval target and positive purchase behavior will also play a regulatory role in the impact of attitude and subjective norms (Ajzen & Kruglanski, 2019).

## 2.5  Theories on user engagement

In this section, we will review important research models and basic theories proposed for the acceptance of users. In fact, these theories and models have been studied for a long time and they are closely related. This part introduces the important theories, mainly including the expectations confirmation theory (abbreviated as ECT), the innovation diffusion theory (IDT), the social cognitive theory (SCT), the technology organization and environment (abbreviated as TOE), the model of PC utilization (MPCU) and the motivational model (MM). They are developed from several fields of natural and social sciences.

### 2.5.1  MPCU (1991)

Triandis (1979) proposes a research framework for analyzing the process of behavior occurrence and then discuss the variables that affect individuals' use of PC. He points out that behavior has a series of objective consequences explained by individuals. From these results, individuals can feel that they have been strengthened. He also discusses the perceived consequences of reinforcement after its impact on behavior. His study finds that social factors, convenience, related arousal, and habits will affect behavior intention to varying degrees.

Thompson et al. (1991) further develops the above model. They extend it in the context of

information system, and then comprehensively predict and analyze the PC utilization. Their study finds that this model can be used to accurately predict personal acceptance and the use of information technology. The results show that when people use personal computers, they will be affected by factors such as convenience, habits, expected consequences, social norms, and feelings. These researchers have made an in-depth analysis of the mechanism and discovered some basic laws. They also add job suitability and complexity to the model to dynamically explain the problem of perceived consequences. In this model, there is an important assumption that users have rich experience in using personal computers (see Annex B, Figure 2.24).

## 2.5.2 MM (1992)

Davis et al. (1992) have explored the adoption and issues of new technologies through motivation theory (Koo et al., 2015; V. V. Venkatesh & Speier, 1999). They analyze the basic motivation of people to use certain technologies in the workplace. Their results show that these factors can significantly affect individuals' intention to adopt technology. They explain the extrinsic motivation to use technology as perceived usefulness from using the technology, and intrinsic motivation to use technology as perceived enjoyment of using the technology.

Davis et al. (1992) have reported the internal relationship between enjoyment and usefulness. If the information system is useful, the intention will be significantly affected by enjoyment. In other words, the fun of information systems will enhance the acceptance of useful systems. However, it has less effect on the acceptance of useless systems (Annex B, Figure 2.25).

In addition, Vallerand (1997) proposes a hierarchical model, which is a general model about extrinsic motivation and intrinsic motivation.

## 2.5.3 TOE (1992)

L. Tornatzky and Fleischer (1990) propose the technology organization and environment framework (namely TOE). They believe that environment, organization, and technology will affect the process of technological innovation .

The TOE theory makes appropriate modifications and adjustments to the problems of IT adoption and then develops the corresponding research framework. In this way, we can use it to analyze the assimilation and adoption of its innovation (Oliveira & Martins, 2011). At present, this theory has been regarded as an important method to analyze the adoption of IT

by an organization (Hameed et al., 2012; see Annex B, Figure 2.26).

## 2.5.4 SCT (1995)

Based on the social cognitive theory (Hameed et al., 2012), D. R. Compeau and Higgins (1995a) comprehensively discuss the use of computers mainly through factors such as anxiety and emotion, self-efficacy, expectation of personal results. Because this theoretical model has some special properties, we can use it to study the personal use and acceptance of information technology (shown in Annex B, Figure 2.27).

D. R. Compeau and Higgins (1995a) mainly use factors as the required dependent variables. Their results show that the characteristics of self-efficacy include universality, intensity, and amplitude. In addition, some studies (D. Compeau et al., 1999; D. R. Compeau & Higgins, 1995a, 1995b) also propose the construct of usage behavior, including self-efficacy, emotional response, and result expectation for computers. Later, Weeger and Gewald (2013) propose that outcome expectation includes two aspects: personal result expectation and performance result expectation. In addition, it also involves some related emotional reactions to PC.

## 2.5.5 IDT (1996)

In the early 1960s, Rogers develop the innovation diffusion theory (abbreviated as IDT). Later, the theory gain more applications and is regarded as a classic theory in the field of innovation research (L. G. Tornatzky & Klein, 1982). L. G. Tornatzky and Klein (1982) later discusses the law and mechanism of the influence of innovation attributes on individual behavior in a separate study. IDT claims that the relevant attributes mainly include observability, trialability, complexity, compatibility, and comparative advantage. Rogers (2003) further discusses the relevant influencing factors from the perspective of the social system, time, communication channels, and innovation.

Moore and Benbasat (2003) adjust the relevant innovation attributes for the further expansion of IDT in the field of information technology, and improved the analysis construct of personal technology acceptance (Udeh, 2008). On this basis, it can promote individuals to adopt IT, and then gradually spread IT within the organization. In addition, this group of researchers also include the voluntary use into the model. Through the analysis, we can find that the use decision will be greatly affected by ease of use, perceived usefulness, and factor compatibility. They also analyze some factors that would not affect individuals' usage

(Momani & Jamous, 2017; see Annex B, Figure 2.28).

### 2.5.6 ECT (1997)

For expectation confirmation theory (abbreviated as ECT), when perceived performance and expectation are combined with each other, consumers will have satisfaction after purchasing products. Moreover, the above impact will be adjusted to a certain extent by the uncertainty between performance and expectation. The results show that if the performance of the product has significantly exceeded expectations, consumers will form satisfaction after purchasing the product. Otherwise there will be a feeling of dissatisfaction (Oliver, 1980; Spreng et al., 1996; see Annex B, Figure 2.29).

Related constructs include satisfaction, disconfirmation, performance, and expectation. Among them, expectation mainly reflects the relevant expected behavior (Churchill & Suprenant, 1982). Spreng et al. (1996) find that these constructs have certain predictability, mainly reflecting the expected product attributes in the future. In the ECT model, the expectation is mainly used as a comparison standard. Specifically, users use it to analyze and evaluate performance (Halstead, 1999). In addition, the model also assumes that disconfirmation will have a negative impact on satisfaction. Positive disconfirmation leads to satisfaction and vice versa.

## 2.6 Chapter summary

The main purpose of technology acceptance theories is to analyze the individual's acceptance of applications, information systems, and technologies. In addition, it is necessary to fully consider the important influencing factors and constructs, and then conduct a specific analysis (Momani & Jamous, 2017). As a summary, Table 2.9 (show in Annex A) lists the detailed definitions of important constructs from models and theories discussed in previous sections.

This study reviews the literature thoroughly and adopts the sequence diagram to comprehensively summarize the main technology acceptance models. Figure 2.30 (shown in Annex B) illustrates the relevant theories in four different directions in chronological order. Through analysis, these theories and theoretical systems can be developed. These theories and theoretical systems mainly come from the research field of human behavior, and then they are extended to the level of sociology and psychology (Momani & Jamous, 2017).

The first section of this chapter defines the concepts related to the mobile app, introduces three classic types of mobile apps and the development of mobile applications in China,

summarizes the fourth type (i.e. social media), and compares the four types of apps.Then defines the adoption and engagement of mobile apps.

The next session reviews the related studies on mobile app adoption and engagement. We find finds that the existing literature has not addressed the topics of mobile app adoption or engagement.

Section 2.3 discusses the situation of China's top 10 university campus apps, summarizes the main functions of the college campus apps, introduces the business model of college campus apps.The chapter discusses the situation of global top 10 university campus apps, summarizes the main functions of the college campus apps. Then introduces the well-known mobile apps in the market for colleges. The literature on mobile apps is also reviewed. The research summary reveals that academic studies on the adoption and participation of campus mobile apps are still missing.

The last section of this chapter reviews the relevant theories and models of user adoption and user engagement and lists the definitions of all constructs related to the theories.

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# Chapter 3: App Adoption

## 3.1 Research model and hypotheses

### 3.1.1 Research model

The technology-organization-environment (abbreviated as TOE) is proposed by L. Tornatzky and Fleischer (1990) to discuss the firm-level adoption of information system (IS)/information technology (IT) products. As of now, it has gradually developed into a basic theory related to IT adoption and has been paid more and more attention (K. Zhu et al., 2004). Some researchers add variables such as environment, organization, and technology to the theoretical system, which promoted the application of the TOE model in technology adoption and innovation value creation (Hossain & Quaddus, 2011; Oliveira & Martins, 2010; Ramdani et al., 2009; K. Zhu & Kraemer, 2005). At the same time, the model will not be affected by the situation of enterprises and industries (K. Wen & Chen, 2010). Therefore, TOE provides a very important solution for users to deeply explore the post-adoption diffusion and organizational ability development of enterprises (H. F. Lin & Lin, 2008; Salwani et al., 2009; Y. M. Wang et al., 2010; K. Zhu et al., 2004).

Some researchers (L. Tornatzky & Fleischer, 1990) point out that some characteristics will significantly affect the smooth implementation and effective adoption of technological innovation. The main analysis of the TOE framework is:

(i) *Technological context*. It mainly includes some relevant variables that will affect the adoption of innovative results by organizations or individuals (Claycomb et al., 2005; Z. Huang et al., 2008). These include innovation attributes that affect the use of innovation results (both from IDT) (Dedrick & West, 2003; Rogers, 1983). On this basis, other variables are also discussed. The results show that the important variables mainly include perceived indirect and direct benefits, system complexity, testability, and assimilation. Moreover, the influence of observability is not obvious (Carnaghan & Klassen, 2007; Hossain & Quaddus, 2011; Z. Huang et al., 2008; Jang, 2010; H. F. Lin & Lin, 2008; Musawa & Wahab, 2012; Ramdani et al., 2009; Thiesse et al., 2011; Y. M. Wang et al., 2010). The results also confirm that the "compatibility" of variables is very important in many fields, but it has no obvious role in the field of EDI and ERP. Through further analysis, the researchers find that the above

technologies are based on the Internet, which has powerful functions, so compatibility is not an important influencing factor of technology adoption (Hossain & Quaddus, 2011; Z. Huang et al., 2008; Ramdani et al., 2009; Y. M. Wang et al., 2010). In addition, "perceived cost" and "comparative advantage" will change to a certain extent with the level of significance.

(ii) *Organizational context*. It is an important descriptive measure, which mainly involves the management concept, scale, and scope of the enterprise (Salwani et al., 2009). In addition, adoption tendency will be affected by organizational resources, control mechanisms, and organizational communication (Dedrick & West, 2003). For the organizational environment, its variables mainly include organizational preparation, infrastructure, professional knowledge, knowledge accumulation, human resources, innovation support, high-level support, technical resources, technology use, operation ability, knowledgeability, innovation ability, corporate structure, and financial resources. They also point out that technical and financial capabilities would not have a significant impact (Carnaghan & Klassen, 2007; Hossain & Quaddus, 2011; Z. Huang et al., 2008; Jang, 2010; D. Lee et al., 2010; C. Y. Lin, 2009; H. F. Lin & Lin, 2008; Musawa & Wahab, 2012; Ramdani et al., 2009; Raymond & Uwizeyemungu, 2007; Y. M. Wang et al., 2010). For ERP, e-commerce, RFID, and other fields, enterprise-scale is of great importance. If it is aimed at the EDI field, its impact is relatively small (Hossain & Quaddus, 2011; Z. Huang et al., 2008; J. Li et al., 2010; C. Y. Lin, 2009; Ramdani et al., 2009; Salwani et al., 2009; Y. M. Wang et al., 2010). These studies point out that organizations of different sizes have gradually realized that technology will significantly affect the development of business. Therefore, these organizations are usually willing to invest more cost and energy in technology to continuously enhance their competitiveness. The study also find that the role of senior managers' commitment will be affected by various environmental factors (J. Li et al., 2010; Jang, 2010; Ramdani et al., 2009; Thiesse et al., 2011; Y. M. Wang et al., 2010). Some researchers have deeply analyzed inter-organizational variables based on the background of EDI (Z. Huang et al., 2008). They find that partner commitment is a key variable. In addition, dependence on partners and the exercise of partner power are considered to be unimportant variables.

(iii) *Environmental context*. In general, it mainly focuses on the industry in which the enterprise is engaged. It is particularly biased towards some external factors that affect its own industry (Salwani et al., 2009). It is found that it covers some important variables related to the basic characteristics of the industry, such as different stages in the development process of the industry (Depietro et al., 1990). In addition, the factors in the environmental background mainly include network strength, information strength, environmental uncertainty, business

dependence, internal pressure, external pressure, competitive pressure, and customer requirements. The results also show that government regulation is not an important variable (Hossain & Quaddus, 2011; Z. Huang et al., 2008; J. Li et al., 2010; Jang, 2010; H. F. Lin & Lin, 2008; Musawa & Wahab, 2012; Raymond & Uwizeyemungu, 2007; Salwani et al., 2009; Thiesse et al., 2011; Y. M. Wang et al., 2010; K. Zhu et al., 2004).

As discussed in the literature reviews, in recent years, in the field of IS, the research on the use of smart phones is a hot direction. For example, S. H. Kim (2008) comprehensively analyzes the use of smart phone wireless technology in some typical workplaces. He constructed a research model to explore the relationship in depth. The results show that user behavior will be greatly affected by perceived ease of use and perceived usefulness. In addition, user behavior will be affected by behavior intention to a certain extent. The research of Putzer and Park (2010, 2012) focuses on the important factors affecting the behavior of medical staff using smart phones. Boontarig et al. (2012) explain the situation of the elderly using smart phones to use medical services through investigation and research and explore their inner will and acceptance. In addition, Gerogiannis et al. (2012) study consumers' satisfaction with using smart phones. There are many related research reports, which are discussed from different academic angles (Aldhaban, 2012; Y. M. Kang et al., 2011; K. W. Lee et al., 2012; Liao & Hsieh, 2013; Pan et al., 2014; Verkasalo, 2011) and even repurchase behavior (Bojei et al., 2012; Leelakulthanit & Hongcharu, 2012).

It should be pointed out that although there are many relevant reports at present, there are few studies on in-depth analysis of the basic mode of users using applications (C. K. Kim et al., 2013; S. Kang, 2014; Shi, 2009). Shi (2009) find that downloading applications is an indispensable part of users' daily life. They used UTAUT to analyze the main factors affecting consumers' willingness to use applications. By analyzing the literature, we can see that the current research mainly reports convenience (2009), enjoyment (Shi, 2009), social connection (C. K. Kim et al., 2013; S. Kang, 2014), suggestions from others (S. Kang, 2014) and ease of use (S. Kang, 2014). The main purpose of these studies is to explore the factors and basic mechanisms that affect users' attitudes towards using applications.

These studies do not differentiate the application types. They usually think that there is no difference between these applications and cannot effectively distinguish different types of applications. Our research will focus on the potential motivation of those who adopt specific mobile campus service applications. On this basis, it can provide some important guidance for future work. In other words, this research work will be the first report to explore the influencing factors of users' intention to adopt mcs-Apps. In this research, a new mcs-Apps

analysis model will be proposed. Its goal is to comprehensively explain the role of technical features and the characteristics of users. The framework of the model is shown in Figure 3.1.
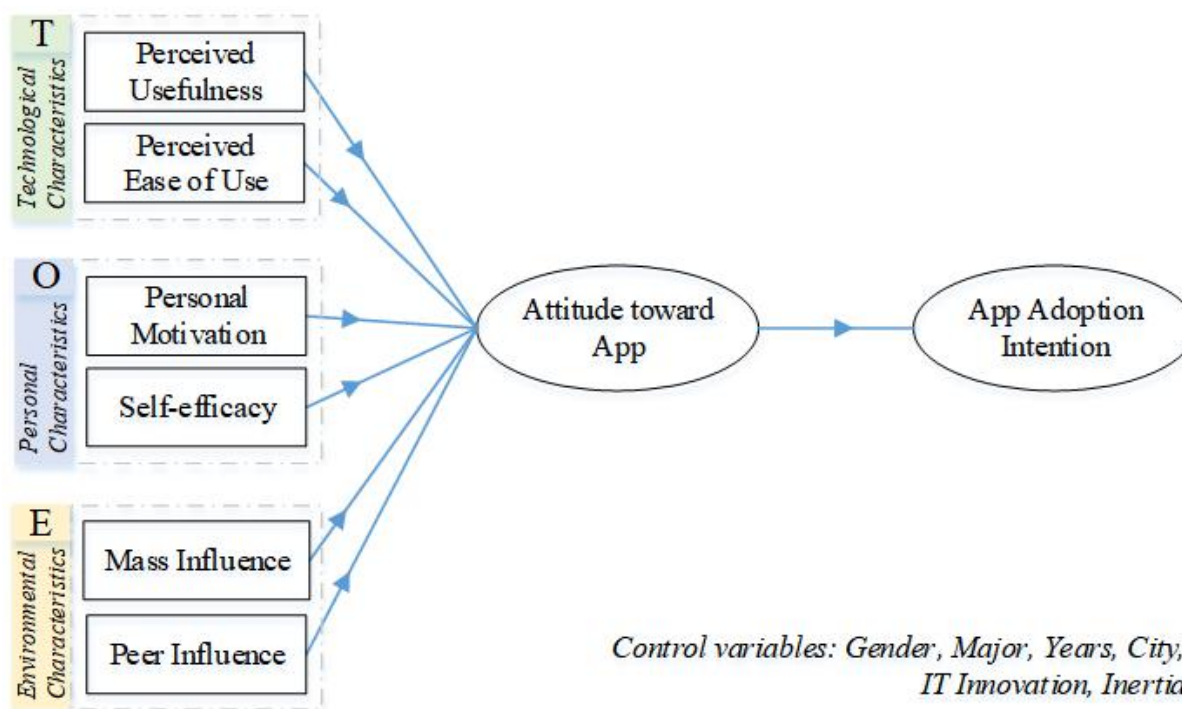


Figure 3.1 Research model A

### 3.1.2 Hypotheses

On the basis of the literature review, we fully combine the campus environmental conditions and TOE framework and propose a new research framework, which includes three aspects: environmental characteristics (peer influence and public influence), personal characteristics (self-efficacy and personal motivation), and technical characteristics (perceived ease of use and perceived usefulness).

**Technological characteristics: PU and PE**

### 3.1.2.1 Perceived usefulness

It mainly refers to the value that users can find through services and products. This indicator is an important factor used in the research of consumer use intention (e.g., Bhattacherjee, 2001) and new technology adoption and acceptance (e.g., Davis, 1989). Davis (1989) point out that consumers who believe that information systems are more important are more likely to have a good attitude and view of IS. One researcher mainly explore the behavior of users using smart phones through the technology acceptance model (abbreviated as TAM) and analyze the influence of law and mechanism of perceived usefulness on users' attitudes (Joo & Sang, 2013; V. S. Lai & Li, 2005; Park et al., 2013). It can be seen that the mobile campus

service application will have a similar impact on students and form a good use attitude. On this basis, this research puts forward the following assumptions, which are specifically described as follows:

**H1a**: Users' specific attitudes towards mcs-Apps will be positively affected by perceived usefulness.

### 3.1.2.2 Perceived ease of use

When we analyze ease of use, we can explore a person's efforts when using the system to perform specific tasks. At this point, we can assume that ease of use is an important prerequisite for usefulness. The study find that if a system is very easy to use, users will need less effort in performing this task. In fact, efforts are relatively limited resources. Therefore, if the user makes few efforts, he will be able to allocate more effort to other tasks. This will help to further improve work performance (Davis et al., 1989).

Perceived ease of use is the opposite of complexity. It is mainly used to describe the extent to which a product can be operated and correctly understood without effort by users. In other words, ease of use mainly reflects the extent to which potential consumers believe that using the product does not require much effort (Fang et al., 2017). It is often considered the expected workload required to use a product or service (J. M. Kang et al., 2015). If a product is complex, consumers need to pay more attention to learning how to operate and understand it (L. Huang & Hsieh, 2012). The results show that ease of use mainly describes consumers' perception of the ease of use of mcs-Apps. If the product is complex, it will make it difficult for consumers to understand its performance and basic functions, so it will significantly affect consumers' usage experience and evaluation results (L. Huang & Hsieh, 2012). Some researchers point out that if users can easily use the basic functions provided by the application, it will help to further enhance the perceived behavior control, so that users have a stronger sense of freedom and are more willing to participate (V. S. Lai & Li, 2005; Peters et al., 2016). A study (L. Huang & Hsieh, 2012) point out that ease of use helps to further reduce users' learning costs and make users more willing to use this product. Some research work has carried out a lot of empirical research on the relationship between user adoption and ease of use. According to the previous analysis, if users think that mcs-Apps is easy to use, they will be willing to choose this application. On this basis, this research puts forward the following assumptions:

H1b: There is a significant positive correlation between users' attitudes towards using mcs-Apps and perceived ease of use.

**Personal characteristics: PM and SE**

### 3.1.2.3  Personal motivation

Previous research results show that the user's personal characteristics are also a key factor in the process of accepting a new product or technology (L. Huang & Hsieh, 2012). Some researchers (Lian & Lin, 2008) point out that if enterprises can accurately understand the basic characteristics of potential consumers, they can achieve better results. These researchers also deeply analyze the internal relationship between optimized personal characteristics and their attitudes. On this basis, they analyze the privacy issues in the process of online shopping from different angles. Through the analysis of consumers' willingness to use the application, we can find true self-efficacy. There is a great correlation between self-efficacy and users' views on executive ability. The results show that the user's personal characteristics will be significantly affected by his internal motivation (Ryan & Deci, 2000).

In the field of psychological research, intrinsic motivation has always been regarded as an important issue worthy of in-depth exploration. It is sometimes further extended to economic interaction (Bénabou & Tirole, 2002). Sometimes it is also related to lifelong enjoyment and sources of vitality (Ryan & Deci, 2000). The study finds that if a person is driven by strong internal motivation, he will be more willing to participate in the activity. In this process, he will think that this acquisition is interesting or can make him feel satisfied (H. Lin, 2007). Some researchers point out that intrinsic motivation is an important factor affecting users' use of IT (Hsu & Lin, 2008). The research results of J. Wu and Lu (Wu & Lu, 2013) show that if a person has a clear internal motivation, they will be willing to actively engage in relevant activities to safeguard their own interests. If users' decisions (such as downloading and installing an mcs-App) can bring some happiness or satisfaction, they will form a strong internal motivation (Hsu & Lin, 2008). On this basis, this research puts forward a hypothetical condition, which is as follows:

**H2a**: The attitude of users towards mcs-Apps will be positively affected by personal motivation.

### 3.1.2.4  Self-efficacy

Some researchers have pointed out that self-efficacy is a key influencing factor of behavior change (K. K. Kim et al., 2011; Y. Wang et al., 2006), or the action needed to believe that they can perform and achieve an achievement (Bandura, 1977). In recent years, this factor has been widely used in the field of IT research. The typical ones are mobile self-efficacy (Keith et al., 2011) and computer self-efficacy (D. R. Compeau & Higgins, 1995a). It is often used to

analyze what tasks people can use their original skills to complete (Bandura, 1977). Some researchers point out (K. K. Kim et al., 2011; Y. Wang et al., 2006) that there is a positive correlation between it and users' attitudes towards it. Therefore, if users have a higher sense of self-efficacy, they will have a better view of mcs-Apps. On this basis, this research puts forward the following assumptions:

**H2b**: The attitude of users towards mcs-Apps will be positively affected by self-efficacy.

**Environmental characteristics: MI and PI**

### 3.1.2.5 Mass Influence

As for social influence, some researchers point out that it refers to people's views and suggestions on whether those important people think they want to use these new systems (AlAwadhi & Morris, 2008). At present, it is considered a prerequisite for the acceptance and application of new technology (Bhattacherjee, 2000). In this theoretical system, communication groups will be significantly affected by social culture and relevant norms (K. K. Kim et al., 2011). Some researchers point out that social influence is sometimes called "peer influence", and discuss its significance (AlAwadhi & Morris, 2008; K. K. Kim et al., 2011). The study find that it is not only related to the influence of peers but also related to the influence of some unfamiliar social members. Some researchers have pointed out that social impact includes both internal and external types (Brancheau & Wetherbe, 1990). In this research, we mainly refer to the research ideas of Brancheau and Wetherbe (1990), and consider the public influence and peer influence (they are external influence and internal influence respectively) to explore the user's attitude towards the apps.

As for mass influence, some studies point out that it is mainly composed of expert opinions, media reports, and various non-personal information (Bhattacherjee, 2000). This study mainly refers to reputation, ranking, and online comments related to applications. Real name users provide some directly related information, which has formed a certain public influence on this basis. Previous empirical research results show that they will significantly affect users' purchase decisions (F. Zhu & Zhang, 2010). Users will carefully check and analyze the reputation and ranking of mcs-Apps and then judge their quality. If the above data is good, users will form a positive attitude. On this basis, this research puts forward a hypothesis, which is as follows:

**H3a**: The attitude of users towards mcs-App will be positively affected by mass influence.

### 3.1.2.6 Peer influence

The study find that peer influence from important people will have a significant impact on the

adoption of new information systems (F. Zhu & Zhang, 2010). In some cases, it will also replace the social influence construct to some extent (AlAwadhi & Morris, 2008). According to Bhattacherjee (2000), interpersonal influence is the word-of-mouth influence from potential users' superiors, colleagues, relatives, or friends. In this way, it can be clearly distinguished from public influence. Previous studies have extensively discussed the impact of road companions on users' acceptance of new technologies and analyzed the main laws and mechanisms (AlAwadhi & Morris, 2008; K. K. Kim et al., 2011; P. Wei & Lu, 2014). In addition, some researchers have specifically discussed the use of e-medical services (Boontarig et al., 2012). On this basis, this research puts forward a hypothetical condition, which is as follows:

**H3b**: Users' attitudes towards using mcs-Apps will be positively affected by peer influence.

### 3.1.2.7 Attitude toward apps

Attitude belongs to psychological tendency. It mainly influences its own decisions through various evaluations and beliefs and makes corresponding responses or choices (Fishbein & Ajzen, 1975). Some factors such as perceived enjoyment (Van der Heijden, 2003), playfulness (Moon & Kim, 2001) and perceived usefulness (Davis, 1989) will affect users' attitudes, and then further affect their behavioral intentions. Previously, a large number of related research results showed that there is a positive correlation between intention and attitude (Bhattacherjee, 2000; K. K. Kim et al., 2011). It can be seen that users' specific attitudes towards using mcs-Apps will be positively affected by users' intention. On this basis, this research puts forward a hypothetical condition, which is as follows:

**H4:** Users' willingness to adopt mcs-Apps will be positively affected by their attitude.

### 3.1.2.8 Control variables

We add a series of control variables to the model to effectively control the possible impact of individual characteristics. These variables mainly include inertia, IT innovation, year of use, city of residence, education level, major, and gender. When selecting variables, we fully consider their possible impact. Some kinds of literature have discussed this topic before (e.g., De Oliveira et al., 2016; Dong & Saha, 1998; Fang et al., 2017; Hameed et al., 2012; Hsiao & Chen, 2016; Jung et al., 2012; Kuo et al., 2013; V. S. Lai & Li, 2005). A study (Jung et al., 2012) point out that if consumers have received a higher level of education, or consumers are relatively young, they usually have a stronger interest and awareness to use e-book readers.

In addition, some researchers (Kwon & Zmud, 1987) have discussed the internal correlation between its innovation and technology adoption. They mainly analyze the

interaction between the two and the possible results. And they explore the existing mechanism. The research work on IT innovation adoption has long been carried out in the context of organizations and individuals, and some meaningful results have been achieved (Damanpour & Schneider, 2006; V. S. Lai & Guynes, 1997; Subramanian & Nilakanta, 1996).

Islam et al. (2020) research indicates five barriers to inertia to the adoption of crowdfunding. The study find that if people believe that they can rely on current information to achieve specific goals, inertia will be a very effective way (Gulati, 1995). Previously, a study (Roos, 1999) has clearly defined this, believing that satisfaction and inertia are important factors affecting the decision. For the consumption field, consumer inertia mainly refers to the that consumers tend to spend in the same store unconsciously according to the consumption experience formed before (Gulati, 1995; Oliver, 1999; Solomon, 2007).

Later, Solomon (Solomon, 2007) point out that if consumers are driven by inertia, they usually do not make a comprehensive analysis and interpretation in the process of making purchase decisions. The analysis shows that consumers will repeatedly go to the same store to buy goods under the action of inertia. This is also very common in the field of online shopping, and many studies have discussed it. (Anderson & Srinivasan, 2003). Dong and Saha (1998) show that the same variable, say firm size, may have quite different effects on adoption inertia and intensity.

## 3.2 Research methods

### 3.2.1 Implementation context

Hangzhou Maihu company is founded in 2009 and develops an mcs-App named Weihouqin based on H5 standard and can run on all kinds of apps (eg. Wechat, Alipay, and Mini programs). The app provides several campus-service-related functions such as campus e-card, quick pay, QR code payment, pay cost, takeout, shopping, and reservation (eg. repair, venues, piano room).

This study conducts a questionnaire survey among 15 universities that have not used my company's mcs-App in China. The students in these universities come from all over the country. We put these universities in alphabetical order. These universities are Beijing Institute of Petrochemical Technology (Beijing), Chengdu College of Arts and Sciences (Chengdu, Sichuan province), Civil Aviation University of China (Tianjin), Harbin Institute of Technology (Harbin, Heilongjiang province), Hunan City University (Changsha, Hunan

province), Kunming University of Science and Technology (Kunming, Yunnan province), Qiqihar University (Qiqihar, Heilongjiang province), Shandong University of Science and Technology (Qingdao, Shandong province), Shanxi Datong University (Datong, Shanxi province), Sichuan Normal University (Chengdu, Sichuan province), Tsinghua University (Beijing), Xiamen National Accounting Institute (Xiamen, Fujian province), Zhejiang Science and Technology University (Hangzhou, Zhejiang), and Zhejiang University (Hangzhou, Zhejiang province).

### 3.2.2 Survey participants

Survey participants are attending college students from undergraduate and graduate programs from 15 Chinese universities and colleges during the academic year of 2021. These included students at junior college, undergraduate, and graduate schools (Master's and Ph.D.). Students, selected through the author's network, scan the QR code to enter the questionnaire and participate in the survey (see Annex F-1).

### 3.2.3 Instrument and measurement items

We use the Likert scale questionnaire to carry out the research work to analyze the potential variables, and then explore the internal relationship between these variables (see Table 3.1). Most measurement items use a 7-point scale to carry out comprehensive analysis and evaluation, ranging from "1- strongly disagree" to "7- strongly agree". The questionnaire mainly includes three different sections. The 1st part is the consent form. Then the second part of this questionnaire elicits respondent demographics. Moreover, the third part of this questionnaire consists of 25 questions that measured 8 variables in the research model.

In the process of measuring the direction of socio-demographic variables, we mainly complete it through a single measurement. We invited researchers proficient in Chinese and English to translate the content from the original English to the corresponding Chinese content. Then another researcher is invited to do the reverse translation. On this basis, we can make the measurement items in the two language versions have a high degree of similarity and measurement function. In this study, a total of 10 college students are invited to participate in the questionnaire survey. Four researchers engaged in management information system research are invited to judge the validity of the questionnaire. The respondents put forward their own views on the basic structure and main contents of the questionnaire. Through these opinions (Annex E.1), it can be considered that its length is reasonable. At the

same time, we also revised the wording of the expression and some vague questions to further improve the effectiveness and rationality of the questionnaire.

The questionnaire consists of three sections (see Annex C). The first part of the questionnaire is the consent form. The second part describes respondent demographics. The third part consists of 34 questions that measured 8 variables in the research model.

Table 3.1 Scale item of constructs

| Constructs | Items | Adapted from |
|---|---|---|
| IT innovation | ITI. I hope to try new information technology research results. | Agarwal & Prasad, 1998 |
| Inertia | INE. If there is a more ideal choice, I will continue to use the current system (that is, maintain the status quo). | Polites & Karahanna, 2012 |
| Perceived usefulness | PU1. In my opinion, this mcs-App is good for my campus life. PU2. In my opinion, it makes my life more relaxed and convenient. PU3. In my opinion, it improves my efficiency. | Davis, 1989; L. Wu et al., 2015 |
| Perceived ease of use | PE1. This mcs-App is easy to use. PE2. In my opinion, it is not difficult to learn its operation method. PE3. In my opinion, most college students can quickly master its use. | Davis, 1989; L. Huang & Hsieh, 2012; Jung et al., 2012; Lu et al., 2014 |
| Personal motivation | PM1. I think using this mcs-App is enjoyable. PM2. I am willing to use it. PM3. I feel very relaxed and happy when using it. | Davis et al., 1992; L. Wu et al., 2015 |
| Self-efficacy | SE1. When I use it, I need to give full play to my personal ability. SE2. When I use it, I have strong independence. SE3. I would like to be considered a leader in using this mcs-App. | Y. Wang et al., 2006; L. Wu et al., 2015 |
| Mass influence | MI1. This mcs-App's ranking is high. MI2. This mcs-App's review is good. MI3. This mcs-App's reputation is good. | Bhattacherjee, 2000; L. Wu et al., 2015 |
| Peer influence | PI1. In my friend's opinion, I need to use it. PI2. In my classmates' opinion, I need to use it. PI3. In the eyes of those who have an impact on my behavior, I need to use it. | K. K. Kim et al., 2011 |
| Attitude toward app | ATT1. In my opinion, using this mcs-App is a very good choice. ATT2. In my opinion, there is a certain reason to use it. ATT3. In my opinion, using it can bring more benefits. ATT4. In my opinion, it has some special features. | Watzdorf et al., 2010 |
| App adoption intention | INT1. I intend to use it in the next month. INT2. I expect to use it in the next month. INT3. I have planned to use it in the next month. | V. Venkatesh et al., 2003 |

Note(s): ITI: IT innovation; INE: Inertia; PU: Perceived usefulness; PE: Perceived ease of use; PM: Personal motivation; SE: Self-efficacy; MI: Mass influence; PI: Peer influence; ATT: Attitude toward App; INT: App adoption intention.

**3.2.4  Sample and data collection**

We used SPSS statistics 25.0 software to analyze the relevant samples and then obtained the main descriptive results. We also use the partial least squares structural equation model (PLS-SEM) for model analysis. It has more advantages than the CB-SEM model, mainly reflected in residual distribution, sample size, and measurement scale (Chin et al., 2003). In this model, the assumption of the normal distribution is relatively loose (Khan et al., 2019; Shiau et al., 2019; Shiau & Chau, 2016). The model includes a large number of model relationships, indicators, and constructs, so the PLS-SEM method is more effective (Gefen et al., 2011). We also conduct in-depth exploration from the perspective of prediction and maximize the variance of endogenous variables based on PLS-SEM (Gefen et al., 2011). We achieve the main goal of the research by predicting the focus. Through a comprehensive analysis, it can be seen that the current research work can be better completed by using the PLS method. Previous researchers (Anderson & Gerbing, 1988) point out that the process of data analysis mainly includes the stage of the measurement model and the stage of structural model analysis and evaluation. The former needs to analyze and evaluate the effectiveness and reliability, while the latter comprehensively tests the relevant assumptions on the basis of checking the structural relationship.

We used an online survey to obtain the required empirical data. This method has more obvious advantages than the previous research survey methods. These advantages are mainly reflected in geographical boundaries, cost-effectiveness, and response time (Bhattacherjee, 2001, 2001; Tan & Teo, 2000). We further confirmed the validity of the questionnaire through pilot testing, and also judged its task relevance, comprehensibility, and logicality. In the pilot test process, a total of 31 respondents. None of them have experience using the app.

In this study, there are 31 subjects in the pilot test, 25 male and 6 female subjects respectively. The proportions of the two sexes are 80.6% and 19.4% respectively. In the process of the pilot test, the load of the correlation factor is not less than 0.5 (Wixom & Watson, 2001). At the same time, we find that the alpha value of Cronbach ranges from 0.929 to 0.986. In addition, the range of comprehensive reliability is 0.955 - 0.990. We also use average variance extraction (abbreviated as AVE) to analyze the convergence validity of judgment constructs. The value of the construction in this research is 0.875 - 0.970, which is higher than 0.5. Through the pilot test, we can effectively ensure the required reliability and validity.

## 3.3 Data analysis and results

### 3.3.1 Data examination

In 2021, the questionnaire is published online. Through five months of collection, we have obtained a total of 1340 responses from Wenjuanxing (A online survey platform). We eliminate the data that did not meet the invitation and retained 1203 valid results. For data screening, we apply the following criteria and exclude the cases where:

(1) The answer duration time is less than 160 seconds (it takes about 2 minutes and 40 seconds to answer the questionnaire).

(2) Respondent claims to have more than 10 years of app usage. (App has been popular among the general public for ten years in China.)

(3) Respondent submits 20 or more same answers out of the 25 measurement items in the questionnaire.

### 3.3.2 Descriptive statistics

Table 3.2 and Figure 3.2 report the demographic statistics of our survey respondents. Among the total 1203 participants, 721 are male (59.9%) and 482 are female (40.1%). The majority of the respondents are undergraduate students (892, 74.1%). According to Weiciyun (A word cloud web generator), the top 5 majors of the respondents are computer science and technology, mechanical engineering, intelligent science and technology, metallurgical engineering, and network engineering (see Annex G-1). The respondents' background includes junior college (1, 0.1%), undergraduate (892, 74.1%), graduate school (master program) (251, 20.9%), and graduate school (doctoral program) (59, 4.9%). The respondents are from 304 cities of residence (illustrated in Figure 3.2). Also of 1,203 respondents, 1,164 (96.8%) respondents have used at least one mcs-App before.

Table 3.2 Demographics information (N = 1,203)

| Measure | Items | Frequency | Percentage(%) |
|---|---|---|---|
| Gender | Male | 721 | 59.9 |
| | Female | 482 | 40.1 |
| Education | Junior college | 1 | 0.1 |
| | Undergraduate | 892 | 74.1 |
| | Graduate school (Master) | 251 | 20.9 |
| | Graduate school (PhD) | 59 | 4.9 |
| City of residence | N/A | 304 | N/A |
| Used? | Yes | 1,164 | 96.8 |

| | No | | 39 | 3.2 |

Note. Used?: Have you used any mcs-Apps before (such as WeChat, Alipay, Campushoy, Wanmei, and eCampus)?
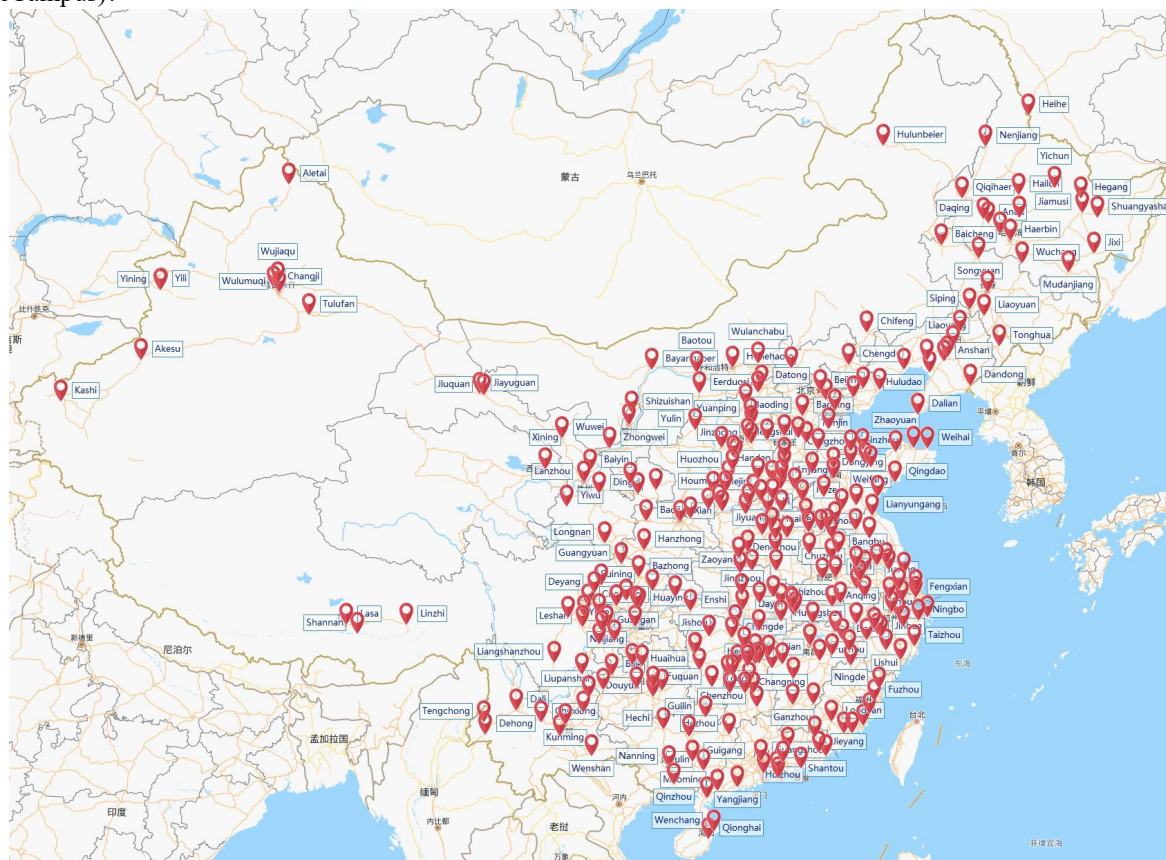


Figure 3.2 Illustration A of respondent's city of residence

Of the 1,203 respondents, Years of usage (M = 3.49, SD = 1.980), IT Innovation (M = 5.711, SD = 1.297), and Inertia (M = 4.303, SD = 1.637). In this study, we calculated some indicators by SmartPLS 3.3, including the skewness, kurtosis, standard deviation, maximum, minimum, median, and mean of each indicator. The calculation results have been indicated in Table 3.3.

Table 3.3 Descriptive statistics of indicators (N=1,203)

| | Mean | Median | Min | Max | Std. | Kurtosis | Skewness |
|---|---|---|---|---|---|---|---|
| Year of usage | 3.490 | 3 | 0 | 10 | 1.980 | 0.509 | 0.649 |
| IT innovation | 5.711 | 6 | 1 | 7 | 1.297 | 1.612 | -1.171 |
| Inertia | 4.303 | 4 | 1 | 7 | 1.637 | -0.752 | -0.152 |
| PU1 | 5.688 | 6 | 1 | 7 | 1.231 | 1.050 | -1.003 |
| PU2 | 5.589 | 6 | 1 | 7 | 1.213 | 1.137 | -0.958 |
| PU3 | 5.504 | 6 | 1 | 7 | 1.271 | 0.961 | -0.922 |
| PE1 | 5.596 | 6 | 1 | 7 | 1.157 | 1.345 | -0.967 |
| PE2 | 5.767 | 6 | 1 | 7 | 1.160 | 1.318 | -1.074 |
| PE3 | 5.766 | 6 | 1 | 7 | 1.195 | 1.416 | -1.112 |
| PM1 | 4.836 | 5 | 1 | 7 | 1.395 | 0.133 | -0.472 |
| PM2 | 4.947 | 5 | 1 | 7 | 1.380 | 0.294 | -0.661 |
| PM3 | 5.024 | 5 | 1 | 7 | 1.355 | 0.339 | -0.594 |

| | | | | | | | |
|-----|-------|---|---|---|-------|--------|--------|
| SE1 | 5.362 | 6 | 1 | 7 | 1.262 | 0.333 | -0.677 |
| SE2 | 4.938 | 5 | 1 | 7 | 1.308 | 0.172 | -0.442 |
| SE3 | 4.574 | 5 | 1 | 7 | 1.554 | -0.389 | -0.375 |
| MI1 | 5.290 | 6 | 1 | 7 | 1.274 | 0.848 | -0.835 |
| MI2 | 5.257 | 5 | 1 | 7 | 1.234 | 0.650 | -0.673 |
| MI3 | 5.307 | 5 | 1 | 7 | 1.243 | 0.720 | -0.726 |
| PI1 | 4.953 | 5 | 1 | 7 | 1.380 | 0.337 | -0.642 |
| PI2 | 4.929 | 5 | 1 | 7 | 1.389 | 0.308 | -0.639 |
| PI3 | 5.036 | 5 | 1 | 7 | 1.387 | 0.292 | -0.648 |
| ATT1 | 5.501 | 6 | 1 | 7 | 1.211 | 1.350 | -0.956 |
| ATT2 | 5.470 | 6 | 1 | 7 | 1.185 | 0.954 | -0.832 |
| ATT3 | 5.560 | 6 | 1 | 7 | 1.217 | 1.664 | -1.089 |
| ATT4 | 5.057 | 5 | 1 | 7 | 1.378 | 0.050 | -0.560 |
| INT1 | 4.940 | 5 | 1 | 7 | 1.468 | 0.198 | -0.718 |
| INT2 | 4.909 | 5 | 1 | 7 | 1.484 | 0.128 | -0.702 |
| INT3 | 4.833 | 5 | 1 | 7 | 1.540 | -0.030 | -0.653 |

Note(s): PU: Perceived usefulness; PE: Perceived ease of use; PM: Personal motivation; SE: Self-efficacy; MI: Mass influence; PI: Peer influence; ATT: Attitude toward App; INT: App adoption intention.

### 3.3.3 Non-response bias

It refers to the influence and bias of those who do not answer the questions related to the questionnaire on the final results. In this study, the non-reply method mainly adopts the relevant procedures proposed by Armstrong and Overton (1977). Specifically, respondents who are late are usually similar to those who do not reply. They are not similar to people who have been interviewed before. All samples are sorted in strict accordance with the order of response time. The top and bottom 25% samples will be analyzed and tested by SPSS 25 (1977). According to the data obtained, there is no significant difference between education level and gender ($P > 0.05$). Therefore, in the current research, non-response bias will not have a great impact (Garrison & Arbaugh, 2007).

### 3.3.4 Common method bias

The study find that if all the data have the same source, there will be a common method deviation, which will eventually affect the effectiveness of the results. In this study, the questionnaire survey results are mainly collected online, so there is no problem that the samples only come from a specific group or region. However, the single factor test method proposed by Harman is used to effectively identify possible common method deviations (Podsakoff & Organ, 1986). Some researchers have pointed out that if the proportion of a single factor in the variance exceeds 50%, there will be a relatively large impact from the common method deviation (Mattila & Enz, 2002). We conduct a comprehensive principal

component factor analysis and find that the sum of the four factors accounted for 64.916% of the total variance. In addition, the proportion of the first factor is 45.019%, and no common factor accounts for more than 50% of the variance (shown in Table 3.4). This research also analyzes the deviation by labeling variables (Chin et al., 2012). The results show that the indicators we focus on (including self-efficacy, personal motivation, perceived ease of use and perceived usefulness, etc.) will not be greatly affected. On this basis, we believe that the common method deviation is not an important issue.

Table 3.4 Total variance explained

| Component | Initial eigenvalues | | |
| --- | --- | --- | --- |
| | Total | % of Variance | Cumulative % |
| 1 | 11.255 | 45.019 | 45.019 |
| 2 | 2.117 | 8.469 | 53.488 |
| 3 | 1.475 | 5.901 | 59.389 |
| 4 | 1.382 | 5.527 | 64.916 |
| 5 | 1.045 | 4.179 | 69.095 |

Extraction method: principal component analysis.

### 3.3.5 Measurement model

We also comprehensively evaluate discriminant validity, convergent validity, and reliability to objectively judge the measurement model. In this study, we used Cronbach's alpha coefficient and the composite reliability proposed by Jöreskog (1971) to reasonably evaluate the reliability of internal consistency. The results show that the range of Cronbach's alpha coefficient is 0.890 - 0.940, and the range of composite reliability value is 0.925 - 0.958. On this basis, we use the structural AVE to further evaluate the convergence validity. According to the data shown in Table 3.5, all factor loads are higher than 0.5 (Wixom & Watson, 2001). Since the AVE values of all constructs are not less than 0.5, they can explain more than 50% of the variance (Chin et al., 2003).

Table 3.5 Scale properties of the measurement model A

| Construct | Item | Standardized item loading | Item mean | Standard deviation | T-statistics | Cronbach's alpha | Composite reliability | AVE |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Perceived usefulness | PU1 | 0.891 | 0.890 | 0.010 | 87.621 | 0.874 | 0.923 | 0.799 |
| | PU2 | 0.903 | 0.902 | 0.007 | 122.038 | | | |
| | PU3 | 0.888 | 0.888 | 0.009 | 100.283 | | | |
| Perceived ease of use | PE1 | 0.853 | 0.853 | 0.012 | 68.347 | 0.809 | 0.886 | 0.722 |
| | PE2 | 0.853 | 0.853 | 0.013 | 63.641 | | | |
| | PE3 | 0.843 | 0.842 | 0.015 | 55.202 | | | |
| Personal motivation | PM1 | 0.912 | 0.911 | 0.007 | 139.692 | 0.901 | 0.938 | 0.835 |
| | PM2 | 0.922 | 0.922 | 0.006 | 163.502 | | | |
| | PM3 | 0.908 | 0.907 | 0.007 | 122.695 | | | |
| Self-efficacy | SE1 | 0.805 | 0.804 | 0.017 | 48.782 | 0.769 | 0.867 | 0.684 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SE2 | 0.866 | 0.866 | 0.010 | 89.409 | | | |
| | SE3 | 0.809 | 0.809 | 0.014 | 58.875 | | | |
| Mass influence | MI1 | 0.878 | 0.878 | 0.010 | 88.749 | 0.873 | 0.922 | 0.798 |
| | MI2 | 0.902 | 0.902 | 0.007 | 121.769 | | | |
| | MI3 | 0.899 | 0.898 | 0.008 | 109.450 | | | |
| Peer influence | PI1 | 0.924 | 0.924 | 0.006 | 151.276 | 0.896 | 0.935 | 0.828 |
| | PI2 | 0.917 | 0.917 | 0.007 | 132.048 | | | |
| | PI3 | 0.888 | 0.888 | 0.009 | 93.592 | | | |
| Attitude toward App | ATT1 | 0.862 | 0.862 | 0.012 | 70.742 | 0.871 | 0.912 | 0.723 |
| | ATT2 | 0.886 | 0.886 | 0.009 | 98.963 | | | |
| | ATT3 | 0.876 | 0.876 | 0.010 | 85.423 | | | |
| | ATT4 | 0.772 | 0.772 | 0.015 | 50.493 | | | |
| App adoption intention | INT1 | 0.923 | 0.923 | 0.006 | 149.899 | 0.914 | 0.946 | 0.853 |
| | INT2 | 0.927 | 0.926 | 0.007 | 127.118 | | | |
| | INT3 | 0.921 | 0.921 | 0.007 | 125.759 | | | |

Note. AVE - average variance extracted.

We also study the correlation ratio between heterotrait-monotrait (HTMT) and Fornell-Larker to objectively evaluate the discriminant validity of the analysis. According to the data in Table 3.6 of this research, the correlation between the two constructs does not exceed the value of the square root of AVE of a construct itself (Fornell & Larcker, 1981; Hair et al., 2011, 2017). Based on these data, we can confirm the discriminant validity of the model.

Table 3.6 Discriminant validity: Fornell-Larcker criterion

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Perceived usefulness | 0.894 | | | | | | | |
| 2. Perceived ease of use | 0.643 | 0.850 | | | | | | |
| 3. Personal motivation | 0.546 | 0.461 | 0.914 | | | | | |
| 4. Self-efficacy | 0.463 | 0.457 | 0.637 | 0.827 | | | | |
| 5. Mass influence | 0.482 | 0.469 | 0.560 | 0.514 | 0.893 | | | |
| 6. Peer influence | 0.389 | 0.347 | 0.496 | 0.497 | 0.571 | 0.910 | | |
| 7. Attitude toward apps | 0.599 | 0.538 | 0.627 | 0.581 | 0.675 | 0.605 | 0.850 | |
| 8. App adoption intention | 0.384 | 0.348 | 0.460 | 0.448 | 0.446 | 0.497 | 0.546 | 0.923 |

Henseler, Ringle, & Sarstedt (2015) first propose the heterotrait-monotrait ratio (HTMT) for in-depth research (Voorhees et al., 2016). Its threshold needs to fully consider the specific background (Franke & Sarstedt, 2019). Some researchers (Henseler et al., 2015) believe that a structural model with construct should adopt 0.90 as its threshold. For the current study, the value is 0.400-0.744, which means that the constructs in the model have established the required discriminant validity. Please refer to Table 3.7 for specific information.

Table 3.7 Discriminant validity: Heterotrsait - monotrait (HTMT)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. Perceived usefulness | | | | | | | |
| 2. Perceived ease of use | 0.757 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3. Personal motivation | 0.615 | 0.529 | | | | | |
| 4. Self-efficacy | 0.562 | 0.571 | 0.767 | | | | |
| 5. Mass influence | 0.551 | 0.552 | 0.632 | 0.627 | | | |
| 6. Peer influence | 0.440 | 0.406 | 0.552 | 0.601 | 0.646 | | |
| 7. Attitude toward apps | 0.685 | 0.634 | 0.709 | 0.711 | 0.774 | 0.686 | |
| 8. App adoption intention | 0.429 | 0.400 | 0.506 | 0.535 | 0.500 | 0.549 | 0.613 |

### 3.3.6 Structural model

#### 3.3.6.1 Model fit measures

Henseler et al. (2014) assess the efficacy of the standardized root mean square residual (SRMR), a model fit measure. The SRMR is defined as the root mean square discrepancy between the observed correlations and the model-implied correlations. A value less than 0.08 is generally considered a good fit (L. Hu & Bentler, 1998). We use the root mean square residual covariance (RMS$_{theta}$), which follows the same logic as SRMR but relies on covariances. The criterion is introduced by Lohmöller (1989) but has not been explored by PLS-SEM researchers until recently. Initial simulation results suggest a (conservative) threshold value for RMS$_{theta}$ of 0.12. That is, RMS$_{theta}$ values below 0.12 indicate a well-fitting model, whereas higher values indicate a lack of fit (1989). The SRMR (RMS$_{theta}$) value 0.041 (0.126) indicates a good fit for our structural model.

#### 3.3.6.2 Collinearity assessment

Before we evaluate and analyze the structural relationship, we should carefully check the collinearity to avoid significant deviation in the regression results. Some researchers believe that the variance inflation factor (VIF) value close to 5 or less should be used (Hair et al., 2011). In the current work, the obtained VIF value does not exceed 5. Therefore, collinearity is not a key issue.

Table 3.8 Variance inflation factor (VIF) values

| Construct | Item | Outer VIF | Inner VIF | |
|---|---|---|---|---|
| | | | Attitude toward apps | App adoption intention |
| Perceived usefulness | PU1 | 2.284 | 2.011 | |
| | PU2 | 2.530 | | |
| | PU3 | 2.287 | | |
| Perceived ease of use | PE1 | 1.622 | 1.857 | |
| | PE2 | 1.898 | | |
| | PE3 | 1.843 | | |
| Personal motivation | PM1 | 2.800 | 2.127 | |
| | PM2 | 3.167 | | |
| | PM3 | 2.643 | | |

| | | | | |
|---|---|---|---|---|
| Self-efficacy | SE1 | 1.463 | 1.922 | |
| | SE2 | 1.827 | | |
| | SE3 | 1.593 | | |
| Mass influence | MI1 | 2.119 | 1.902 | |
| | MI2 | 2.506 | | |
| | MI3 | 2.486 | | |
| Peer influence | PI1 | 3.262 | 1.656 | |
| | PI2 | 3.078 | | |
| | PI3 | 2.282 | | |
| Attitude toward apps | ATT1 | 2.336 | | 1.190 |
| | ATT2 | 2.672 | | |
| | ATT3 | 2.592 | | |
| | ATT4 | 1.620 | | |
| App adoption intention | INT1 | 3.049 | | |
| | INT2 | 3.268 | | |
| | INT3 | 3.152 | | |

### 3.3.6.3 Structural model path coefficients

In this study, we used a total of 5000 subsamples to comprehensively examine the structural model to test the hypothesis. In this process, we should clarify the relevance and importance of all hypothetical paths. In addition, we should also obtain the explained variance. The important results obtained are listed in Figure 3.3.
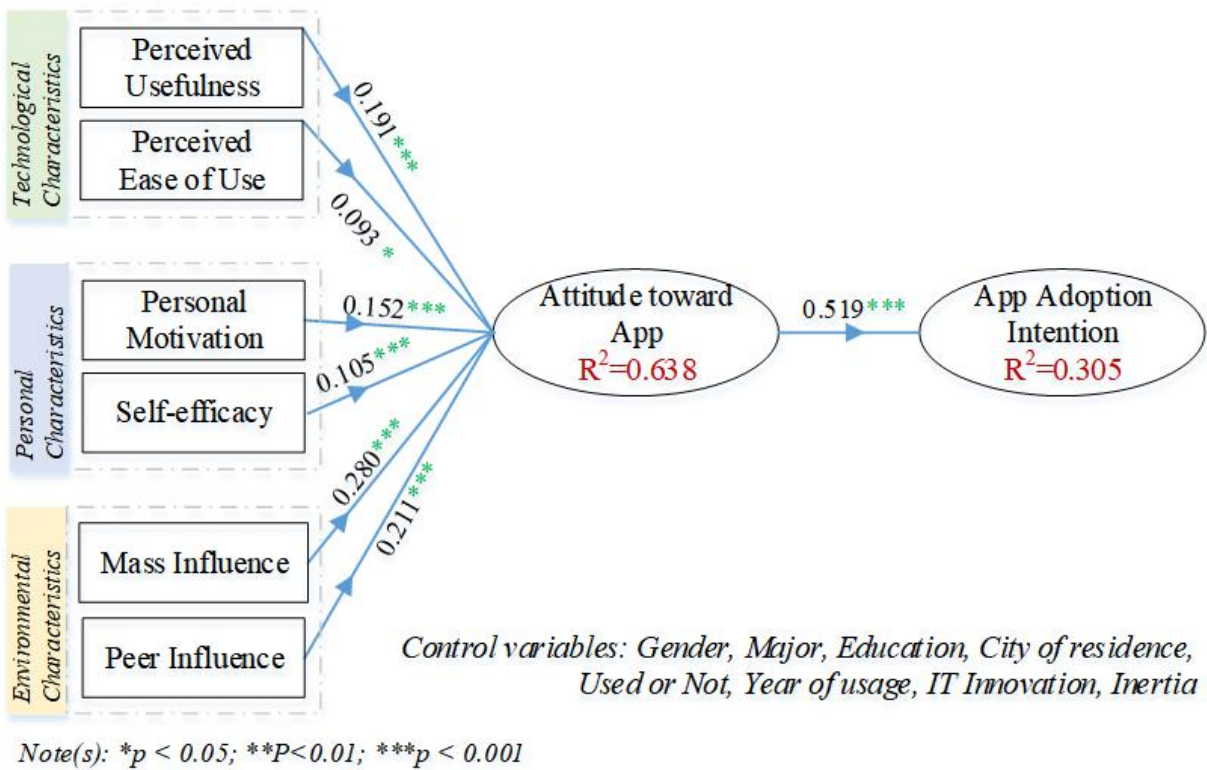


Figure 3.3 The structural model A

The analysis shows that PI (t = 7.101,P ath coefficient = 0.211, p < 0.001) , MI (t = 7.925, Path coefficient = 0.280, p < 0.001), SE (t = 3.769, Path coefficient = 0.105, p < 0.001) , PM

(t = 4.755, Path coefficient = 0.152, p < 0.001) , PE (t = 3.157, Path coefficient = 0.093, p < 0.05) and PU (t = 6.530, Path coefficient = 0.191, p < 0.001) have a positive relationship with ATT. Moreover, ATT has a positive relationship with INT (t = 16.560, Path Coefficient = 0.519, p < 0.001). In other words, the hypotheses proposed in this research can be fully supported by the research data.

Table 3.9 Summary of hypothesis results

| No. | Hypothetical Relationships | Results |
|-----|---------------------------|---------|
| H1a | Perceived Usefulness → Attitude toward App (+) | Supported |
| H1b | Perceived Ease of Use → Attitude toward App (+) | Supported |
| H2a | Personal Motivation → Attitude toward App (+) | Supported |
| H2b | Self-efficacy → Attitude toward App (+) | Supported |
| H3a | Mass Influence → Attitude toward App (+) | Supported |
| H3b | Peer Influence → Attitude toward App (+) | Supported |
| H4 | Attitude toward App → App Adoption Intention (+) | Supported |

### 3.3.6.4 Coefficient of determination ($R^2$)

In this research model, 30.5% willingness variance and 63.8% attitude variance are effectively explained (refer to Table 3.10 in this research for specific data). Therefore, if the value is relatively large, it means that the structural model has better prediction ability. Some researchers (Hair et al., 2011) believe that if its value is around 0.67, it is substantive. Its average value is about 0.33. If the value does not reach 0.19, it means that it is relatively weak.

Table 3.10 The coefficient of determination

| Variable | Coefficients | Remarks |
|----------|-------------|---------|
| Attitude toward apps | 0.638 | substantial |
| App adoption intention | 0.305 | moderate |

### 3.3.6.5 Blindfolding relevance $Q^2$

Generally, we can use Stone-Geisser ($Q^2$) to analyze the prediction correlation and effectively evaluate the prediction ability of the analysis model (Hair et al., 2011). It will use the missing distance of 5-10 in PLS to complete the estimation process (Hair et al., 2011). These researchers (Hair et al., 2011) also find that a reasonable omission distance should be used to better analyze and observe. The analysis shows that the omission distance of 7 should be adopted, and the main reason is that it will not lead to the phenomenon of an integer value in the model estimation. They also find that if $Q^2$ exceeds 0, it means that there is a significant predictive correlation between endogenous construct and exogenous construct (Hair et al., 2011). The $Q^2$ values obtained in this research exceed 0. We can judge that all exogenous constructs have a good predictive correlation (see Annex A, Table 3.12).

### 3.3.7 Control variables

From Table 3.11, it is a confirmed hypothesis that Inertia ( β = -0.026, T=1.96, p<0.05) has a positive impact on app adoption intention and it is significant. They are confirmed hypotheses that year of usage ( β = 0.021, T=0.803, p＞0.05) and IT innovation ( β =0.047, T=1.665, p>0.05) have a positive impact on app adoption intention, but they are not significant. They are confirmed hypotheses that gender ( β =0.023, T=0.971, p>0.05), education ( β =0.032, T=1.138, p>0.05), and used ( β =0.013, T=0.592, p>0.05) negatively affect App Adoption Intention and they are not significant.

Table 3.11 Control variable analysis result

|  | β | T-value | Significance |
| --- | --- | --- | --- |
| Gender → App adoption intention | -0.023 | 0.971 | NS |
| Education → App adoption intention | -0.032 | 1.138 | NS |
| Used → App adoption intention | -0.013 | 0.592 | NS |
| Year of usage → App adoption intention | 0.021 | 0.803 | NS |
| IT Innovation → App adoption intention | 0.047 | 1.665 | NS |
| Inertia → App adoption intention | 0.051 | 1.967 | * |

Note(s): Std β = Coefficient of determination; *p < 0.05; **P<0.01; ***p < 0.001; NS = Not Significant.

## 3.4 Chapter summary

In this chapter, we research factors facilitating Chinese college students to adopt mobile campus service Apps. The research model of this research is shown in Figure 3.1. In the hypothesis section, we have comprehensively introduced the relationship between various constructs. Among them, the dependent variable and intermediary variables are application adoption intention (i.e., INT) and attitude towards application (i.e., ATT). In addition, the independent variables of the model mainly include peer influence (i.e., PI), mass influence (i.e., MI), self-efficacy (i.e., SE), personal motivation (i.e., PM), perceived ease of use (i.e., PE), and perceived usefulness (i.e., PU). The control variables mainly include gender, educational level, major, inertia, IT innovation, year of use, use or not, and city of residence.

Before comprehensive data collection, we need to determine the required indicators and measurement models in combination with the specific conditions of the model. Latent Variables PU (3 indicators), PE (3 indicators), PM (3 indicators), SE (3 indicators), MI (3 indicators), PI (3 indicators), ATT (4 indicators), and INT (3 indicators) are specified. The control variables are measured with single-item measures. We establish the PLS path model by using reflective constructs as target constructs of the research model.

Next, we collect data by conducting a questionnaire survey among 15 Chinese universities. Then we examine the primary issues of the data including outliers, suspicious response patterns and missing data (Hair et al., 2017; X. Y. Zhong et al., 2021).

Fourth, we apply the PLS-SEM algorithms (PLS algorithm, Bootstrapping, and Blindfolding) to estimate the model with the SmartPLS 3.3 software.

We mainly use the reflex measurement model to reasonably analyze the validity and reliability. In the process of evaluating the correlation results of PLS-SEM, we comprehensively analyze the correlation and importance of the coefficient. On this basis, we analyze its significance through the p value, t value, and application of the boot program. In this study, the endogenous construct of the structural model is analyzed by the $R^2$ value to understand its explanatory variance. In addition, we also analyze the predictive correlation (i.e., $Q^2$ value) of the path model through the blindfolding program. Control variables are tested in the final stage.

# Chapter 4:  App Engagement

## 4.1  Research model and hypotheses

### 4.1.1  Research model

In the past period, the continuous development and popularization of mobile technology have had a significant impact on the whole education industry. Contemporary college students cannot live without all kinds of mobile devices. Previous research data show that consumers' loyalty to products will be greatly affected by sales and word-of-mouth (Cheung et al., 2015; Kuo et al., 2013; Oh et al., 2017; Ray et al., 2014; Y. H. Kim et al., 2013). In order to achieve system success, a very important condition is user engagement (Hwang & Thorn, 1999; Peters et al., 2016; Verhagen et al., 2015).

We have realized that it is of great significance, but there is no in-depth study on the participation of users in using mobile campus service applications (mcs-App). Therefore, further research in this field is very necessary. Accordingly, we need to further explore the basic mechanism and behavior characteristics. Engagement is defined as continuance usage and involvement after the initial use, including two actions to interact with the app and use of the app. "Use" and "Interact" are continuous (shown in Figure 2-1).

Some researchers have explained the problems of consumer participation before, but there is no unified view on the antecedents. At present, some researchers mainly discuss the characteristics of consumers' participation behavior in a mobile environment and try to explain it (eg. Fang et al., 2017). Moreover, some researchers have reported that product attributes will play an important role in promoting consumer participation (Chou & Conley, 2009; Peters et al., 2016), but there are few reports on in-depth analysis from the perspective of product attributes. Sometimes, customer participation is regarded as a phenomenon existing in a certain context, that is, it is affected by the actual situation (Brodie et al., 2011; Peters et al., 2016), accordingly, when exploring this research, we should deeply explore the specific phenomenon of customer engagement in combination with the mobile environment. Without an in-depth understanding of the basic attributes of applications or their stimulating effects on user participation, we will not be able to fully explore the participation behavior of mobile applications. Only by forming a systematic understanding of this, can the application be

successfully developed and recognized by the majority of students, so as to improve the effectiveness of the application (eg. identity authentication, access to information, resource acquisition, study assistance, and mobile payment). Based on the analysis of the above problems, this study intends to explore the following research question:

**RQ:** How does mcs-App attribute affect students' behavioral participation intention? What is its specific form?

Given this problem, we should fully realize that it may be inappropriate to explore participation behavior by using the technology participation model (eg. TAM, TPB, and UTAUT). Through in-depth analysis, it can be found that the model cannot effectively provide the theoretical basis for treating application attributes as external stimuli. Therefore, we need to make a reasonable choice of models for the above problems. A very important point is that for these models, their dependent variables are not behavioral manifestations of engagement. They take personal use behavior as the dependent variable (Fang et al., 2017). The stimulus-organism-response (S-O-R) model (Mehrabian & Russell, 1974), in fact, it fully provides a more reasonable theoretical system, so that we can more clearly understand the concepts related to application properties, and deeply grasp the driving mechanism of user behavior participation. Based on the S-O-R model, through in-depth analysis, we find that the product attributes (i.e. stimulation) of mcs-App will have a certain impact on users' internal participation (i.e. organism), and then have a greater impact on users' behavioral participation intention. If application properties are identified as important external stimuli, it will lead to behavioral participation intention. The framework is verified by the UAT test of mobile mcs-App (Hughes, 2016).

User participation is significantly affected by the perceived characteristics of products (Chou & Conley, 2009; Peters et al., 2016). Through the S-O-R model, we can find that cognitive and emotional responses will be greatly affected by environmental stimuli. It usually involves evaluation, experience, and perception. On this basis, some specific psychological responses will appear (Mehrabian & Russell, 1974). For e-commerce systems and information systems, a series of empirical research results based on the S-O-R model shows that if there are sufficient attributes to support users to participate in the interaction, it will bring great stimulation. These aspects include interactivity, navigability, and security. At the same time, it also involves internal reactions and some related behaviors, including customer loyalty and purchase intention (Amirpur & Benlian, 2015; Parboteeah et al., 2009; X. Chen et al., 2017). According to a series of studies, it can be found that the model is mainly applicable to regard product attributes as an important factor affecting user response. The

mcs-App has a high similarity with ordinary commercial websites, and they all have a variety of attributes. It should be pointed out that the combination formed by various product attributes will have a certain impact on users' participation behavior. Peters et al. (2016) hold the above view. Their research find that the use process and effect of mobile BI will be affected by the quality attributes of business intelligence (BI) software., This is supported by other researchers (2016). They point out that for new online games, game customization is one of the product features. It can produce a good consumption experience and obtain more obvious customer behavior participation on this basis. In other words, by using this model, we can provide efficient and fast guidance, then gradually establish the integration model, and clearly show the impact of the interaction between users and mcs-App on behavior participation.

We use S-O-R model to analyze and find that stimulus is an important contextual cue in the external region of an individual. In addition, they will effectively attract attention and have different forms of expression. At present, the main view is that website quality is a key environmental stimulus, which will have a great impact on personal psychological response. Parboteeah's team (Parboteeah et al., 2009) conduct a more in-depth study on this and find that emotion-related attributes will have a certain impact on perceived usefulness, and then make shoppers (O) have a strong purchase impulse (R). The emotion-related attributes mentioned above include the visual impact, shopping atmosphere, guidance, amount of information, and security of the website. Chinese researchers (H. Zhang et al., 2014) have modeled the main technical attributes of social commerce. The factors they studied included perceived sociality, personalization, and interactivity, and then carried out a comprehensive analysis and evaluation. Using this model, they explore the possible stimulus (S) and analyze the main impact on purchase intention (R). Some researchers (Fang et al., 2017) mainly conduct Modeling Research on application attributes. The properties they studied mainly include the basic performance and design of applications, which are regarded as important stimuli for benefit evaluation and experience (S). On this basis, they conduct an in-depth exploration and believed that they would have a certain impact on behavioral participation intention (R). This result has important guiding significance for practical application. On the basis of fully referring to the previous reports, this study mainly further operationalizes the design attributes that can reflect the performance attributes and structural quality of the application and then uses the function capture of mcs-App as an important environmental stimulus that leads to users' cognitive response and emotion (i.e., affective involvement and cognitive involvement) (Organism). In this process, cognitive participation and emotional

participation have a very close interaction, resulting in participation intention (i.e., Response). Some researchers (Amirpur & Benlian, 2015; Charfi, 2014; Ilie & Thompson, 2011; L. C. Wang et al., 2007) have carried out a lot of research on this and provided a rich theoretical basis for sequence relationship. Relevant models can be seen in Figure 4.1. In this framework, the internal relations between different constructs are shown in detail.
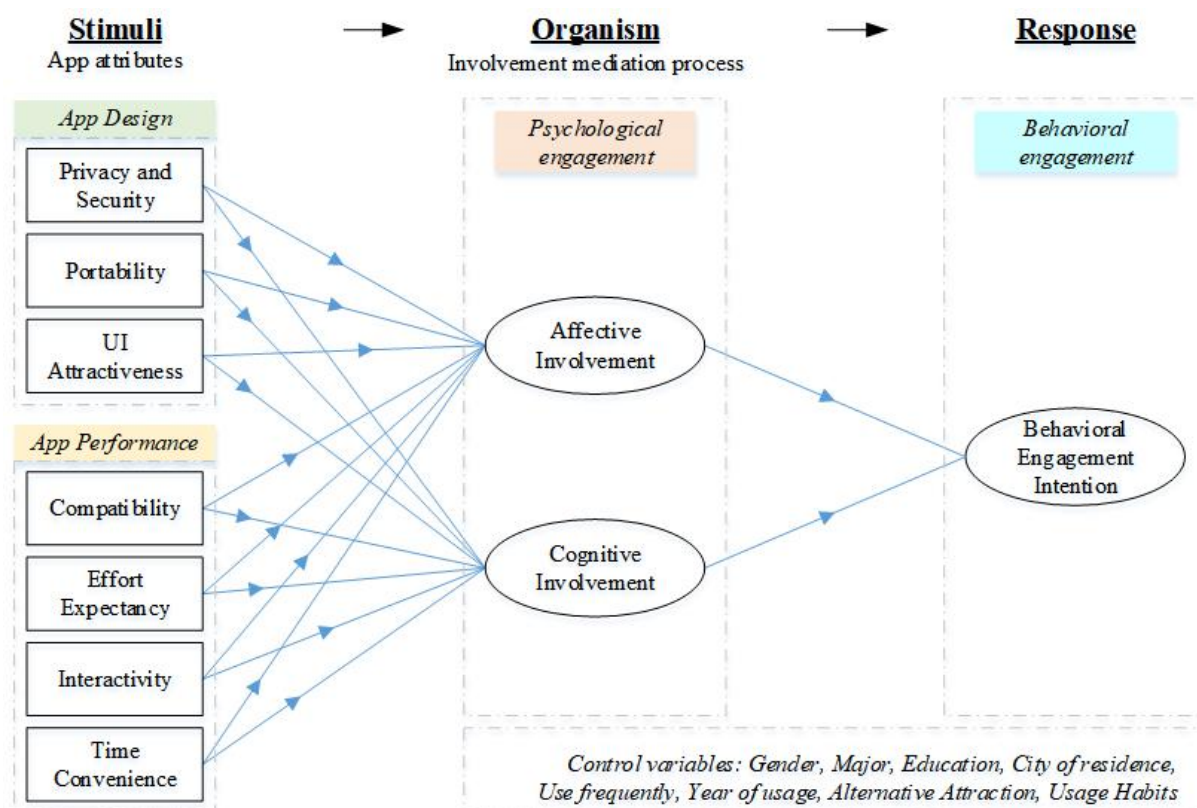


Figure 4.1 Research model B

## 4.1.2 Hypotheses

### 4.1.2.1 User engagement

In recent years, the concept of engagement has been in a large number of fields, which has attracted extensive attention from researchers (Fang et al., 2017). In the view of many scholars, consumer participation will be affected by a series of factors, including sales volume, word-of-mouth, satisfaction, and loyalty (Cheung et al., 2015; Oh et al., 2017; Y. H. Kim et al., 2013). It should be noted that there are still different views on the term "engagement" in many aspects. In addition, the basic definition of customer participation is still unclear and even contradictory (Cheung et al., 2015). However, there are still researchers on different aspects of customer participation (Cheung et al., 2015), including motivational psychological state (Pagani & Mirabello, 2011; Peters et al., 2016; Ray et al., 2014; Schaufeli et al., 2002) and the

behavioral manifestation (Van Doorn et al., 2010), and psychological process (Bowden, 2009).

In terms of the psychological process, participation is usually regarded as an important psychological development process to generate loyalty and customer return (Bowden, 2009). Accordingly, we can regard the psychological process as the close integration of behavior and psychology. Because user participation is very complex and broad, people usually think that its multidimensional view can effectively capture the internal meaning (Cheung et al., 2015; Verhagen et al., 2015). In our research model, we comprehensively consider two aspects: behavioral participation and psychological participation, in which the former mainly represents behavioral performance and the latter mainly represents a psychological state. On this basis, we can further explore the main role and significance of user participation in mcs-Apps. Schaufeli et al. (2002) do a lot of work in this field. Later, other researchers (Fang et al., 2017) defined psychological participation in more detail. They point out that it is actually the positive psychological state of users, with remarkable characteristics such as absorption, dedication, and vigor.

Firstly, a*bsorption* mainly refers to the situation where users put all their energy into the tourism app. In this state, the user cannot feel the passage of time and is very engaged.

Secondly, *dedication* mainly refers to the creativity and enthusiasm of users in this regard.

In addition, *vigor* mainly refers to the level of psychological elasticity and energy that users have in the process of using mobile programs. In addition, it also involves how willing users are to invest some energy in this aspect.

There is a certain correlation between psychological participation and heart flow, but there are also some differences. Some researchers believe that flow is the process when someone is engaged in an activity, which has a high degree of concentration (Mahnke et al., 2015). We can think that psychological participation and "flow" have a certain similarity, that is, people are highly focused on the activities they are engaged in, but it does not achieve a very high experience like flow. Generally speaking, psychological participation has higher persistence and stability (Hallberg & Schaufeli, 2006). For flow experience, the following conditions should be met: first, people should achieve a good balance between adjustment and skills; Secondly, people should have clear goals; Third, people need some immediate feedback (Csikszentmihalyi, 1990). At present, researchers have discussed the performance and mechanism of flow in different environments (Cuny et al., 2015). In addition, psychological participation does not need to involve perceptual control.

In general, user involvement mainly refers to people having a strong psychological sense

of identity for a specific object because of certain interests or needs (Cuny et al., 2015). Therefore, compared with participation, psychological participation has a wider scope, which covers different dimensions such as absorption, dedication, and vitality. By comparing the two, we can find that participation only includes the dedication dimension of psychological participation. We can regard dedication as a high degree of investment (Schaufeli et al., 2002).

For the behavior engagement that this study focuses on, its specific definition is that users maintain uninterrupted interaction with mcs-App (Fang et al., 2017). This is in good agreement with previous studies (for example, Fang et al., 2017; Verhagen et al., 2015; Y. H. Kim et al., 2013). This study mainly expounds on the main objectives of behavioral participation. Although we have found some basic conceptual differences after careful comparison, there is a great correlation between behavioral participation intention and participation behavior (Peters et al., 2016; Y. H. Kim et al., 2013). After a comprehensive analysis of the research data in this field, we find that some researchers (Cheung et al., 2015; Fang et al., 2017) deeply explore the two aspects of psychological and behavioral participation. It should be noted that Fang et al. (Cheung et al., 2015; Fang et al., 2017) are the first to explore the specific impact of the product attributes of mobile applications on behavior participation. They also deeply analyze the basic process and mechanism.

Therefore, mcs-Apps can allow users to participate in various activities that can meet their needs. However, it should be pointed out that there is still very little research on why users have been using the system. Considering that there is still very little empirical data on mcs-Apps participation behavior, we should further develop effective models to better expand the literature data. On this basis, we can more clearly explore the specific concept of application attributes. Then, we can also analyze how it affects the continuous participation of users.

### 4.1.2.2 Stimuli: mcs-App attributes

The results of some researchers show that product attributes can lead to the continuous development of internal cognition and play a very important role (Chou & Conley, 2009; S. Lee et al., 2011; Peters et al., 2016). In addition, S. Lee et al. (2011) find that the attributes of technical products mainly include the communication ability, performance, and appearance of products, among which the latter mainly involve archetypal and visual appeal. Among them, some people have clearly defined communication ability as the ability of products to help users clearly express their wishes and methods (S. Lee et al., 2011). Thorbjørnsen's team (Thorbjørnsen et al., 2007) made an in-depth elaboration on self-expression, believing that it

refers to the way users use products. At the same time, it also refers to the process in which users show their values and their own characteristics to others. The study also find that the product's communication power attribute plays a very important role in the expression process of user identity. Some famous technology products and luxury brands have strong communication power (typical products such as iPhone). In other words, communication ability mainly involves the ability to clearly express the user's identity. There is no direct correlation between it and social interaction. In this study, we consider that most users will not use the mobile app to express themselves, so we no longer consider its communication ability attribute. On this basis, we can better explore this issue in depth.

Other researchers point out that product design will significantly affect its prototype and visual appearance (S. Lee et al., 2011). Considering this factor, this study explores the design book attribute and performance attribute of the application to deeply analyze the related topics of application participation.

In fact, software quality mainly involves two aspects: structural quality and functional quality. Among them, performance attributes mainly describe the degree to which the application can realize its original function or effect, or these attributes mainly reflect the basic function quality of the software. At the same time, design attributes mainly describe the specific situation that the application can meet the original non-functional requirements. Therefore, design attributes cover the structural quality of software (Fang et al., 2017).

On the basis of fully drawing on the previous literature (S. Lee et al., 2011), this study will further conceptualize the design attributes and basic performance of the application and finally form a multi-dimensional construct. In this mechanism, it contains a series of sub-attributes. Some scholars point out that the innovation and practicability of the product will significantly affect its competitive advantage, and will also play a great role in the success of its performance (I. C. Chang et al., 2016; S. Lee et al., 2011; Peters et al., 2016).

Previous studies have found that in general, these factors are related to a series of technical attributes contained in the innovation perception feature framework (PCI), in which the latter mainly refers to complexity, compatibility, and advantages (Rogers, 2003). In addition, in the PCI framework, the basic features contained in innovation will have a significant impact on the use of products. Some researchers point out that only complexity, compatibility and comparative advantage will bring a more consistent effect (J. M. Kang et al., 2015; Lu et al., 2014). J. M. Kang et al. (2015) hold that the above three factors are closely related to participation experience. Considering these problems, ease of use, compatibility, and comparative advantages will be included in the performance attributes in this study. The

main reason is that the performance of mcs-App will affect the continuous use, participation, and dissemination of users. (Y. H. Kim et al., 2013).

Some scholars point out that if the quality of product design is high, it will be able to effectively distinguish it from other competitors, further improve the user experience and obtain good user evaluation (S. Lee et al., 2011). According to the analysis model of ISO / IEC 9126, the design characteristics of software can be clearly defined. These features mainly include portability, maintainability, efficiency, availability, reliability, and functionality. We can sample some of these attributes to fully evaluate the quality level of software. In this study, we choose the required sub-attributes according to the actual needs: first, the basic attributes related to context; Then there are the attributes that do not obviously overlap with the performance attributes; In addition, it also involves the actual views of users. Considering that we cannot analyze and evaluate maintainability, effect, and reliability from the perspective of users, the application design attributes adopted in the current model mainly include UI attraction (i.e., usability), portability, and security protection mechanism (i.e., product function). In the S-O-R model, the above sub-attributes will stimulate users' psychological participation to a certain extent (see Table 4.12 in Annex A).

**(1) App design attributes: privacy and security, portability, and UI attractiveness**

Kinds of literature have discussed the academic issues related to the **privacy and security** of mobile applications. Some researchers point out that it mainly refers to the perception of how users access or disclose some important personal data in the program (eg. Smith et al., 1996). Moreover, they also deeply discuss the basic principles. In fact, the original literature usually does not pay much attention to this gap, but for mobile applications, this attribute is very important and worthy of our in-depth analysis and discussion. The study find that some individuals or organizations want to use the privacy and security vulnerabilities in the application to obtain the important basic data of users, and then use it illegally to achieve some specific purposes. In recent years, people have been used to using mobile phones to arrange life or work, which makes the above gaps attract much attention. It is of great significance to carry out relevant research. It is pointed out that for Android applications, the serious problem is that applications can access some authorized information, but users actually do not understand this (Fang et al., 2017). For the mobile tourism application studied in this study, relevant users need to disclose some important data to tourism companies to obtain necessary services, so their privacy and security will be greatly threatened. The above information includes detailed bills or specific locations (Pentina et al., 2016). If there is no high security and privacy protection in the application, it will be difficult for users to

effectively control their information-sharing behavior in the network, which will eventually have a great impact on their willingness to disclose their own information or actively participate in the interaction process (Morosan & DeFranco, 2015; Pentina et al., 2016; Staddon et al., 2012). Accordingly, considering the above factors, we should take effective measures to solve these gaps. On this basis, users will show stronger interest and enthusiasm in the application. These users will actively participate in the interaction process related to the application and achieve good interaction results. At present, there are much empirical research data on this issue. A typical example is a research carried out by Staddon et al. (2012). Their research results show that there is a certain correlation between user participation and privacy issues. They conduct a more comprehensive analysis of this. Therefore, the following proposes are put forward:

**H1a**: There is a positive correlation between both the security and privacy of an mcs-App and the users' affective involvement.

**H1b**: There is a positive correlation between both the security and privacy of an mcs-App and the users' cognitive involvement.

Some researchers have deeply discussed the **portability** of mobile applications. They point out that it mainly refers to the actual execution ability of applications in various mobile operating systems (i.e., OS; Fang et al., 2017). When this study discusses this topic, it mainly focuses on the accessibility and availability of applications in various operating systems. It is found that portability helps to further enhance accessibility. On this basis, users do not need to switch frequently between operating systems, so they can continue to use the original application, which helps to maintain a reasonable personal perceived cost. Their use will not change significantly or be lost. In 2003, Burnham mainly refers to the time required for users to learn new products better (Burnham et al., 2003). With the continuous improvement of portability, we will be able to achieve highly consistent functional design and UI between different operating systems. In addition, the learning cost required by users after switching devices will be significantly reduced. In this study, we will deeply explore the cost of personal relationship loss. It mainly refers to the process of interaction between different users, which will eventually bring some emotional loss due to the interruption of contact due to the influence of relevant factors (Burnham et al., 2003; L. Huang & Hsieh, 2012). If the application has good portability, it can run smoothly in various operating systems, so as to effectively avoid the above problem of interpersonal relationship loss (L. Huang & Hsieh, 2012). On this basis, users will have a strong interest and enthusiasm in using and are willing to invest a lot of energy in it, and always maintain a high enthusiasm for learning and using

(Peters et al., 2016). The study find that if the application has good portability, it will have the opportunity to obtain a large number of potential users. After doing so, users will have the opportunity to gain rich shared knowledge through communication with other users. In particular, users can get significantly better social interaction, it will further improve the user experience. Accordingly, users will be willing to devote much energy and time to the application, and always maintain a high degree of enthusiasm and interest. According to the above analysis, after gradually reducing the cost of learning and interpersonal loss, users will get a better usage experience. The portability of mcs-App helps users more actively participate in the process of learning and using applications. Based on the above analysis, we put forward two hypotheses:

**H2a**: For mcs-App, there is a positive correlation between its portability and users' affective involvement.

**H2b**: For mcs-App, there is a positive correlation between its portability and users' cognitive involvement.

In recent years, the research on **UI attractiveness** has attracted much attention. It mainly refers to the user's perception of the aesthetic attraction of mcs-App. It is found that it mainly comes from various design factors of UI, including shape, layout, and color matching (Fang et al., 2017). Higgins (2006) holds that user participation is mainly affected by user experience. If the UI has good visual appeal, it will significantly improve the user experience and ultimately enable users to participate more actively (Peters et al., 2016). Some researchers point out that good UI design will help to improve user interaction and attention, and bring good use results (Coursaris & Van Osch, 2016; Cyr et al., 2006; S. Lee et al., 2011; Santosa et al., 2005; Y. J. Wang et al., 2011). In addition, if UI design has good visual appeal, it will greatly improve the user's interactive experience (Rozendaal, 2007; Santosa et al., 2005). It is pointed out that if the visual appeal of UI design is relatively poor, it will affect the participation enthusiasm of users (Brangier & Desmarais, 2013). Good interface design can significantly enhance people's curiosity and make them have a strong interest in using it (Peters et al., 2016). On this basis, users will be willing to devote too much energy and time to the application, and then always maintain a high degree of enthusiasm. In other words, if mcs-App can bring good visual effects or provide sufficient sensory stimulation, it will significantly enhance the participation enthusiasm of users. There are many reports about them, which have brought a lot of significance. The research results of Peters et al. (2016) show that this correlation can be reflected in mobile business intelligence systems. Chinese researchers S. H. Chang et al. (2014) and D. Y. J. Wang et al. (2011) also discuss this. They

find that if UI design has a strong attraction, it will greatly affect the interest of users and ultimately have a very positive effect. Therefore, we can think that if mcs-App has a high level of UI design, it will help to improve the participation of users. Considering the above analysis, this study puts forward two hypotheses:

**H3a**: For mcs-App, there is a positive correlation between its UI design aesthetics and users' affective involvement.

**H3a**: For mcs-App, there is a positive correlation between its UI design aesthetics and users' cognitive involvement.

**(2) App performance attributes: compatibility, effort expectancy, interactivity, and time convenience**

The study find that **compatibility** mainly reflects the consistency between users' perception of using the application and their needs (J. M. Kang et al., 2015). This indicator shows the main views of users on the satisfaction of their interests and needs. Some researchers sample the task technology fitting model (TTF) for research and find that if the task features and technical features can be fitted with high quality, it will have a great impact on the above perception (Larsen et al., 2009; W. S. Lin & Wang, 2012). The above attitude factors will significantly affect the wide participation of customers (Ray et al., 2014; Van Doorn et al., 2010). According to these analyses, there is a significant correlation between its compatibility and psychological participation in the development of applications. Some previous empirical studies have fully demonstrated the above relationship. Tan and Chou (2008) find that there is a large correlation between compatibility and users' psychological experience. The research results of J. M. Kang et al. (2015) show that compatibility will significantly affect the user's participation experience. Therefore, we can judge that the compatibility of the application will be related to the high level of psychological participation. Meuter et al. (2005) believe that compatibility will significantly affect the idea of users preparing to use self-service technology. They have conducted a more in-depth discussion on the main influencing factors and specific internal mechanism and put forward a novel mechanism. Considering the above analysis, this study puts forward two hypotheses:

**H4a**: For mcs-App, there is a positive correlation between compatibility and users' affective involvement.

**H4b**: For mcs-App, there is a positive correlation between compatibility and users' cognitive involvement.

Some researchers have clearly defined **effort expectancy** and believe that it is actually the ease of use of technology (V. Venkatesh et al., 2003). This indicator mainly reflects the

views of consumers on the difficulty of use. If in the view of users, using technology does not require a lot of time and energy, it will help to make better use of the technology. Other research results show that the performance expectation of information technology will be affected by effort expectation (V. Venkatesh et al., 2003). Some researchers have discussed the impact of effort expectation on users' use of mobile technology and related services (eg. mobile banking, mobile shopping) from different perspectives (Park et al., 2007; K. Yang, 2010; T. Zhou et al., 2010). These researchers find that the ease of use of mcs-Apps will significantly affect users' involvement enthusiasm and attitude, and ultimately affect users' use. If the mcs-Apps is easy to use in the eyes of users, they will have stronger affective and cognitive participation. In other words, if mcs-Apps app has good usability, users will have a significantly stronger willingness and enthusiasm to participate. Considering the above analysis, this study puts forward two hypotheses:

**H5a**: There is a positive correlation between effort expectancy and affective involvement.

**H5b**: There is a positive correlation between effort expectancy and cognitive involvement.

Here, **interactivity** mainly refers to the specific degree to which the communicating party can act (Y. Liu & Shrum, 2002). It needs to gradually establish close contact with users and provide some important information at the same time. This indicator is very important for web design, advertising, and marketing (Cyr et al., 2009; Goggin & Spurgeon, 2007; T. Lee, 2005; Macias, 2003; Teo et al., 2003). Some research results show that for e-retailers, mobile interactivity and network interactivity will have a great impact on the overall operation performance (Gu et al., 2013). These studies also analyze and discuss the mechanism. Some researchers have also explored the cognitive (H. Kim & Niehm, 2009; Sicilia et al., 2005) and emotional (H. Kim & Niehm, 2009; Sicilia et al., 2005) issues of interactivity. The study find that if the mobile website has relatively high interactivity, it will correspondingly improve the usefulness of the mobile website and the user's use intention (Coursaris & Sung, 2012). Chinese researchers T. Zhou and Lu (2011) conduct an in-depth analysis on the main factors of interactivity and find that they will significantly affect the user's flow experience. They also point out that these results will involve users' attention, perceived control, and perceived enjoyment. In addition, other researchers have discussed the predictive effect of interactivity on the hedonic value users get when shopping online (Yoo et al., 2010). Relevant research reports have been relatively rich (Koufaris, 2002; Menon & Kahn, 2002), and some scholars even discuss the topic of full participation (Sicilia et al., 2005). According to the above analysis, interactivity will have an important impact on the interest and attraction of users using mcs-Apps. Considering the above analysis, this study puts forward two hypotheses:

**H6a**: There is a positive correlation between interactivity and affective involvement.

**H6b**: There is a positive correlation between interactivity and cognitive involvement.

For the retail industry, if consumers can perceive the **convenience of time**, they will be more willing to choose relevant services (J. M. Kang et al., 2015). If some services have clear time requirements, it will be particularly applicable. The author also makes an in-depth analysis of different specific cases (Hourahine & Howard, 2004). Because of its good time convenience, users will not be limited by time and can easily use mobile network services. Some research results show that this index will significantly affect perceived value (Kleijnen et al., 2007) and experience value (Tojib & Tsarenko, 2012). This indicator will also have a great impact on users' motivation and emotion to use the application. Accordingly, according to the analysis of this index, we can think that using mcs-Apps will bring some interest and attraction, among which there is high importance. Considering the above analysis, this study puts forward two hypotheses:

**H7a**: There is a positive correlation between time convenience and affective involvement.

**H7b**: There is a positive correlation between time convenience and cognitive involvement.

### 4.1.2.3 Organism: affective and cognitive involvement

Some researchers have defined **involvement** as the perceptual relevance formed by people because of their own needs, interests, or values (Zaichkowsky, 1985). In recent years, there have been many research reports on the relationship between involvement construct and consumption behavior (Zaichkowsky, 1985). At present, there are mainly academic views on cognitive involvement and affective involvement (Zaichkowsky, 1994). In addition, some researchers have fully explored the main components and influencing factors of emotional participation from the perspective of mcs-App and achieved rich results. It has been found that if users have strong feelings for such applications, they will have more significant interests and desires. In addition, if consumers have strong emotional participation in a website, they will have strong purchase intention (Z. Jiang et al., 2010). Other scholars point out that service experience will significantly affect consumers' satisfaction and ultimately affect their views and attitudes towards the brand (Grace & O'Cass, 2004). If users need to use mcs-App, if emotional clues are involved, it will help to enhance emotional participation. In other words, if there is a good feeling state, consumers will have a stronger emotional willingness to participate and have a strong motivation to use the application. On the contrary, consumers will have negative emotions, form a poor view of the application, and have no strong interest in using and participating, which will eventually seriously affect the use of

mcs-Apps. Considering the above analysis, this study puts forward this hypothesis:

**H8**. There is a positive correlation between affective involvement and behavioral engagement intention.

If we make an in-depth analysis of mcs-Apps, we can find that **cognitive involvement** is actually the rationality related to it perceived by people (J. M. Kang et al., 2015). It mainly includes utilitarian motivation. If a person is cognitively involved in the application, he will gradually realize that the application has great significance. Some studies have pointed out that shopping results will be greatly affected by cognitive state. These factors include consumers' proximity behavior and satisfaction (Eroglu et al., 2003). According to the research of Z. Jiang et al. (2010), if users form a high degree of cognitive participation in the website, they will be more willing to buy relevant products or services. The study find that when users use mcs-Apps if there is utilitarian motivation, it will help to further enhance cognitive participation. It can be seen that with strong cognitive participation, consumers will be more willing to use the application. In addition, low cognitive participation will lead to low intention. Considering the above analysis, this study puts forward this hypothesis:

**H9**: There is a positive correlation between cognitive involvement and behavioral engagement intention.

### 4.1.2.4 Control variables

In this model, we sampled a series of control variables to effectively control the impact of individual characteristics. These variables include major, gender, year of usage, education, city of residence, use frequently, year of usage, alternative attraction, and usage habits. They are chosen mainly because they affect participation. This has been discussed in detail in some literature (e.g., De Oliveira et al., 2016; Fang et al., 2017; Hsiao & Chen, 2016; Jung et al., 2012; Kuo et al., 2013; Wilmer & Chein, 2016). The research results of Jung et al. (Jung et al., 2012) show that consumers with higher education or younger age usually have a stronger interest in using or buying new e-book readers.

Some researchers have studied the basic concept of alternative attraction. They point out that it mainly refers to the situation where consumers can get a good perception from relevant service providers. If other competitors in the market can provide better prices or quality services, consumers are likely to find other attractions (Keaveney, 1995; Ping Jr, 1993). As the market competition becomes more intense, consumers will have the opportunity to obtain more favorable service or product quotations and then choose their preferred suppliers (Bansal et al., 2004; Jones & Sasser, 1995; Keaveney, 1995; Kuo et al., 2013). The alternative

attraction may weaken customer engagement intention based on inertia and further motivate customers to switch to other more attractive apps (Kuo et al., 2013).

Wilmer and Chein (2016) propose two usage habits driving people to engage with their smartphones, first, it is difficult for individuals to effectively suppress the impulse of examination; secondly, consumers want to find more ideal stimulation. On this basis, Wilmer and Chein (2016) put forward the participation scale related to it. The main purpose is to form an effective index for the use of this technology. It mainly includes the following components: first, it includes the use of social media related to a telephone; secondly, it involves the update speed of public status; in addition, phone-checking behavior is included.

## 4.2 Research methods

### 4.2.1 Implementation context

Relevant data collection work is completed through the mcs-App research and development project. In this project, we jointly designed and implemented a widely used mcs-App with a campus-related enterprise. Its name is ePay100 (eg. Wechat, Alipay, and Mini programs). It widely provides some campus-service functions including campus e-card, quick pay, QR code payment, pay cost, takeout, shopping, and reservation (eg. repair, venues, piano room).

The company's mcs-App is used in more than 100 Chinese universities and colleges, and 14 universities are randomly selected for the questionnaire survey in this study. The students in these universities come from all over the country. These universities in are respectively Hunan Normal University (Changsha, Hunan province), Ningbo University of Finance & Economics (Ningbo, Zhejiang province), Hangzhou Normal University (Hangzhou, Zhejiang province), Hebei University of Engineering (Handan, Hebei province), Northwest Normal University (Lanzhou, Gansu province), China Jiliang University (Hangzhou, Zhejiang province), Hangzhou Dianzi University (Hangzhou, Zhejiang province), Yanshan University (Qinhuangdao, Hebei province), Ningbo University (Ningbo, Zhejiang province), Fujian University of Technology (Fuzhou, Fujian province), Hangzhou Medical College (Hangzhou, Zhejiang province), Zhejiang University of Technology (Hangzhou, Zhejiang province), Zhejiang University of Finance & Economics (Hangzhou, Zhejiang province) and Zhejiang Institute of Economics and Trade (Hangzhou, Zhejiang province).

## 4.2.2 Survey participants

Survey participants are attending college students from undergraduate and graduate programs from 14 Chinese universities and colleges during the academic year of 2021. These include students at junior college, undergraduate, and graduate schools (Master's and Ph.D.). Students scan the QR code to enter the questionnaire and participate in the survey (see Annex F-2)

## 4.2.3 Instrument development

The main construct is treated as the first-order reflection construct corresponding to a series of reflection indexes. In this process, full reference is made to the previous research results, and then appropriate modifications and improvements are made according to the actual situation (see Table 4.1 in this study) (Jarvis et al., 2003). These indicators are fully evaluated and analyzed by the Likert scale, which covered seven different levels. We used the same single measurement method to evaluate sociodemographic variables. We then invited people with good Chinese and English skills to translate the relevant content. Then, the reverse translation version is translated to ensure that the measurement items of the two languages are highly similar. On this basis, it is able to effectively analyze and evaluate the same construct. The questionnaire survey is conducted on a total of 10 undergraduate students in the same university. At the same time, four researchers are invited to confirm the validity and quality of the questionnaire. We also fully considered the feedback (as shown in Annex E.2 of this study) and appropriately modified some contents of the questionnaire.

The questionnaire consists of three sections (see Annex D). The first part of the questionnaire is the consent form. The second part describes respondent demographics. The third part consists of 39 questions that measured 10 variables in the research model.

Table 4.1 Scale items of constructs

| Constructs | Items | Adapted from |
|---|---|---|
| Alternative attraction | ALA. Please rate the attractiveness of other products. | Kuo et al., 2013 |
| Usage habits | USH. I am used to using the current version system. | Wilmer & Chein, 2016 |
| Privacy and security | PS1. In my opinion, the security of using and installing this mcs-App is very high. | Nepomuceno et al., 2014 |
| | PS2. In my opinion, this mcs-App can effectively protect my sensitive data. | |
| | PS3. In my opinion, the related products provided by this mcs-App have high security. | |
| | PS4. In my opinion, sending some sensitive information through this mcs-App has good security. | |
| | PS5. In my opinion, this mcs-App has good security | |

| | | |
|---|---|---|
| | features and privacy. | |
| Portability | PT1. In different mobile operating systems, the present mcs-App can run smoothly. | Fang et al., 2017 |
| | PT2. Its operating system compatibility is very good. | |
| | PT3. It can be applied to different operating systems. | |
| UI attractiveness | UI1. Its user interface design is very clean and concise. | Coursaris & Van Osch, 2016; Cyr et al., 2006 |
| | UI2. Its user interface design has high complexity. | |
| | UI3. Its user interface design is very attractive. | |
| | UI4. Its user interface design has high aesthetics. | |
| | UI5. Its user interface design has a good visual effect. | |
| | UI6. Its user interface design has a strong attraction. | |
| Compatibility | CP1. It has good compatibility with my campus preferences. | L. Huang & Hsieh, 2012; Jung et al., 2012; Lu et al., 2014 |
| | CP2. It is very consistent with my actual campus needs. | |
| | CP3. It can better meet the needs of the campus. | |
| Effort expectancy | EE1. In my opinion, I have a clear interaction with it. | V. Venkatesh et al., 2003 |
| | EE2. I can easily use this mcs-App. | |
| | EE3. In my opinion, this mcs-App has good ease of use. | |
| | EE4. I find this mcs-App easy to learn and use. | |
| Interactivity | IT1. It can provide me with all kinds of information packages in time. | J. M. Kang et al., 2015; T. Lee, 2005 |
| | IT2. It can provide me with information packages related to specific locations. | |
| | IT3. It can provide me with the most ideal service or basic information. The above services and information are closely related to my location and situation. | |
| Time convenience | TC1. I can freely access it without time constraints and then get the required services or information. | J. M. Kang et al., 2015; T. Lee, 2005 |
| | TC2. I can freely access it without being restricted by location and then get the required services or information. | |
| | TC3. I can visit it at any time or place according to my actual needs. | |
| | TC4. For time-critical services, it is very applicable (this situation mainly includes order status tracking or last-minute reservation). | |
| Affective involvement | AI1. Using this mcs-App is exciting. | Hsieh et al., 2008; J. M. Kang et al., 2015; H. Wang et al., 2013 |
| | AI2. I find it very attractive when using this mcs-App. | |
| | AI3. I find it very interesting to use this mcs-App. | |
| Cognitive involvement | CI1. After I used it, my campus arrangement has significantly improved. | Hsieh et al., 2008; J. M. Kang et al., 2015; H. Wang et al., 2013 |
| | CI2. After I use it, I can arrange my campus time more efficiently. | |
| | CI3. Using this mcs-App is needed for me. | |
| | CI4. In my opinion, it is very important to use this mcs-App. | |
| Behavioral engagement intention | BEI1. I hope to use this mcs-App in the future. | Hall-Phillips et al., 2016; Verhagen et al., 2015 |
| | BEI2. I hope to have the opportunity to participate in its various activities. | |
| | BEI3. I hope to support more members through it. | |

| | |
|---|---|
| BEI4. I'd like to recommend it to others if I have the opportunity. | |

Note(s): ALA: alternative attraction; USH: usage habits; PS: privacy and security; PT: portability; UI: UI attractiveness; CP: compatibility; EE: effort expectancy; IT: interactivity; TC: time convenience; AI: affective involvement; CI: cognitive involvement; BEI: behavioral engagement intention.

### 4.2.4 Sample and data collection

In the process of investigation, students with ePAY 100 use experience are mainly selected as the research object. This study uses the method of a pilot test to analyze the effectiveness of the main contents of the questionnaire. In addition, we also analyze the relevance, comprehensibility, and logic of the questionnaire. During the test, a total of 95 students with experience in using the application are studied.

All samples are deeply analyzed by IBM SPSS statistics 25.0 software to obtain the required descriptive results. Then, we also use the PLS-SEM model to comprehensively analyze and discuss the research model. This model has lower requirements on residual distribution, sample size, and measurement scale than the CB-SEM model (Chin et al., 2003). In addition, the assumption of normal distribution in the PLS-SEM model is also relatively loose (Hair et al., 2019; Khan et al., 2019; Shiau et al., 2019; Shiau & Chau, 2016). Some researchers believe that the PLS-SEM model has better applicability and efficiency after fully considering the complexity of the model (Gefen et al., 2011). If it is explored from the perspective of prediction, the use of the PLS-SEM model will help to increase the variance of explaining endogenous variables (Hair et al., 2017). On the basis of full research, we believe that PLS is a model suitable for this study. Anderson and Gerbing (1988) hold that in the process of data analysis, measurement models will be needed, and in addition, evaluation of structural models will be needed. They have different functions.

On this basis, we use an online survey to collect the required empirical data. The research shows that this method has a series of advantages. Among them, the typical advantages include not being affected by geographical conditions, as well as good economics and efficiency (Bhattacherjee, 2001, 2001; Tan & Teo, 2000).

We collect 95 respondents for the pilot test, among whom 46 (48.4%) are male and 49 (51.6%) are female. In addition, 93 out of these 95 respondents are undergraduate students, with 1 from junior college and 1 from graduate school (Ph.D.). When we carry out the pilot test, the factor load used is not less than 0.5 (Wixom & Watson, 2001). The range of comprehensive reliability is 0.917 - 0.967. In addition, Cronbach's alpha value ranges from 0.878 to 0.950. We use AVE to comprehensively evaluate the convergent validity of

constructs. It should be noted that the value of the construct is 0.734 - 0.906, significantly exceeding 0.5. The pilot test results show that the instrument has good validity and reliability.

## 4.3 Data analysis and results

### 4.3.1 Data examination

In March 2021, we released the questionnaire online. In five months, we received a total of 2,768 survey data (Wixom & Watson, 2001). We first eliminate the data that did not meet the requirements and then obtained a total of 2,076 valid data to carry out this research work. For data screening, we apply the following criteria and exclude the cases where:

(1) The answer duration time is less than 240 seconds (it takes about 4 minutes to answer the questionnaire).

(2) Respondent claims to have more than 10 years of app usage. (App has been popular among the general public for ten years in China.)

(3) Respondent submits 30 or more same answers out of the 39 measurement items in the questionnaire.

### 4.3.2 Descriptive statistics

Table 4.2 and Figure 4.2 report the demographic statistics of our survey respondents. Among the total 2,702 participants, 916 are male (44.2%) and 1,156 are female (55.8%). According to Weiyiyun, the top 5 majors are accounting, software engineering, computer science and technology, and English (see Annex G-2). The respondents' background includes junior college (486, 23.5%), undergraduate (1,309, 63.2%), graduate school (master program) (246, 11.9%), and graduate school (doctoral program) (31, 1.5%). The respondents are from 343 cities of residence. Also, of the 2,702 respondents, 2,014 (97.2%) respondents are frequent mcs-App users with average 3.75 years of usage (SD = 1.835 years), alternative attraction (M = 4.66, SD = 1.380), and usage habits (M = 5.47, SD = 1.241).

Table 4.2 Demographics information (N = 2,702)

| Characteristics | Categories | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 916 | 44.2 |
| | Female | 1,156 | 55.8 |
| Education | Junior college | 486 | 23.5 |
| | Undergraduate | 1,309 | 63.2 |
| | Graduate school (Master) | 246 | 11.9 |
| | Graduate school (PhD) | 31 | 1.5 |

| City of residence | | 343 | |
|---|---|---|---|
| Use frequently? | Yes | 2,014 | 97.2 |
| | No | 58 | 2.8 |

Note. Use frequently: Do you often use mcs-Apps (such as WeChat, Alipay, Campushoy, Wanmei, and eCampus)
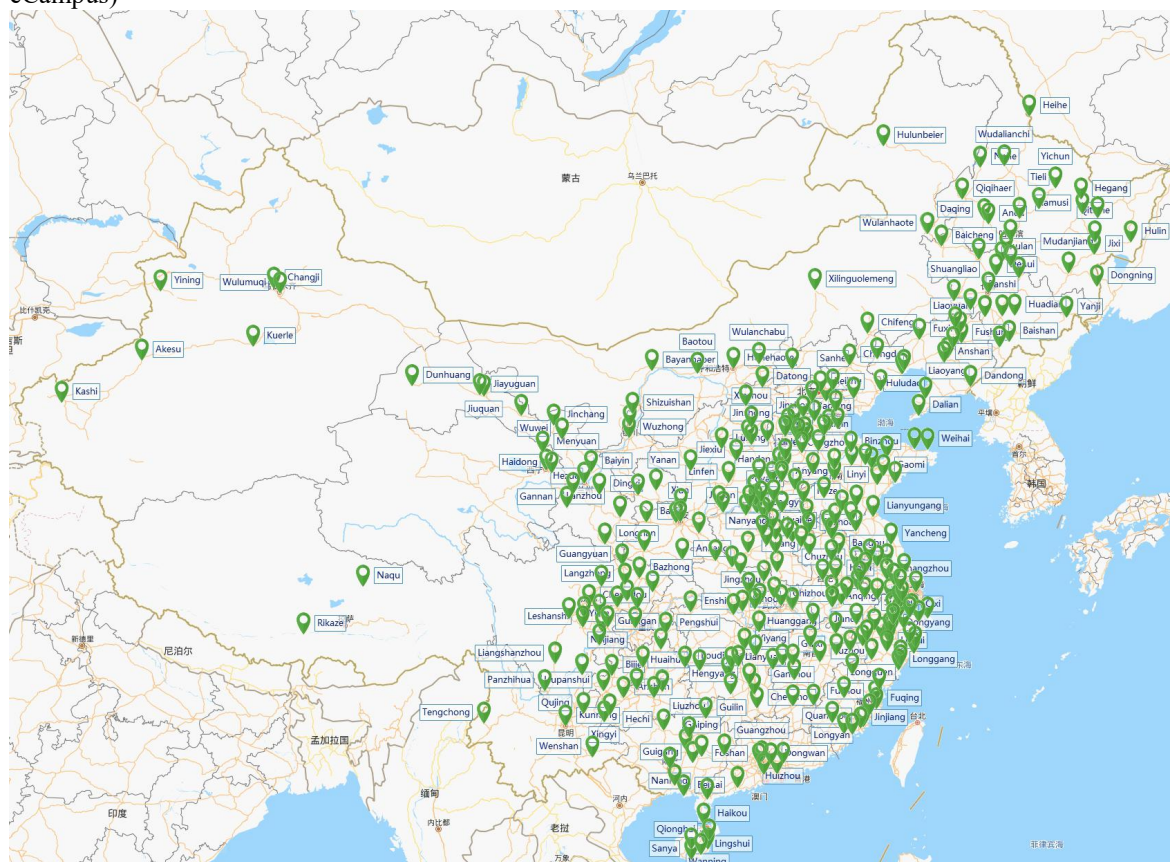


Figure 4.2 Illustration B of respondent's city of residence

Table 4.3 reports the descriptive statistics of each indicator, calculated by the analysis software SmartPLS 3.3. We can find that the skewness value and kurtosis value of the index are in the interval of -1 and +1. If absolute values exceed 1, they belong to nonnormal data (Hair et al., 2017). According to these results, the data on kurtosis and skewness meet the requirements of normality.

Table 4.3 Descriptive statistics of indicators (N=2,072)

| | Mean | Median | Min | Max | Std. | Kurtosis | Skewness |
|---|---|---|---|---|---|---|---|
| YU | 3.753 | 3 | 0 | 10 | 1.835 | 0.630 | 0.703 |
| ALA | 4.665 | 5 | 1 | 7 | 1.380 | 0.116 | -0.404 |
| USH | 5.469 | 6 | 1 | 7 | 1.241 | 0.648 | -0.827 |
| PS1 | 4.905 | 5 | 1 | 7 | 1.314 | 0.171 | -0.507 |
| PS2 | 4.592 | 5 | 1 | 7 | 1.367 | -0.096 | -0.375 |
| PS3 | 4.833 | 5 | 1 | 7 | 1.302 | 0.111 | -0.477 |
| PS4 | 4.280 | 4 | 1 | 7 | 1.463 | -0.409 | -0.271 |
| PS5 | 4.528 | 5 | 1 | 7 | 1.374 | -0.111 | -0.370 |
| PT1 | 5.191 | 5 | 1 | 7 | 1.236 | 0.314 | -0.581 |
| PT2 | 5.177 | 5 | 1 | 7 | 1.216 | 0.530 | -0.641 |

| | | | | | | | |
|-----|-------|---|---|---|-------|--------|--------|
| PT3 | 5.209 | 5 | 1 | 7 | 1.228 | 0.277 | -0.570 |
| UI1 | 5.143 | 5 | 1 | 7 | 1.347 | 0.494 | -0.741 |
| UI2 | 4.850 | 5 | 1 | 7 | 1.324 | 0.139 | -0.526 |
| UI3 | 4.410 | 4 | 1 | 7 | 1.388 | -0.221 | -0.307 |
| UI4 | 4.575 | 5 | 1 | 7 | 1.350 | -0.042 | -0.412 |
| UI5 | 4.480 | 5 | 1 | 7 | 1.386 | -0.147 | -0.378 |
| UI6 | 4.501 | 5 | 1 | 7 | 1.396 | -0.121 | -0.377 |
| CP1 | 4.938 | 5 | 1 | 7 | 1.284 | 0.289 | -0.578 |
| CP2 | 5.142 | 5 | 1 | 7 | 1.280 | 0.465 | -0.666 |
| CP3 | 4.978 | 5 | 1 | 7 | 1.305 | 0.075 | -0.519 |
| EE1 | 5.285 | 5 | 1 | 7 | 1.240 | 0.725 | -0.761 |
| EE2 | 5.510 | 6 | 1 | 7 | 1.210 | 0.410 | -0.755 |
| EE3 | 5.482 | 6 | 1 | 7 | 1.223 | 0.874 | -0.889 |
| EE4 | 5.626 | 6 | 1 | 7 | 1.189 | 0.952 | -0.930 |
| IT1 | 4.501 | 5 | 1 | 7 | 1.530 | -0.306 | -0.447 |
| IT2 | 4.364 | 5 | 1 | 7 | 1.554 | -0.452 | -0.380 |
| IT3 | 4.542 | 5 | 1 | 7 | 1.543 | -0.280 | -0.498 |
| TC1 | 5.231 | 5 | 1 | 7 | 1.276 | 0.614 | -0.755 |
| TC2 | 5.197 | 5 | 1 | 7 | 1.281 | 0.159 | -0.580 |
| TC3 | 5.300 | 5 | 1 | 7 | 1.282 | 0.552 | -0.774 |
| TC4 | 4.831 | 5 | 1 | 7 | 1.431 | 0.097 | -0.554 |
| AI1 | 4.455 | 4 | 1 | 7 | 1.406 | -0.080 | -0.375 |
| AI2 | 4.524 | 5 | 1 | 7 | 1.390 | -0.084 | -0.413 |
| AI3 | 4.515 | 5 | 1 | 7 | 1.445 | -0.195 | -0.364 |
| CI1 | 4.932 | 5 | 1 | 7 | 1.345 | 0.270 | -0.641 |
| CI2 | 4.821 | 5 | 1 | 7 | 1.369 | 0.057 | -0.522 |
| CI3 | 4.964 | 5 | 1 | 7 | 1.444 | -0.045 | -0.604 |
| CI4 | 4.741 | 5 | 1 | 7 | 1.458 | -0.172 | -0.477 |
| BEN1 | 5.161 | 5 | 1 | 7 | 1.360 | 0.327 | -0.717 |
| BEN2 | 4.902 | 5 | 1 | 7 | 1.360 | 0.153 | -0.546 |
| BEN3 | 4.971 | 5 | 1 | 7 | 1.353 | 0.135 | -0.569 |
| BEN4 | 4.809 | 5 | 1 | 7 | 1.430 | -0.023 | -0.519 |

Note(s): ALA: alternative attraction; USH: usage habits; PS: privacy and security; PT: portability; UI: UI attractiveness; CP: compatibility; EE: effort expectancy; IT: interactivity; TC: time convenience; AI: affective involvement; CI: cognitive involvement; BEN: behavioral engagement intention.

### 4.3.3 Non-response bias

The so-called non-response bias mainly refers to the that those who do not participate in the questionnaire may have some bias against the data obtained. For this method, we mainly refer to the suggestions made by Armstrong and Overton (Armstrong & Overton, 1977). The researchers' view is that late respondents may be more similar to those who did not respond. In the current survey, we mainly analyze the situation of early and late respondents (mainly including education and gender) to effectively solve the above issues (Shiau & Luo, 2012). Among them, the number of early respondents is 908 and the number of late respondents is 1,164. According to their chi-square test results, there is no significant difference between

them in the above two aspects (p > 0.05). On this basis, the possibility of not responding to deviation is effectively excluded (Garrison & Arbaugh, 2007).

### 4.3.4 Common method bias

If the sources of data are the same, they will have common methodological deviations. The result is that it will affect the overall effectiveness of the research work. In the current research, the form of an online questionnaire is adopted, so the samples studied do not have a group and regional restrictions. This study uses Harman's one-way test to identify common method deviations (Garrison & Arbaugh, 2007). Some studies have pointed out that if a single factor has a proportion of more than 50%, the deviation will be a greater threat (Mattila & Enz, 2002). The data obtained from principal component factor analysis are listed in Table 4.4 in detail. We can find that the total proportion of the four factors reached 66.666%. The proportion of the first factor is about 48.426%. This study also uses the labeled variable method to carry out analysis and testing (Chin et al., 2012). It is indicated that marker variables do not affect privacy and security, portability, UI attractiveness, compatibility, effort expectancy, interactivity, time convenience, affective involvement, cognitive involvement, or behavioral engagement intention. As a result, it is concluded that for the present work, common method bias is in fact not a very critical issue.

Table 4.4 Total variance explained

| Component | Initial eigenvalues | | |
| --- | --- | --- | --- |
| | Total | % of Variance | Cumulative % |
| 1 | 18.886 | 48.426 | 48.426 |
| 2 | 2.802 | 7.185 | 55.611 |
| 3 | 2.446 | 6.271 | 61.882 |
| 4 | 1.866 | 4.784 | 66.666 |
| 5 | 1.517 | 3.889 | 70.554 |
| 6 | 1.074 | 2.755 | 73.309 |

Extraction method: principal component analysis.

### 4.3.5 Measurement model

In the evaluation and analysis of internal consistency reliability, we use Cronbach's alpha and Jöreskog composite reliability (Jöreskog, 1971). The results show that the range of composite degrees is 0.878 -0.951. In addition, the range of Cronbach's alpha value is 0.904 -0.945. In Table 4.5, all factor results are not less than 0.5 (Wixom & Watson, 2001). It is found that AVE values also exceed 0.5. AVE is to make a judgment about the convergent validity of each construct. Based on the AVE, the construct explains at least 50% of the variance of its items

(Chin et al., 2003). In this study, reliability, convergent validity, and discriminant validity validate our measurement model.

Table 4.5 Scale properties of the measurement model B

| Construct | Item | Standardized item loading | Item mean | Standard deviation | T statistics | Cronbach's Alpha | Composite reliability | AVE |
|---|---|---|---|---|---|---|---|---|
| Pivacy and security | PS1 | 0.850 | 0.850 | 0.008 | 102.936 | 0.922 | 0.941 | 0.762 |
| | PS2 | 0.887 | 0.887 | 0.007 | 134.564 | | | |
| | PS3 | 0.888 | 0.888 | 0.006 | 157.846 | | | |
| | PS4 | 0.842 | 0.842 | 0.009 | 98.840 | | | |
| | PS5 | 0.897 | 0.897 | 0.006 | 156.169 | | | |
| Portability | PT1 | 0.910 | 0.909 | 0.006 | 146.584 | 0.913 | 0.945 | 0.853 |
| | PT2 | 0.934 | 0.934 | 0.004 | 242.135 | | | |
| | PT3 | 0.926 | 0.926 | 0.004 | 238.196 | | | |
| UI Attractiveness | UI1 | 0.755 | 0.755 | 0.013 | 56.724 | 0.940 | 0.953 | 0.771 |
| | UI2 | 0.867 | 0.867 | 0.008 | 114.070 | | | |
| | UI3 | 0.902 | 0.902 | 0.005 | 198.887 | | | |
| | UI4 | 0.908 | 0.908 | 0.005 | 169.320 | | | |
| | UI5 | 0.909 | 0.909 | 0.005 | 194.006 | | | |
| | UI6 | 0.915 | 0.915 | 0.004 | 208.637 | | | |
| Compatibility | CP1 | 0.898 | 0.898 | 0.005 | 166.438 | 0.892 | 0.933 | 0.822 |
| | CP2 | 0.905 | 0.905 | 0.006 | 151.905 | | | |
| | CP3 | 0.917 | 0.917 | 0.005 | 203.398 | | | |
| Effort Expectancy | EE1 | 0.871 | 0.871 | 0.007 | 130.390 | 0.908 | 0.935 | 0.783 |
| | EE2 | 0.885 | 0.885 | 0.008 | 109.636 | | | |
| | EE3 | 0.908 | 0.908 | 0.005 | 172.183 | | | |
| | EE4 | 0.876 | 0.876 | 0.009 | 97.311 | | | |
| Interactivity | IT1 | 0.924 | 0.924 | 0.005 | 189.638 | 0.921 | 0.950 | 0.864 |
| | IT2 | 0.931 | 0.931 | 0.004 | 217.019 | | | |
| | IT3 | 0.933 | 0.933 | 0.004 | 243.096 | | | |
| Time Convenience | TC1 | 0.910 | 0.910 | 0.005 | 174.746 | 0.890 | 0.925 | 0.754 |
| | TC2 | 0.894 | 0.894 | 0.006 | 141.473 | | | |
| | TC3 | 0.872 | 0.872 | 0.008 | 114.241 | | | |
| | TC4 | 0.794 | 0.794 | 0.011 | 71.054 | | | |
| Affective Involvement | AI1 | 0.941 | 0.941 | 0.004 | 249.455 | 0.934 | 0.958 | 0.883 |
| | AI2 | 0.940 | 0.940 | 0.003 | 284.176 | | | |
| | AI3 | 0.939 | 0.939 | 0.003 | 270.660 | | | |
| Cognitive Involvement | CI1 | 0.874 | 0.874 | 0.007 | 123.795 | 0.900 | 0.930 | 0.770 |
| | CI2 | 0.885 | 0.884 | 0.007 | 135.834 | | | |
| | CI3 | 0.872 | 0.872 | 0.007 | 118.611 | | | |
| | CI4 | 0.879 | 0.879 | 0.006 | 141.672 | | | |
| Behavioral Engagement Intention | BEN1 | 0.875 | 0.875 | 0.008 | 110.399 | 0.900 | 0.930 | 0.770 |
| | BEN2 | 0.916 | 0.916 | 0.005 | 199.840 | | | |
| | BEN3 | 0.905 | 0.905 | 0.006 | 163.514 | | | |
| | BEN4 | 0.871 | 0.871 | 0.008 | 112.718 | | | |

Note(s): AVE - average variance extracted.

We also deeeply analyze the correlation ratio between heterotrait-monotrait (i.e. HTMT) and Fornell-Larcker to comprehensively analyze the effectiveness. The results are shown in

Table 4.6. Through comprehensive comparison, we can clearly find that the correlation between constructs does not exceed the square root of AVE (Fornell & Larcker, 1981; Hair et al., 2011, 2017). According to the above analysis, the model has good discriminant validity.

Table 4.6 Discriminant validity: Fornell-Larcker criterion

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Privacy and Security | 0.873 | | | | | | | | | |
| 2. Portability | 0.551 | 0.923 | | | | | | | | |
| 3. UI Attractiveness | 0.538 | 0.565 | 0.878 | | | | | | | |
| 4. Compatibility | 0.538 | 0.612 | 0.606 | 0.907 | | | | | | |
| 5. Effort Expectancy | 0.439 | 0.583 | 0.477 | 0.689 | 0.885 | | | | | |
| 6. Interactivity | 0.395 | 0.423 | 0.560 | 0.470 | 0.361 | 0.929 | | | | |
| 7. Time Convenience | 0.482 | 0.575 | 0.548 | 0.639 | 0.637 | 0.623 | 0.869 | | | |
| 8. Affective Involvement | 0.489 | 0.478 | 0.652 | 0.548 | 0.430 | 0.635 | 0.609 | 0.940 | | |
| 9. Cognitive Involvement | 0.494 | 0.520 | 0.577 | 0.635 | 0.545 | 0.544 | 0.669 | 0.740 | 0.877 | |
| 10. Behavioral Engagement Intention | 0.508 | 0.539 | 0.560 | 0.621 | 0.568 | 0.498 | 0.665 | 0.674 | 0.786 | 0.892 |

Henseler et al. (Fornell & Larcker, 1981; Hair et al., 2011, 2017) propose the heterotrait-monotrait ratio (i.e., HTMT) for research and analysis (Voorhees et al., 2016). It should be noted that its threshold needs to be clearly defined by fully considering the specific circumstances and needs (Franke & Sarstedt, 2019). For example, Henseler et al. (2015) believe that for structural models with construct, their threshold should be 0.90. For this study, its range is 0.387 - 0.806. Therefore, all constructs involved in the model have their discriminant validity. For details, please refer to Table 4.7 in this study.

Table 4.7 Discriminant validity: Heterotrsait - monotrait (HTMT)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Privacy and Security | | | | | | | | |
| 2. Portability | 0.600 | | | | | | | |
| 3. UI Attractiveness | 0.580 | 0.615 | | | | | | |
| 4. Compatibility | 0.590 | 0.677 | 0.662 | | | | | |
| 5. Effort Expectancy | 0.474 | 0.636 | 0.517 | 0.759 | | | | |
| 6. Interactivity | 0.427 | 0.461 | 0.598 | 0.515 | 0.387 | | | |
| 7. Time Convenience | 0.531 | 0.638 | 0.599 | 0.717 | 0.706 | 0.681 | | |
| 8. Affective Involvement | 0.526 | 0.517 | 0.694 | 0.599 | 0.459 | 0.684 | 0.664 | |
| 9. Cognitive Involvement | 0.542 | 0.573 | 0.627 | 0.708 | 0.597 | 0.595 | 0.746 | 0.806 |

## 4.3.6 Structural model

### 4.3.6.1 Model fit measures

Henseller et al. (2015) comprehensively analyze the main efficacy of standardized root mean square residual (i.e., SRMR). They find that it belongs to model fitting measurement. It is actually the root mean square difference between the correlation we can observe and the

model correlation. If a value is less than 0.08, we can judge that it is an ideal fitting (L. Hu & Bentler, 1998). In addition, we also used root mean square residual covariance (i.e., RMS$_{theta}$) for analysis. It has logic similar to the SRMR described above. It should be pointed out that the latter has a certain dependence on covariance. Lohmöller (1989) first introduced the standard, and then gradually attracted the attention of relevant researchers. According to the obtained data, we can find that the threshold corresponding to RMS$_{theta}$ is 0.12. If its value does not exceed 0.12, it means that it has a good fitting effect. On the contrary, it means that it has a relatively poor-itting effect (Henseler et al., 2014). The SRMR (RMS$_{theta}$) value 0.041 (0.101) indicates good fit of our structural model.

### 4.3.6.2 Collinearity assessment

Before we carry out the evaluation and analysis of the structural relationships, we need to comprehensively check the collinearity to avoid the deviation of regression results. In this study, the variance expansion factor (VIF) values corresponding to all constructs are calculated, as shown in Table 4.8. According to the research of Hair et al. (2011), these values do not exceed 5 and are close to 5. We find that the obtained VIF values are not more than 5, so collinearity is not a very important issue.

Table 4.8 Variance inflation factor (VIF) values

| Construct | Item | Outer VIF | Inner VIF | | |
|---|---|---|---|---|---|
| | | | Affective involvement | Cognitive involvement | Behavioral engagement intention |
| Privacy and security | PS1 | 2.718 | 1.691 | 1.691 | |
| | PS2 | 3.170 | | | |
| | PS3 | 3.084 | | | |
| | PS4 | 2.589 | | | |
| | PS5 | 3.485 | | | |
| Portability | PT1 | 2.820 | 2.066 | 2.066 | |
| | PT2 | 3.566 | | | |
| | PT3 | 3.263 | | | |
| UI attractiveness | UI1 | 2.045 | 2.087 | 2.087 | |
| | UI2 | 3.103 | | | |
| | UI3 | 3.957 | | | |
| | UI4 | 4.069 | | | |
| | UI5 | 4.801 | | | |
| | UI6 | 4.801 | | | |
| Compatibility | CP1 | 2.337 | 2.641 | 2.641 | |
| | CP2 | 2.794 | | | |
| | CP3 | 2.995 | | | |
| Effort expectancy | EE1 | 2.299 | 2.314 | 2.314 | |
| | EE2 | 2.996 | | | |
| | EE3 | 3.075 | | | |

| | | | | | |
|---|---|---|---|---|---|
| | EE4 | 2.909 | | | |
| Interactivity | IT1 | 3.236 | 1.879 | 1.879 | |
| | IT2 | 3.554 | | | |
| | IT3 | 3.437 | | | |
| Time convenience | TC1 | 3.667 | 2.608 | 2.608 | |
| | TC2 | 3.295 | | | |
| | TC3 | 2.641 | | | |
| | TC4 | 1.643 | | | |
| Affective involvement | AI1 | 3.988 | | | 2.294 |
| | AI2 | 3.927 | | | |
| | AI3 | 3.895 | | | |
| Cognitive involvement | CI1 | 2.761 | | | 2.343 |
| | CI2 | 2.934 | | | |
| | CI3 | 2.789 | | | |
| | CI4 | 2.879 | | | |
| Behavioral engagement intention | BEN1 | 2.581 | | | |
| | BEN2 | 3.515 | | | |
| | BEN3 | 3.248 | | | |
| | BEN4 | 2.490 | | | |

Note(s): The green font indicates a VIF value less than 3.0

### 4.3.6.3 Structural model path coefficients

In order to fully test the hypothesis, a total of 5000 subsamples are used to analyze and check the structural model. At this time, the relevance and importance of the hypothetical path need to be determined. In addition, we should also get the variance related to interpretation. Finally, the obtained data are listed in detail in Figure 4.3 of this study.
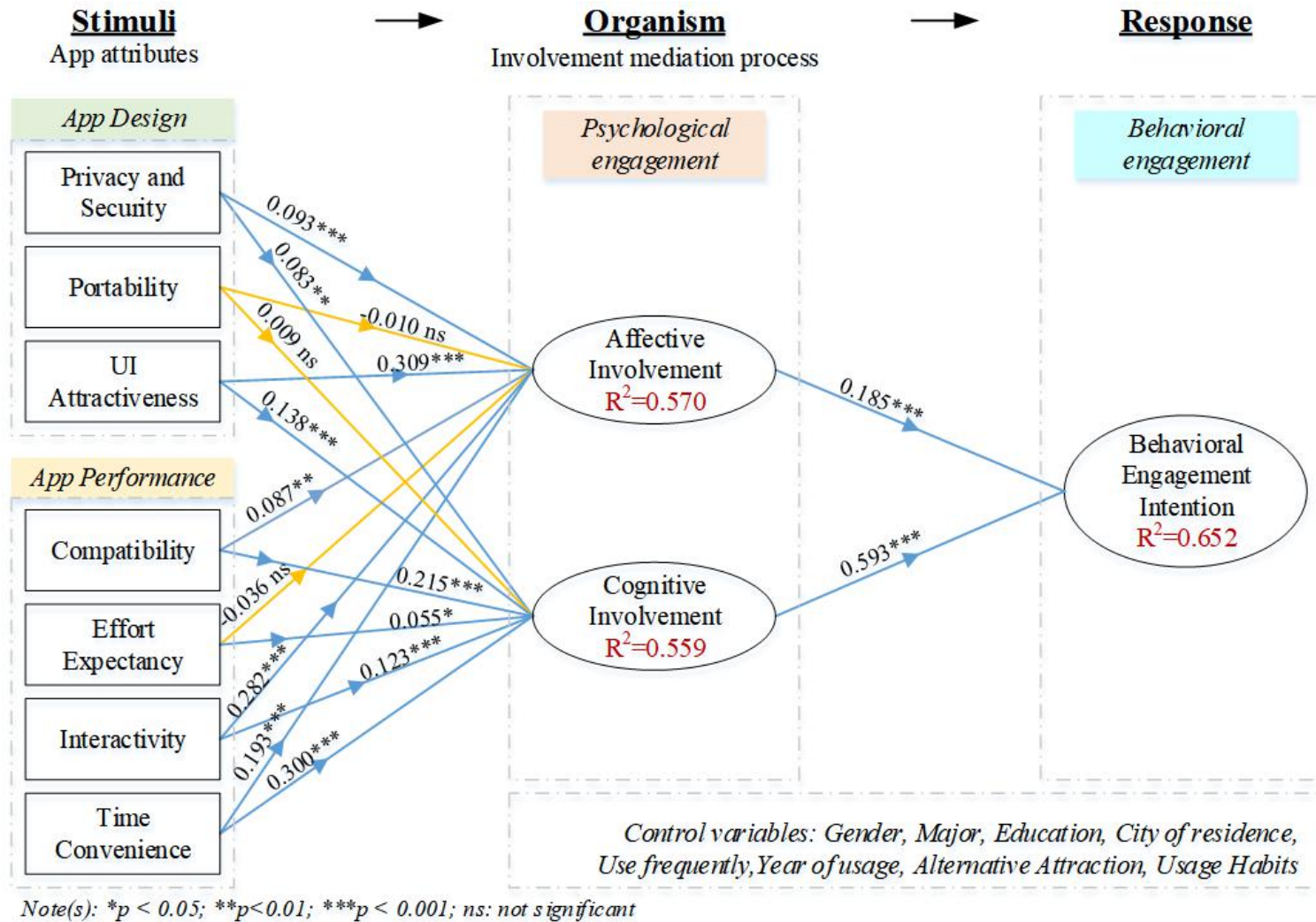
Figure 4.3 The structural model B

It is indicated that UI (Path coefficient = 0.309, t = 11.348, p < 0.001), PS (t = 3.569, path coefficient = 0.093, p < 0.001), CP (Path coefficient = 0.087, t = 2.966, p < 0.01), IT (Path coefficient = 0.282, t = 10.977, p < 0.001), and TC (Path coefficient = 0.193, t = 6.860, p < 0.001) have positive correlation with AI.

It is indicated that EE (Path coefficient = 0.055, t = 2.015, p < 0.05), CP (Path coefficient = 0.1215, t = 7.159, p < 0.001),PS (Path coefficient = 0.083, t = 2.954, p < 0.01), UI (Path coefficient = 0.138, t = 5.509, p < 0.001), TC (Path coefficient = 0.300, t = 10.194, p < 0.001), and IT (Path coefficient = 0.123, t = 4.911, p < 0.001) have positive correlation with CI.

Moreover, it is indicated that PT (Path coefficient = 0.009, t = 0.324, p > 0.05) is positively correlated with CI, but not significant.

Although the impact of EE (Path coefficient = -0.036, t = 1.427, p > 0.05) and PT (Path coefficient = -0.101, t = 0.414, p > 0.05) on AI are not significant, the relationship are opposite to our expectation. Hypothesis testing result see Table 4.9.

Table 4.9 Summary of hypothesis results

| No. | Hypothetical Relationships | Results |
|---|---|---|
| H1a | Privacy and Security → Affective Involvement (+) | Supported |
| H1b | Privacy and Security → Cognitive Involvement (+) | Supported |
| H2a | Portability → Affective Involvement (-) | Not supported |
| H2b | Portability → Cognitive Involvement (-) | Not supported |
| H3a | UI Attractiveness → Affective Involvement (+) | Supported |
| H3b | UI Attractiveness → Cognitive Involvement (+) | Supported |
| H4a | Compatibility → Affective Involvement (+) | Supported |
| H4b | Compatibility → Cognitive Involvement (-) | Not supported |
| H5a | Effort Expectancy → Affective Involvement (+) | Supported |
| H5b | Effort Expectancy → Cognitive Involvement (+) | Supported |
| H6a | Interactivity → Affective Involvement (+) | Supported |
| H6b | Interactivity → Cognitive Involvement (+) | Supported |
| H7a | Time Convenience → Affective Involvement (+) | Supported |
| H7b | Time Convenience → Cognitive Involvement (+) | Supported |
| H8 | Affective Involvement → Behavioral Engagement Intention (+) | Supported |
| H9 | Cognitive Involvement → Behavioral Engagement Intention (+) | Supported |

## 4.3.6.4 Coefficient of determination ($R^2$)

The determination coefficient ($R^2$) related to latent variables is shown in the table. Generally, $R^2$ is mainly used to describe the variance explained by independent variables among dependent variables. Through in-depth analysis, if it has a relatively high value, it means that the structural model has good prediction ability. Henseler et al. (2009) propose that if the value of $R^2$ is around 0.67, it can be judged that it is substantive. If its value is lower than 0.19, it means that it is relatively weak. It is clear that the present model can well explain 65.2% of

the variance for behavioral engagement intention, 57.0% of the variance for affective involvement, and 55.9% of the variance for cognitive involvement (see Table 4.10).

Table 4.10 The coefficient of determination

| Latent variable | R Square | Remark |
|---|---|---|
| Affective involvement | 0.570 | substantial |
| Cognitive involvement | 0.559 | substantial |
| Behavioral engagement intention | 0.652 | substantial |

### 4.3.6.5 Blindfolding relevance $Q^2$

Generally speaking, we can sample Stone-Geisser's ($Q^2$) to objectively analyze the test correlation. On this basis, we can fully grasp the prediction ability of the model (Hair et al., 2014). It mainly uses the omission distance in PLS for reasonable estimation and analysis (Hair et al., 2014). In addition, Hair and Hult et al. (2014) also point out that we need to analyze this index to meet some special requirements. After in-depth analysis, we set the missing distance to 6. The main reason is that this value can bring better results. Some researchers point out that if $Q^2$ If the value exceeds 0, it means that there is a strong predictive correlation between endogenous and exogenous constructs (Hair et al., 2014). According to the analysis results, $Q^2$ All values exceed 0. Accordingly, we can clearly judge that all exogenous constructs have a good predictive correlation (see Annex A, Table 4.13).

### 4.3.7 Control variables

The table reports the analysis of control variables. From the table, it is a confirmed hypothesis that usage habits (β=0.091, T=5.591, p<0.001), alternative attraction (β=0.061, T=3.689, p<0.001), education (β=0.031, T=2.220, p<0.05) and gender (β=0.028, T=1.989, p<0.05) positively affect behavioral engagement intention. It is a confirmed hypothesis that uses frequently (β= -0.0.15, T=1.023, p>0.05) negatively affects behavioral engagement intention, and year of usage (β=0.019, T=1.477, p>0.05) positive affects behavioral engagement intention, but it should be pointed out that they are not significant (shown in Table 4.11).

Table 4.11 Control variable analysis result

| | β | T-value | Significance |
|---|---|---|---|
| Gender → BEI | 0.028 | 1.989 | * |
| Education → BEI | 0.031 | 2.220 | * |
| Use frequently → BEI | -0.015 | 1.023 | NS |
| Year of usage → BEI | 0.019 | 1.477 | NS |
| Alternative attraction → BEI | 0.061 | 3.689 | *** |
| Usage habits → BEI | 0.091 | 5.591 | *** |

Note(s): BEI=behavioral engagement intention;  β = coefficient of determination; *p < 0.05; **P<0.01; ***p < 0.001; NS = not significant.

## 4.4 Chapter summary

In this chapter, we research factors facilitating Chinese college students to engage in mobile campus service apps. We show the model in Figure 4.1 of this study. It is indicated that the dependent variable is behavioral engagement intention (BEI) and the mediators are affective involvement (AI) and cognitive involvement (CI). The independent variables include interactivity (IT), UI attractiveness (UI), effort expectancy (EE), portability (PT), compatibility (CP), privacy and security (PS), and time convenience (TC). The control variables include gender, major, education, city of residence, use frequently, year of usage, alternative attraction, and usage habits.

We then propose indicators and measurement models according to the research model. Latent Variables PS (5 indicators), AI (3 indicators), BEN (4 indicators), CI (4 indicators), PT (3 indicators), TC (4 indicators), UI (6 indicators), IT (3 indicators), EE (4 indicators) and CP (3 indicators), are specified. The control variables are measured with single-item measures. We establish the PLS path model by using reflective constructs as target constructs of the research model.

Next, we collect data by conducting a questionnaire survey among 14 Chinese universities. On this basis, we further examine the primary issues of the data including suspicious response patterns (eg. outliers, straight lining and inconsistent answers) and missing data.

Fourth, we apply the PLS-SEM algorithms (PLS algorithm, Bootstrapping, and Blindfolding) to estimate the model with the SmartPLS 3.3 software.

Finally, we use reflective measurement models to evaluate both validity and reliability. We examine the relevance and significance of coefficients before we assess the PLS-SEM results. On this basis, we use a series of indicators of bootstrapping to test its significance. Then, we also use $R^2$ values (i.e., coefficients of determination) to test the explanatory variance related to endogenous constructs (affective involvement, cognitive involvement, behavioral engagement intention) in the structural model. In order to objectively and reasonably analyze the prediction correlation of the path model, we mainly carry out the research through a blindfolding program. Control variables are tested in the final stage.

# Chapter 5: Discussion and Conclusion

## 5.1 Discussion

In previous studies, researchers have formed a good consensus on the significance of customer adoption/engagement in maintaining sustainable customer relationships and promoting business success (Brodie et al., 2013; Brodie & Hollebeek, 2011; Cheung et al., 2015; Dovaliene et al., 2015; Fang et al., 2017; R. P. Wang, 2019; S. F. Wang, 2020). At present, the research on customer adoption/engagement is considered to be a hot direction in this field. One problem that needs to be pointed out is that although mcs-App is an important means of the business relationship that some enterprises mainly engaged in campus-related business need to seek, there is still very little in-depth research on customers' adoption/engagement in mcs-App.

### 5.1.1 App adoption

The present work mainly identifies the antecedents of user app adoption intention with mcs-Apps from the technological, personal, and environmental perspectives. Our results have confirmed that environmental characteristics (including peer influence and mass influence), personal characteristics (app self-efficacy and personal motivation) and app technological characteristics (app perceived ease of use and perceived usefulness) are important cues driving mcs-App adoption. Furthermore, we perform the post hoc tests and present our results. The table reveals that the perceived ease of uses on mcs-App adoption is 0.048 (t = 3.138, CI = [0.019, 0.080]), indirect effect of perceived usefulness on mcs-App adoption is 0.099 (t = 5.979, CI = [0.067, 0.131]), personal motivation on mcs-App adoption is 0.079 (t = 4.633, CI = [0.046, 0.113]), self-efficacy on mcs-App adoption is 0.054 (t = 3.761, CI = [0.026, 0.083]), mass influence on mcs-App adoption is 0.145 (t = 5.979, CI = [0.108, 0.1861]), and peer influence on mcs-App adoption is 0.110 (t = 5.979, CI = [0.077, 0.145]),   which suggests that mass influence and peer influence of app environmental characteristics exert the largest impact on mcs-App adoption (see Annex A, Table 5.1).

Therefore, we propose some suggestions/recommendations to college management teams and campus-related companies, and mcs-App developers.

**5.1.1.1 Perceived usefulness**

(1) Administrative orders are issued and must be used, such as app clocking and attendance.

(2) Bind users to must-use functions, such as scanning for meals.

**5.1.1.2 Perceived ease of use**

(1) Push app introduction in the official group.

(2) Release and use the notification function.

(3) Share the operation demonstration video.

**5.1.1.3 Personal motivation**

(1) Provide the function to query information related to individuals, such as scholarship query, and grade query.

(2) It means that the app will be more convenient than past. For example, in the past, students used to bring their cards to eat, but now they only need to bring their mobile phones.

**5.1.1.4 Self-efficacy**

(1) Provide integral modules for students to compare with themselves.

(2) Provide a ranking function, you can compare with the surrounding students.

**5.1.1.5 Mass influence**

(1) Provide the recommendation function, which can be seen by other students when using the scene.

(2) Refer to app Pinduoduo's shake mode and ask classmates around to open a red packet.

**5.1.1.6 Peer influence**

(1) Provide the function of recommending fellow students to use.

(2) Provide the sharing function of moments.

In the initial use stage of a mobile campus service app, college students explore the functions of the app based on curiosity or simply wanting to gain some new experience. The empirical study in Chapter 3 shows that inertia has a positive and significant effect on app adoption intention. IT innovation has a positive impact on app adoption intention. Therefore, based on the research of exploring the use of mobile campus service app, this study proposes the following suggestions for schools and enterprises/companies that provide mobile campus service apps.

(1) Mass influence factors. (a) Before the implementation of the mobile campus service app project, the university will publicize college students through the university-level

publicity platform and the department-level publicity platform, with forms of pictures, texts, and shorters. (b) Before the app implementation, the Student Affairs Department and Youth League Committee of the university should publicize it to college students in advance. (c) Carry out a campaign with the theme of "Mobile Campus Service App" through the school's community and spread the words to more college students through on-site publicity.

(2) Peer influence factors. (a) Provide sharing functions. After using the mobile campus service app, college students share it with their classmates and their hometown, forming secondary communication and attracting more new users (college students). (b) The school can organize trainings for the president of each class to have an in-depth understanding of the mobile campus service app. The class president will then influence his peers in the same class, which will produce better results.

(3) The Usefulness of app that students are concerned about. (a) The QR code is printed on the admission letter of each student, and the student can scan the code to download the mobile campus service app. Alternatively, he/she can scan the code and follow the school's WeChat service account (or WeChat mini program). (b) Before new students come to school, they can use the mobile service app to choose dormitory in advance, purchase beddings, get invited into a WeChat group of freshmen. With the app, new students can also have the chance to know the school sooner, as well as the college/department, the program curriculums, and possible directions after graduation. (c) Provide online payment service functions, such as online payment of tuition fees, CET-4 and CET-6 fees, online payment of water and electricity bills. In doing so, students can enjoy various services anytime and anywhere.

(4) Ease of use of the app that students are concerned about. (a) Considering the 1.2 billion users of WeChat, the university can provide WeChat service account, WeChat subscription account, and WeChat mini program to college students as a mobile campus service app (or as a Portal). As students are familiar with WeChat, introductions to a school WeChat service account, WeChat subscription account, and WeChat mini program will be more easily accepted.

(5) SFVs is a great way of communication in today's new media era. The school can make SFVs appeal to college students by introducing the characteristics of the mobile campus service app and promoting the convenience, effectiveness and efficiency features carried by the app. The school can also produce a variety of short videos of  app use tips, and encourage college students to share with their classmates and hometown.

(6) As college students are young and energetic, setting sports column on mobile campus service app will enhance their attention to mobile campus service apps. Sports column can be

used to cover school sports news, event information.

## 5.1.2  App engagement

Based on the previous studies, we can take into account the relevance of customer participation (Brodie et al., 2013; Brodie & Hollebeek, 2011; Cheung et al., 2015; Dovaliene et al., 2015; Fang et al., 2017; R. P. Wang, 2019; S. F. Wang, 2020). It is necessary to analyze the connotation of the application attribute and explore the law and mechanism of its influence on mcs-App participation. We mainly analyze the domain of application attributes based on the S-O-R model, and further demonstrate how it can promote behavioral participation intention through the factors of cognitive participation and emotional participation. In the empirical research carried out in this research, some meaningful results have been obtained.

This research mainly analyzes the antecedents of the interaction between users and mobile applications from the perspective of application attributes. We find that design attributes (mainly UI attractiveness, security and privacy) and performance attributes (mainly time convenience, interactivity, and app compatibility) are very important factors for mcs-App engagement. Among them, the significant impact is the time convenience and UI attraction of the application. They have played a great role in their respective attributes. On this basis, we have carried out a series of post-tests in this research (see Annex A, Table 5.2).

The table reports that the indirect effect of privacy and security on mcs-App engagement is 0.066 (t = 3.339, CI = [0.029,0.107]), UI attractiveness on mcs-App engagement is 0.139 (t = 7.051, CI = [0.101,0.178]), compatibility on mcs-App engagement is 0.143 (t = 6.723, CI = [0.103,0.186]), interactivity on mcs-App engagement is 0.125 (t = 6.940, CI = [0.090,0.160]), and time convenience on mcs-App engagement is 0.214 (t = 10.066, CI = [0.171,0.254]), which suggests that UI attractiveness and compatibility of app attributes exert the largest effect on mcs-App engagement.

In addition, our results show that there is a negative correlation between mcs-App engagement and portable app design. We speculate that participants rarely change their phones to different operating systems (such as from Android to iOS) during their school years and that they are not sensitive to compatibility. The app performance of effort expectancy is found to be negatively associated with mcs-App engagement as well. Our speculation is the increasing phone app popularity, participants have experiences in app usage, resulting in app effect expectancy not promoting mcs-App engagement.

Third, this research fully analyzes the methods and conclusions of some previous

researchers (Cheung et al., 2015; Fang et al., 2017; J. M. Kang et al., 2015), regards the concept of user involvement as behavioral involvement, and psychological involvement, and then makes a comprehensive exploration. The data we obtained show that psychological involvement plays a significant driving role in users' behavioral participation intention. Here, psychological involvement includes cognitive involvement and emotional involvement. In other words, psychological involvement provides sufficient explanatory power to behavioral participation intention.

As a result, some recommendations are proposed to college management teams and campus-related companies, and mcs-App developers.

### 5.1.2.1 Privacy and security

(1) Single sign-on with the unified identity of the school.

(2) Bind Wechat ID to achieve a single sign-on function.

(3) Restrict or prohibit the use of face recognition function.

### 5.1.2.2 Portability

(1) Improve the compatibility with the Dingtalk app, Wechat app, DingtalkGov app (A special government app developed by Zhejiang Big Data Development Administration [ZBDDA] which based on Dingtalk technology framework), bank apps, and other apps.

(2) Compatibility of different phones, compatibility of different operating systems, such as iOS vs Android, HarmonyOS (Huawei operating system) vs MIUI (Xiaomi operating system), Windows 10 vs Windows 7 on PC, Google Chrome vs Microsoft Edge or 360 (Qihu browser) on the browser.

### 5.1.2.3 UI attractiveness

(1) Invite professional artists to design several sets of interfaces and fonts in line with the aesthetic concept of college students.

(2) Reference national apps, such as Alipay and Wechat, and combine campus applications to provide UI suitable for college students.

### 5.1.2.4 Compatibility

(1) Pay attention to the smoothness of the user experience.

(2) Improve the convenience of opening the application, and reduce the depth of clicking.

### 5.1.2.5 Effort expectancy

(1) Promote the point and reward system.

(2) Promote pull mode and reward members who recommend friends for app use.

### 5.1.2.6 Interactivity

(1) Appointment mode, such as studio appointment, push notification of successful appointment and unlock password.

(2) Order mode, online supermarket after the order can be picked up or home delivery.

(3) In self-service mode, online orders can be picked up at the catering counter.

### 5.1.2.7 Time convenience

(1) Online ordering, after ordering, you can take it from the self-service counter, saving time in line.

(2) Teachers can take attendance by taking reports from students on their mobile phones and saving time.

In the stage of continuous use of mobile campus service app, college students have accepted the functions of mobile campus service app and can often use the app for their university life and study. The empirical study in Chapter 4 shows that alternative attraction and usage habits have significant positive effects on behavioral integration intention.

Based on the engagement research model of msc-App, taking college students as the survey object, we study app attributes, mediation of involvement, and engagement intention. We propose the following suggestions for schools and enterprises/companies providing mobile campus service apps to promote college students to use mobile campus service apps more continuously.

(1) Privacy and security that students are concerned about. (a) When using the mobile campus service app for the first time, students need to provide their name and student number, and they need to provide their mobile phone number, that is, they are bound by their names, student ids, and mobile phone numbers, to be paired with a unique dynamic verification code (referring to the 6-digit dynamic verification code sent by the system platform to the mobile phone designated by students). (b) During daily use, if students need to change their mobile phone numbers, they need to go to the designated department with a valid ID, make a face-to-face confirmation, and check the dynamic password of the mobile phone. (c) for important information (e.g., consumption flow; or that the dormitory electricity is below the preset threshold), the app should inform the students in time, and allow students to retrieve the details later. (d) When the threshold is triggered (for example, the consumption amount exceeds the limit), students are required to provide the dynamic key sent by the system platform to the mobile phone for verification.

(2) Time convenience, which is a concerned for students. The university and the enterprise jointly provide the following services to students through the mobile campus service app. (a) Personal appointment. For example, college students can know the information of visitors in advance. (b) Bus reservations. For example, college students can book the school bus in advance, specifying the time and choosing the route. (c) Meal reservations. For example, college students can book lunch, dinner, birthday parties, and room in advance. Students can book the time and place of food delivery. College students can also book the way of food delivery (i.e., dine-in, self-pickup, or take-out). (d) Booking of venues. For example, college students can book sports facilities, medical check appointments, and library study rooms in advance.

(3) As a product of the new media era, SFVs are an emerging way of information dissemination, which is suitable for the fragmented reading habits of college students. (a) The school produces official promotional SFVs to introduce the features and functions of the mobile campus service app; (b) Make videos of students' specific experiences and experiences in using apps, so that students can "speak"/" speak out "by themselves, and play a better publicity role for other students. (c) Make a variety of small videos using skills, which are easier to be watched by college students and easier to spread.

(4) Health is a basic human need. Everyone needs health. Mobile campus service app provides sports column, and schools with conditions can independently provide app (such as WeChat Service Account and mini program). By referring to the health and fitness app (such as Gudong/Goodong app and Keep app), the function overview of the exercise app is physical education course (related to teaching), personal exercise plan, personal exercise record, personal fitness course, exercise and fitness guidance (Yan & Li, 2021). College students rely on sports apps to carry out fitness exercises anytime and anywhere and develop good exercise habits (A. S. Li, 2019).

## 5.2 Conclusion

### 5.2.1 Implications for research and practice

#### 5.2.1.1 Theoretical implications

Alturas (2021) used the method of exploratory bibliometrics to deeply explore a series of research and academic works related to the acceptance of technical models, to propose a universal research model. The present research reviews the relevant theories of adoption

comprehensively: (1) TRA (Fishbein & Ajzen, 1975), (2) TPB (Ajzen, 1991), (3) DTPB (S. Taylor & Todd, 1995a, 1995b), (4) TAM (Davis, 1985; Davis, Bagozzi, & Warshaw, 1989), (5) TAM2 (V. Venkatesh & Davis, 2000), (6)TAM3 (V. Venkatesh & Bala, 2008), (7) C-TAM-TPB (S. Taylor & Todd, 1995a), (8) UTAUT (V. Venkatesh et al., 2003), (9) UTAUT2 (V. Venkatesh et al., 2012), (10) MISS (DeLone & McLean, 1992), (11) UMISS (DeLone & McLean, 2003), (12) PII (Zaichkowsky, 1985), (13) CMUA (Beaudry & Pinsonneault, 2005), (14) TRPB (Ajzen & Kruglanski, 2019). This study reviews the following theories of engagement comprehensively also: (1) MPCU (Thompson, Higgins, & Howell, 1991), (2) MM (Davis, Bagozzi, & Warshaw, 1992), (3) TOE framework (L. Tornatzky & Fleischer, 1990), (4) SCT (D. R. Compeau & Higgins, 1995a), (5) IDT (Moore and Benbasat, 1996), (6) ECT (Oliver, 1977). Furthermore, we propose a chronological graph of technology acceptance theories, adapted from Momani and Jamous (2017).

Second, this study proposes the definitions of adoption and engagement in the Chinese campus context. Conceptually, engagement and adoption are different behaviors. Engagement may occur after adoption (namely the first-time use). Adoption is defined as the initial use, including three actions of downloading the app, installing the app, and using the app. "Use" may be one or more times. Engagement is defined as continuance usage and involvement after the initial use, including two actions to interact with the app and use the app. "Use" and "Interact" are continuous. These two concepts fill the gap in relevant concepts of mobile campus service apps in China.

This research proposes an mcs-App adoption model. It is also one of the earliest studies on the mechanism and influencing factors of an mcs-App. This research analyzes the internal correlation between application features from the perspective of basic theory (including technological, personal, and environmental characteristics), attitude toward apps, and app adoption intention. We further test these relationships empirically with a real mcs-App. We analyze its main antecedents in the mobile campus environment to further enrich the theory in this field.

In addition, this research also proposes an mcs-App engagement model. It is no longer limited to the basic concepts of application adoption. This study is one of the earliest studies on the influencing factors of mcs-App engagement. We use the S-O-R framework to explore the internal relationship between behavioral participation intention, psychological participation, and application attributes. On this basis, we carried out the related UAT test to conduct empirical research on the original theory. We analyze its main antecedents in the mobile campus environment, which further enriches the theory of behavior participation

research. The existing literature has analyzed the consequences of the interaction between customers and apps (Dovaliene et al., 2015), but there is still a lack of research on the antecedents. Based on previous experience, this research comprehensively compares and analyzes the attributes of the two types of applications as the main antecedent of promoting mcs-App engagement. On this basis, promote the further improvement of relevant theories.

### 5.2.1.2 Managerial implications

Regarding the first research question "What is the current status of campus service app usage in China?", my study suggests the following:

(1) Both the existing literature and the analysis of the apps owned by the top 10 Chinese universities suggest that, Chinese universities have various types of mcs-Apps, and that these apps have also become the new media in students' daily life.

(2) From the perspective of functions, the functions of mcs-Apps can be summarized as identification, information acquisition, resource acquisition, learning assistance, and mobile payment.

(3) From the perspective of the business model, the method of "school-enterprise cooperation to develop, school organization to apply" is more common.

(4) A gap that has not yet been solved is the co-existence of multiple university-level and school/department-level apps, which are relatively cluttered and lack central planning. This is a prevailing and imminent problem that begs for a solution by universities to better serve their students.

Regarding the second research question "What factors make college students use an app (download, install, and use it) for the first time?", my study suggests the following:

(1) In terms of significance, the factors include perceived usefulness, personal motivation, self-efficacy, mass influence, peer influence, and perceived ease of use, with ascending values.

(2) In terms of the path coefficient, the factors include mass influence, peer influence, perceived usefulness, personal motivation, self-efficacy, and perceived ease of use, with decreasing values.

Regarding the third research question "What factors enable college students to continuously use the app and continue to interact with the app?", We have the following answers:

(1) From the significance of affective involvement, the factors include UI attractiveness, interactivity, time convenience, privacy and security, and compatibility, with ascending values.

From the significance of cognitive involvement, the factors include time convenience, compatibility, UI attractiveness, interactivity, privacy and security, and effort expectancy, with ascending values.

(2) From the perspective of the path coefficient of affective involvement, the factors include UI attractiveness, interactivity, time convenience, privacy and security, compatibility, effort expectation, and portability, with decreasing values. From the path coefficient of cognitive involvement, the factors include time convenience, compatibility, UI attractiveness, interactivity, privacy and security, effort expectancy, and portability, with decreasing values.

Regarding the fourth research question "What management strategies can be proposed to improve the adoption and engagement of campus service apps?", my study suggests the following:

(1) In terms of mcs-App adoption, university administrators and companies developing the mcs-App should focus on factors including "perceived usefulness, personal motivation, self-efficacy, mass influence, and peers influence". Following the above principle, university administrators need to formulate more detailed countermeasures according to specific situations on campus from the perspective of guiding students to adopt the mcs-App. With the same principle, the development company should work hard on the product itself (such as app design and app performance), and provide more high-quality after-sales service (for countermeasures, refer to 5.1.1).

(2) In terms of mcs-App engagement, university administrators and companies developing the mcs-App should focus on factors including "UI attractiveness, interactivity, time convenience, privacy and security, and compatibility". Following the above principle, university administrators need to formulate more detailed countermeasures according to specific situations on campus from the perspective of guiding students to use the mcs-App. With the same principle, the development company should work hard on the product itself (such as app design and app performance), and provide more high-quality after-sales service (for countermeasures, refer to 5.1.2).

### 5.2.2 Limitations and future research directions

These findings are helpful to guide researchers in this field to carry out further research, but it still has some shortcomings.

Firstly, there is no coding for student majors as a control variable. Therefore, quantitative statistical analysis of student majors is not possible, and only word frequency analysis can be done. Future research could code major categories and then study them as a control variable.

Secondly, literature work has studied the topic that customers' participation in the field of digital marketing affects their purchase intention (Clement Addo et al., 2021). Future research could incorporate the way of live broadcast as an influential factor for the promotion of mcs-App.

Third, some scholars research the commentary on information systems (IS)/information technology (IT) role in emergency and pandemic management (Shiau et al., 2021), the COVID-19 pandemic crisis. Future research could consider the epidemic as a special case for research.

Finally, according to the analysis of the students' suggestions, it is suggested to reduce the frequency of advertisements. Future research could add advertising construct and its (perceived) negative effect on the mcs-App adoption intention. To sum up, we are not sure whether these conclusions can be applied to other countries and regions in the world. Considering this analysis, we should fully consider the potential cultural impact related to mcs-App adoption and engagement in the next research work, to obtain a more comprehensive research conclusion.

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# Annex A: List of Tables

Table 1.1 The number of users and percentage of netizens in China

| Apps | March 2020 | | December 2018 | | |
| | Mobile netizens(in millions) | Percentage of netizens | Mobile netizens(in millions) | Percentage of netizens | annual growth rate |
| --- | --- | --- | --- | --- | --- |
| IM | 89,012 | 99.2% | 78,029 | 95.5% | 14.1% |
| Payment | 76,508 | 85.3% | 58,339 | 71.4% | 31.1% |
| Searching | 74,535 | 83.1% | 65,396 | 80.0% | 14.0% |
| News | 72,642 | 81.0% | 65,286 | 79.9% | 11.3% |
| Shopping | 70,749 | 78.9% | 59,191 | 72.5% | 19.5% |
| Music | 63,274 | 70.5% | 55,296 | 67.7% | 14.4% |
| Game | 52,893 | 59.0% | 45,879 | 56.2% | 15.3% |
| Literature | 45,255 | 50.5% | 41,017 | 50.2% | 10.3% |
| Education | 42,023 | 46.9% | 19,416 | 23.8% | 116.4% |
| Takeout | 39,653 | 44.2% | 39,708 | 48.6% | -0.1% |

Source: CNNIC (2020)

Table 2.3 App statistics for the top 10 universities in China

| Top 10 universities | College-owned app | WeChat service account | WeChat subscription account | Mini program | Total |
| --- | --- | --- | --- | --- | --- |
| Tsinghua University | 2 | N/A | 10 | 1 | 13 |
| Peking University | 4 | N/A | 5 | 1 | 10 |
| Fudan University | 1 | N/A | 6 | 1 | 8 |
| University of Science and Technology of China | N/A | 1 | 4 | N/A | 5 |
| Zhejiang University | 3 | N/A | 6 | 1 | 10 |
| Shanghai Jiao Tong University | 1 | 2 | 4 | 1 | 8 |
| Nanjing University | 1 | 1 | 5 | 1 | 8 |
| Sun Yat-sen University | 1 | 1 | 5 | 1 | 8 |
| Wuhan University | 2 | N/A | 5 | 1 | 8 |
| Harbin Institute of Technology | 3 | N/A | 4 | 1 | 8 |

Notes: (1) Tsinghua University website is https://www.tsinghua.edu.cn/ (2) Peking University website is https://www.pku.edu.cn/ (3) Fudan University website is https://www.fudan.edu.cn/ (4) University of Science and Technology of China website is https://www.ustc.edu.cn/ (5) Zhejiang University website is https://www.zju.edu.cn/ (6) Shanghai Jiao Tong University website is https://www.sjtu.edu.cn/ (7) Nanjing University website is https://www.nju.edu.cn/ (8) Sun Yat-sen University website is https://www.sysu.edu.cn/ (9) Wuhan University website is https://www.whu.edu.cn/ (10) Harbin Institute of Technology website is http://www.hit.edu.cn/

Table 2.4 Social media app statistics for the top 10 Chinese universities (Chinese version)

| | Kwai | Tiktok | Weibo | WeChat subscription account | WeChat mini program | WeChat channel | Today's headlines |
| --- | --- | --- | --- | --- | --- | --- | --- |

|  | | | | | | |
|---|---|---|---|---|---|---|
| Tsinghua University | √ | √ | √ | √ | | |
| Peking University | | | √ | √ | | |
| Fudan University | | √ | √ | √ | √ | | √ |
| University of Science and Technology of China | | | | | | |
| Zhejiang University | | √ | √ | √ | √ | | √ |
| Shanghai Jiao Tong University | | | √ | √ | √ | |
| Nanjing University | | | √ | √ | √ | |
| Sun Yat-sen University | | | √ | √ | √ | √ |
| Wuhan University | | | √ | √ | | |
| Harbin Institute of Technology | | | | √ | | |

Notes: (1) Kwai website is https://www.kuaishou.com/ (2) TikTok website is https://www.tiktok.com/ (3) Weibo website is https://weibo.com/ (4) Weixin Official Accounts Platform (Service Account, Subscription Account, Mini Program, and WeChat Work) website are https://mp.weixin.qq.com/cgi-bin/loginpage?t=wxm2-login&lang=en_US&token=/ (5) WeChat channel website is https://channels.weixin.qq.com (6) Today's headlines (Toutiao) website is https://www.toutiao.com/

Table 2.5 Social media app statistics for the top 10 Chinese universities (English version)

|  | Facebook | Instagram | Twitter | YouTube | Linkedin | Weibo | TikTok | Bilibili | WeChat |
|---|---|---|---|---|---|---|---|---|---|
| Tsinghua University | √ | √ | √ | √ | √ | | √ | | √ |
| Peking University | √ | √ | √ | √ | √ | √ | √ | √ | √ |
| Fudan University | √ | √ | √ | | √ | √ | √ | | √ |
| University of Science and Technology of China | | | | | | | | | |
| Zhejiang University | √ | √ | √ | √ | √ | | | | |
| Shanghai Jiao Tong University | √ | √ | √ | √ | | √ | √ | √ | √ |
| Nanjing University | | | | | | √ | | | √ |
| Sun Yat-sen University | √ | √ | √ | √ | | √ | √ | √ | √ |
| Wuhan University | | | | | | | | | |
| Harbin Institute of Technology | √ | | √ | | √ | | | √ | √ |

Notes: (1) Facebook website is https://www.facebook.com/ (2) Instagram website is https://twitter.com/ (3) Twitter website is https://www.linkedin.com/ (4) YouTube website is https://www.youtube.com/ (5) Linkedin website is https://www.instagram.com/ (6) Weibo website is https://www.bilibili.com (7) Tiktok website is https://weibo.com/ (8) Bilibili website is https://www.tiktok.com/ (9) WeChat Service Account website is https://mp.weixin.qq.com/cgi-bin/loginpage?t=wxm2-login&lang=en_US&token=/

Table 2.6 App statistics for the top 10 global universities

| No. | Rank | University/Institute | Country | Official app | Years | Number of apps |
|---|---|---|---|---|---|---|
| 1 | 1 | Harvard University* | United States | Harvard College Mobile | 7+ | 17 |
| 2 | 2 | Massachusetts Institute of Technology | United States | MIT Mobile | 10+ | 18 |
| 3 | 3 | Stanford University* | United States | Stanford Mobile | 1+ | 20 |
| 4 | 4 | University of California--Berkeley* | United States | UC Berkeley Mobile | 11+ | 6 |
| 5 | 5 | University of Oxford | United | N/A | N/A | 2 |

| No. | Rank | University/Institute | Country | App | | Ages | Count |
|---|---|---|---|---|---|---|---|
| | | | Kingdom | | | | |
| 6 | 6 | Columbia University* | United States | Columbia University：CC & SEAS | | 6+ | 16 |
| 7 | 7 | University of Washington | United States | My UW | | N/A | 7 |
| 8 | 8 | University of Cambridge | United Kingdom | N/A | | N/A | 3 |
| 9 | 9 | California Institute of Technology | United States | N/A | | 3+ | 2 |
| 10 | 9 | Johns Hopkins University | United States | JHUMobile | | 10+ | 7 |

Notes: * indicates University has a sport app; JHUmobile 's developer is Johns Hopkins Digital.
(1) Harvard University website is https://www.harvard.edu/ (2) Massachusetts Institute of Technology website is https://www.mit.edu/ (3) Stanford University website is https://www.stanford.edu/ (4) University of California--Berkeley website is https://www.berkeley.edu (5) University of Oxford website is https://www.ox.ac.uk/ (6) Columbia University website is https://www.columbia.edu/ (7) University of Washington website is https://www.washington.edu/ (8) University of Cambridge website is https://www.cam.ac.uk/ (9) California Institute of Technology website is https://www.caltech.edu/ (10) Johns Hopkins University website is https://www.jhu.edu/

Table 2.7 App statistics for the top 10 global universities (social media App)

| No. | Rank | University/Institute | Facebook | Instagram | Twitters | YouTube | iTunes U | Medium | LinkedIn | Weibo | Pinterest | Tiktok | Coursera | Edx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | Harvard University | √ | √ | √ | √ | | | | | | | | |
| 2 | 2 | Massachusetts Institute of Technology | √ | √ | √ | √ | | | | | | | | √ |
| 3 | 3 | Stanford University | √ | √ | √ | √ | √ | | | | | | | |
| 4 | 4 | University of California--Berkeley | √ | √ | √ | √ | | √ | | | | | | |
| 5 | 5 | University of Oxford | √ | √ | √ | √ | √ | √ | √ | √ | | | | |
| 6 | 6 | Columbia University | √ | √ | √ | √ | | | √ | | | | | |
| 7 | 7 | University of Washington | √ | √ | √ | √ | | | √ | | √ | | | |
| 8 | 8 | University of Cambridge | √ | √ | √ | √ | | | √ | √ | | √ | | |
| 9 | 9 | California Institute of Technology | √ | √ | √ | √ | | | | | | | √ | √ |
| 10 | 9 | Johns Hopkins University | √ | √ | √ | √ | | | | | | | | |

Notes: (1) Facebook website is https://www.facebook.com/ (2) Instagram website is https://www.instagram.com/ (3) Twitter website is https://twitter.com/ (4) YouTube website is https://www.youtube.com/ (5) iTunes website is https://www.apple.com/itunes/ (6) Medium website is https://medium.com/
 (7) LinkedIn website is https://www.linkedin.com/ (8) Weibo website is https://weibo.com/ (9) theConversation website is https://theconversation.com/ (10) Pinterest website is https://www.pinterest.com/ (11) Tiktok website is https://www.tiktok.com/ (12) Coursera website is https://www.coursera.org/ (13) Edx website is https://www.edx.org/

Table 2.8 Apps of MIT

| No. | Apps | Category | Version |
|---|---|---|---|
| 1 | MIT Forum 219 | Business | N/A |
| 2 | MIT Orbit | | 3y ago |
| 3 | Learner Credential Wallet | Education | 9mo ago |
| 4 | MIT App Inventor | | N/A |

| 5 | MIT Atlas | | 7mo ago |
|----|-----------|---|---------|
| 6 | MIT Coin | | 1y ago |
| 7 | MIT Mobile | | 10y ago |
| 8 | MIT Tim Tickets | | 9mo ago |
| 9 | NICS Mobile | | N/A |
| 10 | Tablet.2008x | | 1y ago |
| 11 | MIT Recreation | Health & Fitness | 1y ago |
| 12 | CPW 2021 | | N/A |
| 13 | HackMIT | Productivity | N/A |
| 14 | MIT CPW 2020 | | 3y ago |
| 15 | MIT CPW 2022 | | N/A |
| 16 | MIT Ori 2021 | Socail Networking | 9mo ago |
| 17 | Private Kit | Ulilites | 2y ago |
| 18 | MIT Voice App | | 3y ago |

Notes:3y ago - 3 years ago; 9mo ago - 9 months ago, other analogy.

Table 2.9 Definitions of all constructs related to the theories

| Constructs | Definition | Author(s) and year |
|------------|------------|--------------------|
| Active Goals | "The main reason why people choose a certain behavior is to pursue the following goals: first, the experience and results achieved after the implementation of this behavior, which is the so-called procurement goal; The second is to obtain the goal recognized by others, which is the so-called approval goal. People can achieve procurement goals and approval goals through specific means". | Ajzen & Kruglanski, 2019 |
| Attitude Toward Behavior | "The individual's specific feelings (i.e. evaluative emotions) about the implementation of relevant behaviors". | Fishbein & Ajzen, 1975 |
| Evaluation | "Relevant implicit evaluation responses to the results". | Fishbein & Ajzen, 1975 |
| Actual Behavioral Control | "It refers to the conditions, resources and skills that people have to perform a certain behavior". | Fishbein & Ajzen, 1975 |
| Affect | "The degree of personal preference for certain behaviors (typical, such as the use of PC)". | Venkatesh et al., 2003 |
| Affect Towards Use | "Personal feelings of hatred, disgust, depression, excitement or joy about certain behaviors". | Thompson et al., 1991 |
| Anxiety | "Various emotional reactions described when an individual performs certain behaviors, such as personal use of a PC". | Venkatesh et al., 2003 |
| Behavioral Beliefs | "It refers to the probability of behavior producing some experience and results". | Ajzen, 2006 |
| Beliefs | "It refers to the probability of some results produced by an individual in the process of performing a specific behavior". | Davis et al., 1989 |
| Compatibility | "The consistency between an innovation and the experience, inner needs and values of the adopter". | Moore & Benbasat, 1991, 1996 |

| Complexity | "The extent to which an innovative achievement is considered difficult to use or master". | Thompson et al., 1991 |
|---|---|---|
| Control Beliefs | "It is related to the perception of related factors that affect behavior". | Ajzen, 2006 |
| Ease of Use | "It refers to the extent to which an innovative achievement is considered difficult to grasp and understand". | Moore & Benbasat, 1991 |
| Effort expectancy | "(a) Firstly, it is the degree to which a technology is easy to use; (b) Secondly, it refers to "users' views and attitudes towards the difficulty of use or operation". | (a) Venkatesh et al., 2003 (b) J. M. Kang et al., 2015 |
| Experience | "It refers to the relevant knowledge and skills that individuals have in the process of using some technologies. In addition, it also involves the specific time period corresponding to the use of these technologies". | J. M. Kang et al., 2015 |
| Extrinsic Motivation | "It refers to the main views and attitudes of users towards the implementation of an activity. It can achieve meaningful results that are different from activities. Typical examples include job promotion, salary increase or job performance improvement.". | Davis et al., 1992 |
| Facilitating Conditions | (a) "It is up to the observer to agree on the environmental factors that contribute to the implementation of a certain behavior. A typical example is to charge users for the return of goods and provide necessary convenience to the return process. The study found that when we use the information system, we can provide a favorable condition for relevant users to further improve the utilization of the system.".<br><br>(b) "Then there are objective factors. Several observers agree to promote a certain behavior to take place more smoothly. When personal computers are widely used, relevant users will get sufficient convenience to promote the effective improvement of system utilization." | (a) Venkatesh et al., 2003 (b) Thompson et al., 1991 |
| Image | "The use of innovation is actually to improve people's status or image in the whole society". | Thompson et al., 1991 |
| Interactivity | "It refers to the extent to which the communicating party can implement certain actions in terms of messages or communication media, and it also involves the synchronization of the above effects". | Liu & Shrum, 2002 |
| Intrinsic Motivation | "It is considered that the user wants to execute an activity without any obvious reinforcement except the process of executing the activity itself". | Davis et al., 1992 |
| Job Relevance | "Personal views on the relevance of the target system to its work". | Venkatesh & Davis, 2000 |
| Job-fit | "The degree to which a person believes that using a computer helps to enhance his job performance". | Thompson et al., 1991 |
| Long-term Consequences | "It mainly refers to the results that relevant returns can be obtained in some stages in the future". | Thompson et al., 1991 |

| Mass influence | "It mainly involves a non-personal information, opinions put forward by industry experts and media reports". | Bhattacherjee, 2000, p.413 |
|---|---|---|
| Normative Beliefs | "It refers to people's perception and behavior expectations for some key groups or individuals. These objects include colleagues, superiors, doctors, teachers, friends, family members and spouses". | Bhattacherjee, 2000 |
| Outcome Expectations-Performance | "It refers to the relevant consequences related to performance caused by behavior. In other words, it is some work results related to performance expectations". | Compeau & Higgins, 1995b |
| Outcome Expectations-Personal | "It refers to the personal consequences of behavior. In other words, it is closely related to personal sense of achievement and self-esteem". | Compeau & Higgins, 1995b |
| Output Quality | "In the view of users, the degree to which the system can successfully complete relevant tasks". | Venkatesh & Davis, 2000 |
| Perceived Behavioral Control | (a) "When performing an action, individuals will feel difficult or easy". (b) "Under the premise of using the information system, the individual's comprehensive perception of the relevant constraints of behavior". | (a) Ajzen, 1991 (b) Taylor & Todd, 1995 |
| Perceived Ease of Use | "In people's view, the degree to which they can easily use a system". | Davis, 1989 |
| Perceived Usefulness | "The extent to which a person can effectively use the system to achieve better job performance". | Davis, 1989 |
| Relative Advantage | "The innovation achievements are evaluated as exceeding the previous technology". | Moore & Benbasat, 1991 |
| Result Demonstrability | "It refers to the tangibility of an innovative achievement". | Moore & Benbasat, 1991 |
| Results Demonstrability | "It refers to the tangibility of people using an innovative achievement, which mainly involves two aspects: communicability and observability". | Moore & Benbasat, 1991 |
| Self-efficacy | "It mainly refers to the analysis and judgment of the possibility of someone using a certain technology to achieve some tasks". | Venkatesh et al., 2003 |
| Social Factors | "It mainly refers to the specific internalization of the individual's subjective culture of the reference group. In addition, it also involves some interpersonal agreements formed by people". | Thompson et al., 1991 |
| Social Influence | "(a) It refers to whether most people think he should adopt a new system "; (b) "At present, it has developed into a key leading factor required for the use of new technologies" | (a) AlAwadhi & Morris, 2008, p.4 (b) Bhattacherjee, 2000 |
| Subjective Norm | "Those very important people think whether he should do some controversial behavior". | Fishbein & Ajzen, 1975 |
| Time Convenience | "How can users' perception of the benefits of time convenience affect the implementation of services". | Adapted from J. M. Kang et al. (2015) |
| Usage | "It refers to the specific degree of use of a technology". | Compeau & Higgins, 1995b |
| Visibility | "In the organization, people can see how much other members use the system". | Moore & Benbasat, 1991 |

| Voluntariness | "In the view of potential adopters, the impact of adoption on non-mandatory". | Venkatesh & Davis, 2000 |
|---|---|---|
| Voluntariness of Use | "It refers to the specific degree to which the use of innovative achievements is regarded as voluntary". | Moore & Benbasat, 1991 |

Table 3.12 The predictive relevance ($Q^2$)

| Exogenous Variable | Endogenous Variable | $Q^2$ | Remark | Overall Predictive |
|---|---|---|---|---|
| | INT | 0.255 | Medium | Yes |
| PU | ATT | 0.455 | Large | |
| PE | | | | |
| PM | | | | |
| SE | | | | |
| MI | | | | |
| PI | | | | |

Note(s): Omission distance is at 7.

Table 4.12 Characteristics and subcharacteristics in ISO/IEC 9126

| Characteristic | Subcharacteristics |
|---|---|
| Functionality | Suitability, accuracy, interoperability, security, functionality compliance* |
| Reliability | Maturity*, fault tolerance*, recoverability*, reliability compliance* |
| Usability | Understandability, learnability, operability, attractiveness, usability compliance* |
| Efficiency | Time behavior, resource utilization, efficiency compliance* |
| Maintainability | Analyzability, changeability, stability, testability, maintainability compliance* |
| Portability | Adaptability, installability, replacebility, coexistence, portability compliance* |

*Denotes the omitted subcharacteristics in Jung et al.(2004) survey

Source: Jung et al., 2004

Table 4.13 The predictive relevance ($Q^2$)

| Exogenous Variable | Endogenous Variable | $Q^2$ | Remark | Overall Predictive |
|---|---|---|---|---|
| | INT | 0.513 | Large | |
| PS | | | | |
| PT | | | | |
| UI | | | | |
| CP | AI | 0.499 | Large | Yes |
| | CI | 0.425 | Large | |
| EE | | | | |
| IT | | | | |
| TC | | | | |

Note(s): Omission distance is at 6.

Table 5.1 Total indirect effort of latent variables in model A

| | Indirect effect | 95% CI | T-value | Sig. |
|---|---|---|---|---|
| Perceived usefulness -> INT | 0.099 | [0.067, 0.131] | 5.979 | Y |
| Perceived ease of use -> INT | 0.048 | [0.019, 0.080] | 3.138 | Y |
| Personal motivation -> INT | 0.079 | [0.046, 0.113] | 4.633 | Y |
| Self-efficacy -> INT | 0.054 | [0.026, 0.083] | 3.761 | Y |
| Mass influence -> INT | 0.145 | [0.108, 0.186] | 7.235 | Y |

| | | | | |
|---|---|---|---|---|
| Peer influence -> INT | 0.110 | [0.077, 0.145] | 6.282 | Y |

Note(s): INT: app adoption intention; CI: confidence intervals; Sig.: Significance.
  *p < 0.05; **P<0.01; ***p < 0.001;

Table 5.2 Total indirect effort of latent variables in model B

| | Indirect effect | 95% CI | T-value | Sig. |
|---|---|---|---|---|
| Privacy and security → BEI | 0.066 | [0.029,0.107] | 3.339 | Y |
| Portability → BEI | 0.003 | [-0.033,0.038] | 0.173 | N |
| UI attractiveness → BEI | 0.139 | [0.101,0.178] | 7.051 | Y |
| Compatibility → BEI | 0.143 | [0.103,0.186] | 6.720 | Y |
| Effort expectancy → BEI | 0.026 | [-0.013,0.063] | 1.344 | N |
| Interactivity → BEI | 0.125 | [0.090,0.160] | 6.940 | Y |
| Time convenience → BEI | 0.214 | [0.171,0.254] | 10.066 | Y |

Note(s): BEI: behavioral engagement Intention; CI: confidence intervals; Sig.: Significance.

# Annex B: List of Figures
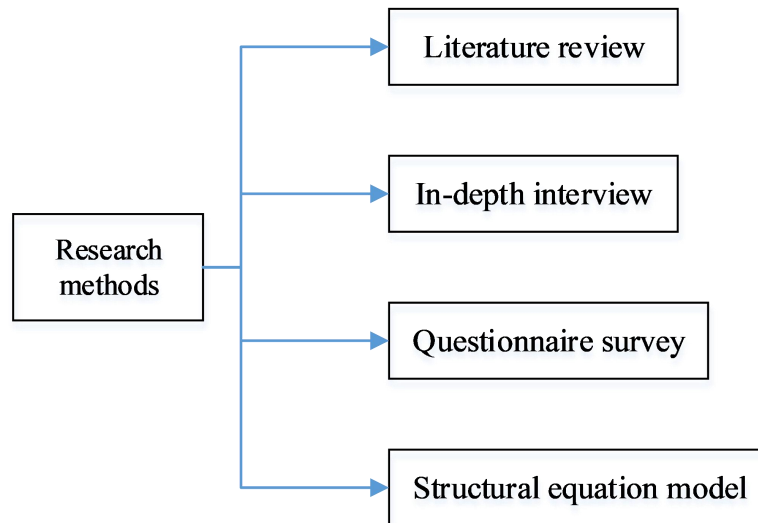


Figure 1.1 Research methods
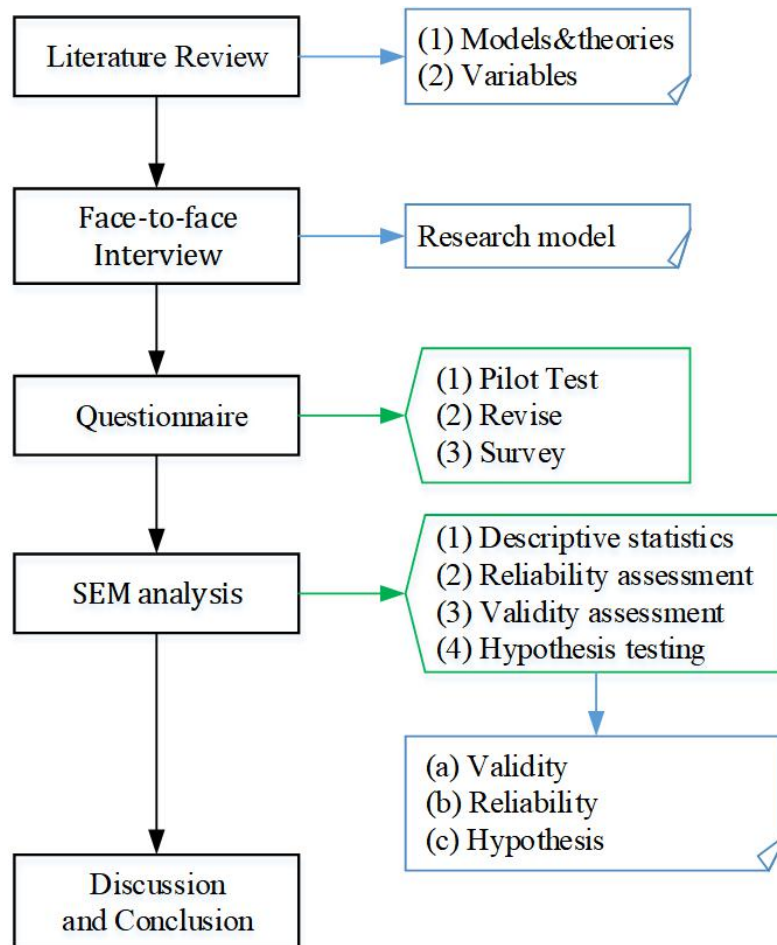


Figure 1.2 Research process

Factors Facilitating Chinese College Students to Adopt and Engage in Mobile Campus Service Apps
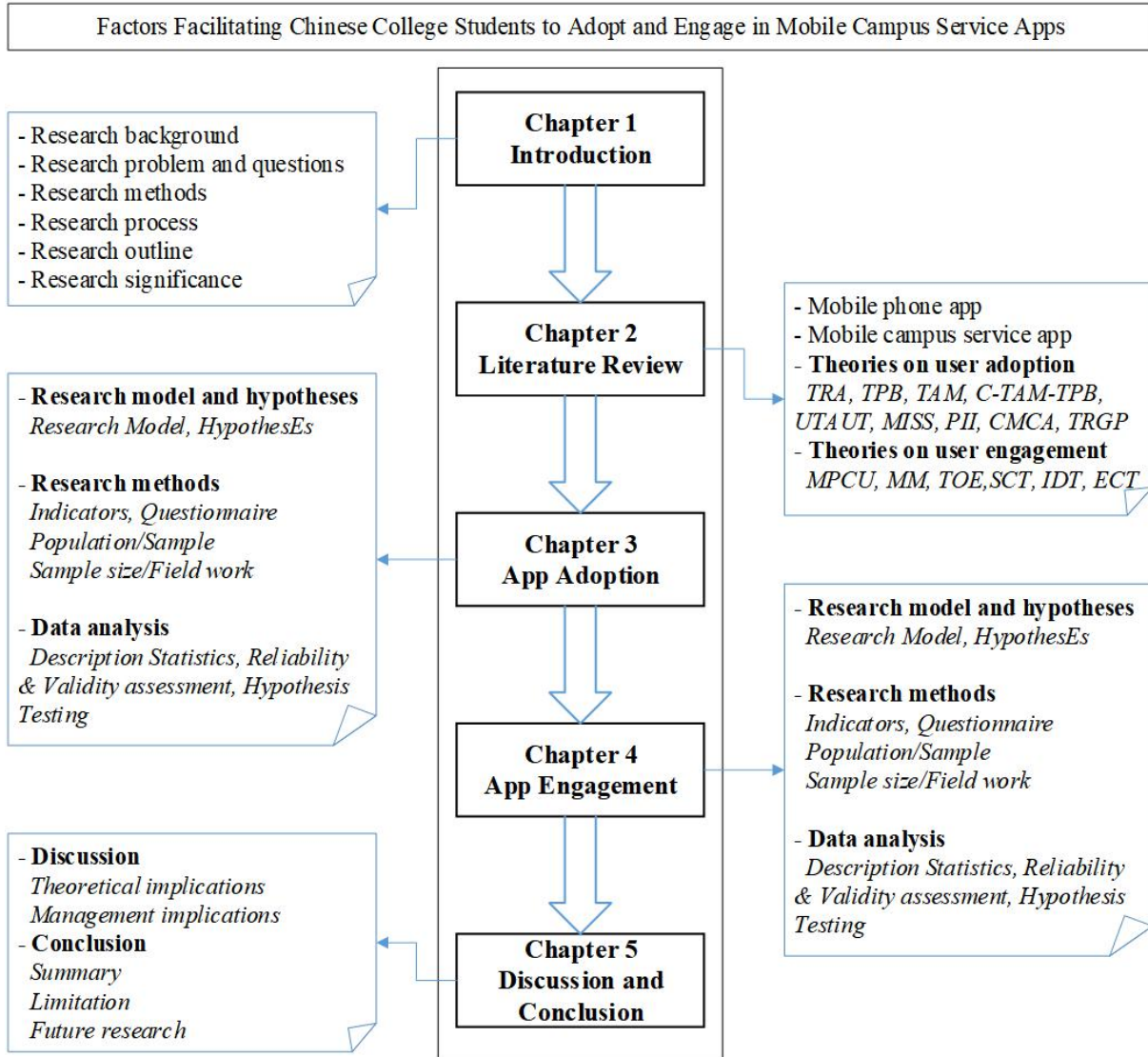


Figure 1.3 Research outline
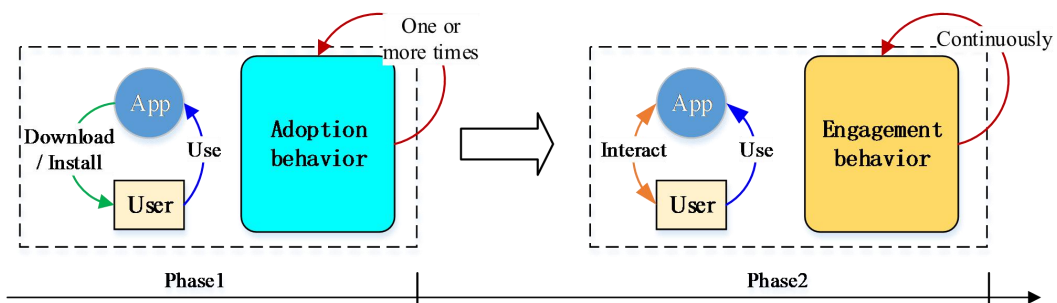


Figure 2.1 The phases of app usage
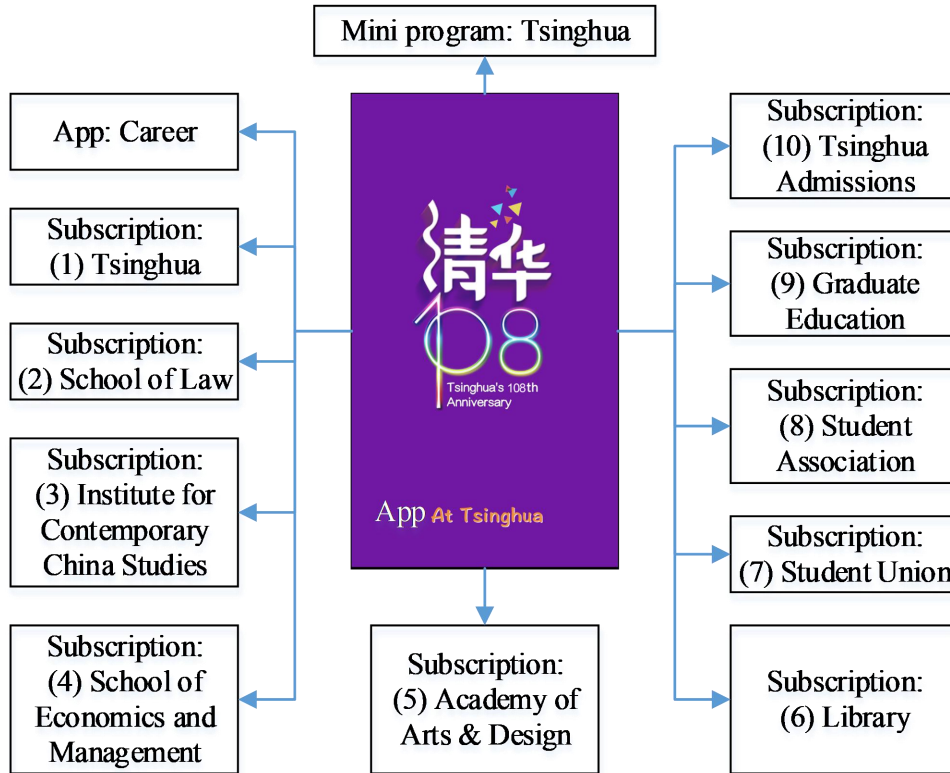
Figure 2.2 App map of Tsinghua University
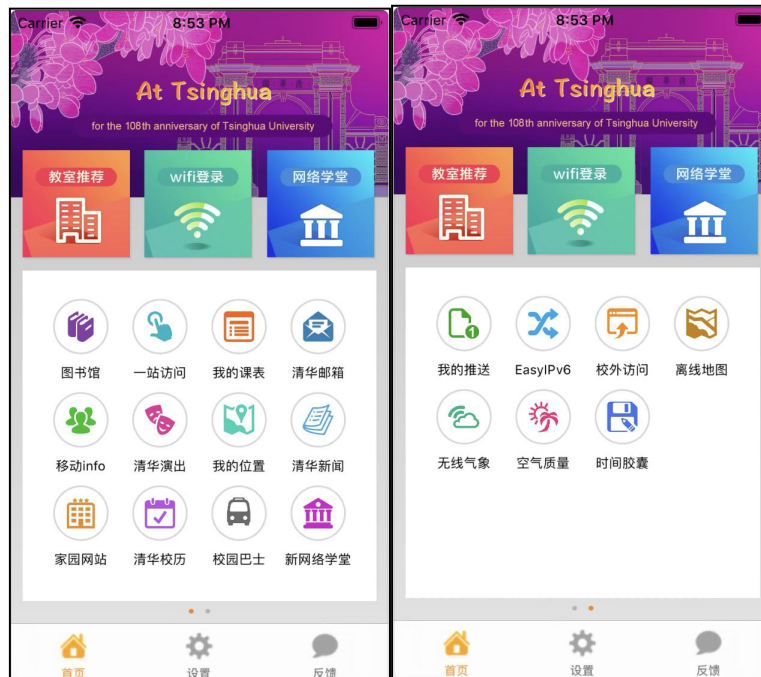


Figure 2.3 Screenshot of At Tsinghua app
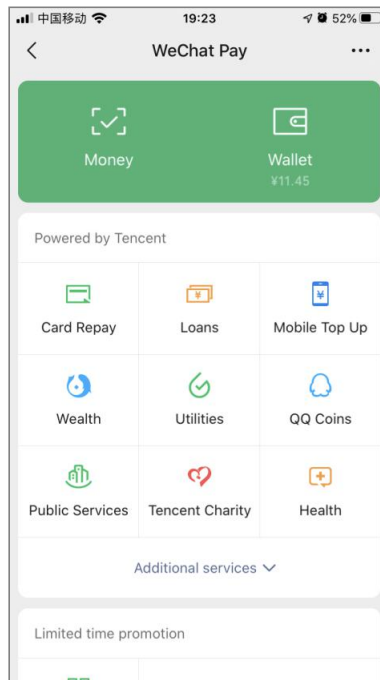
Figure 2.4 Screenshot of WeChat Pay



Figure 2.5 Screenshot of AliPay app
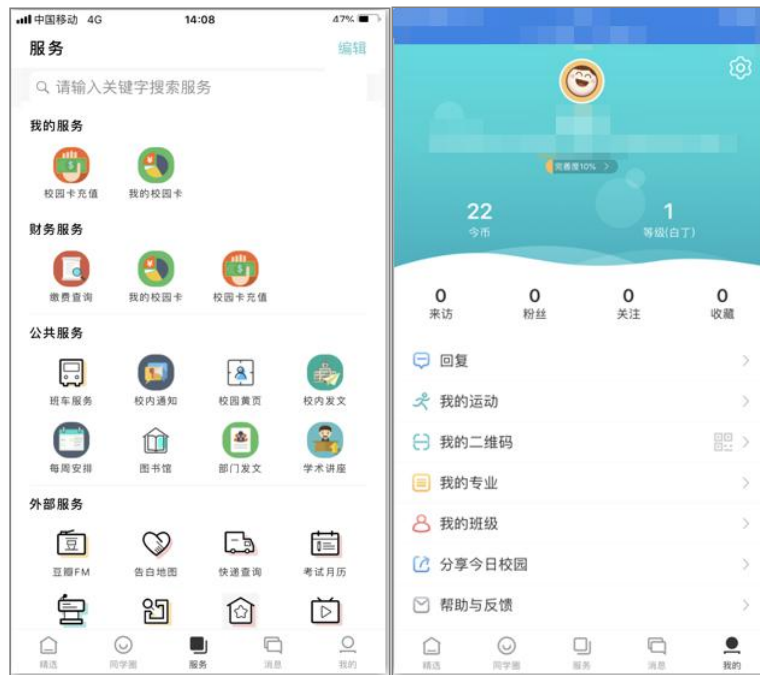
Figure 2.6 Screenshot of Campushoy app



Figure 2.7 Screenshot of Wanmei app
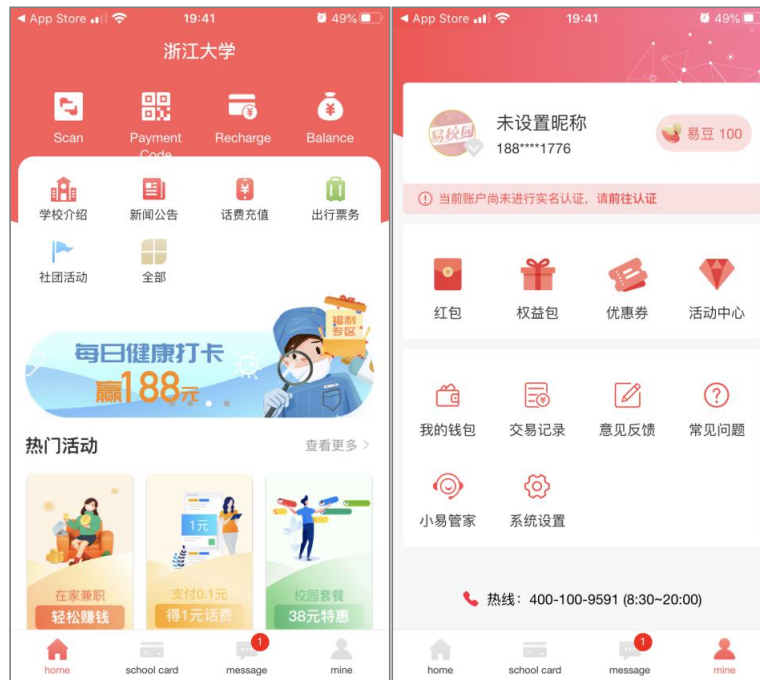
Figure 2.8 Screenshot of eCampus app
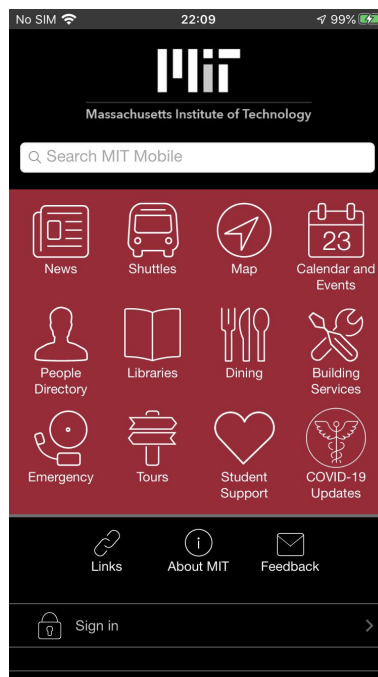


Figure 2.9 Screenshot of MIT Mobile app
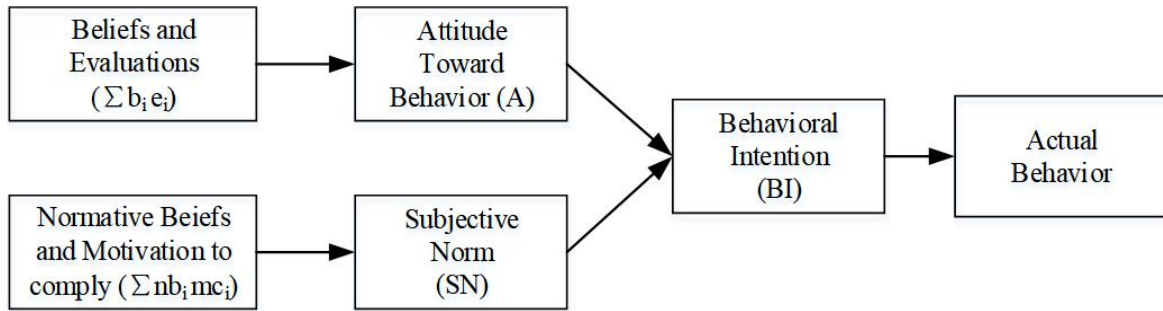
Figure 2.10 Theory of reasoned action (TRA)

Source: Fishbein and Ajzen (1975)
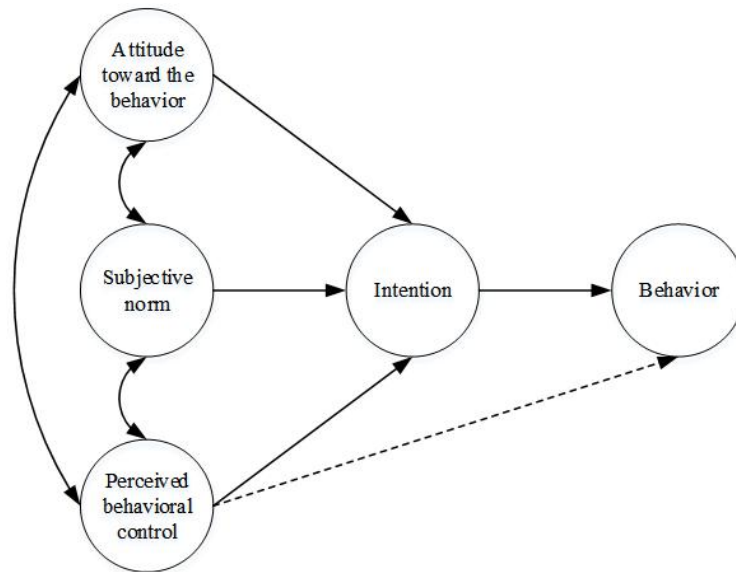


Figure 2.11 Theory of planned behavior (TPB)

Source: Ajzen (1991)
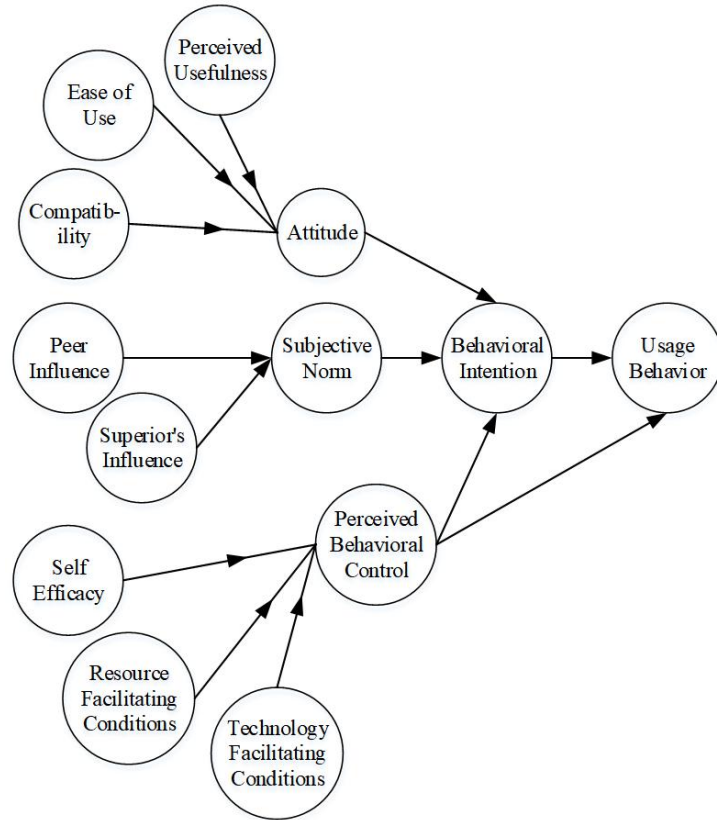
Figure 2.12 Decomposed theory of planned behavior (DTPB)

Source: Taylor and Todd (1995a)
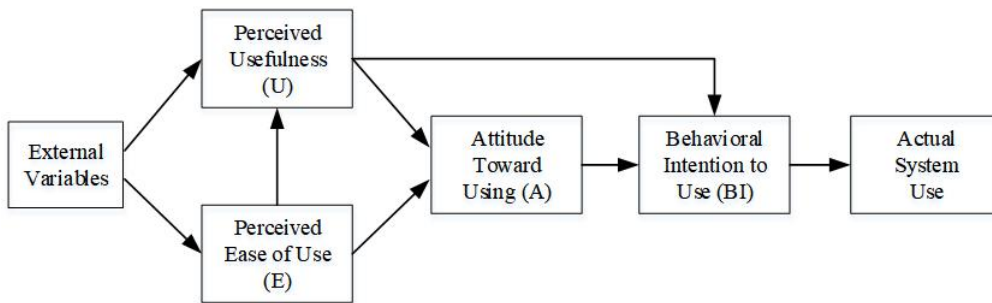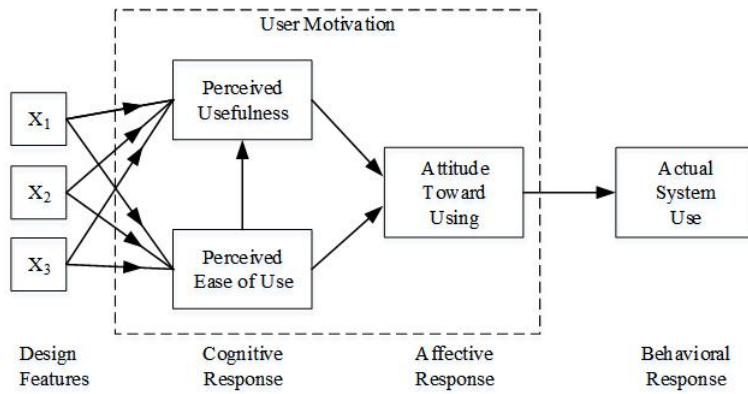




Figure 2.13 Technology acceptance model (TAM)

Source: Davis (1985); Davis et al. (1989)
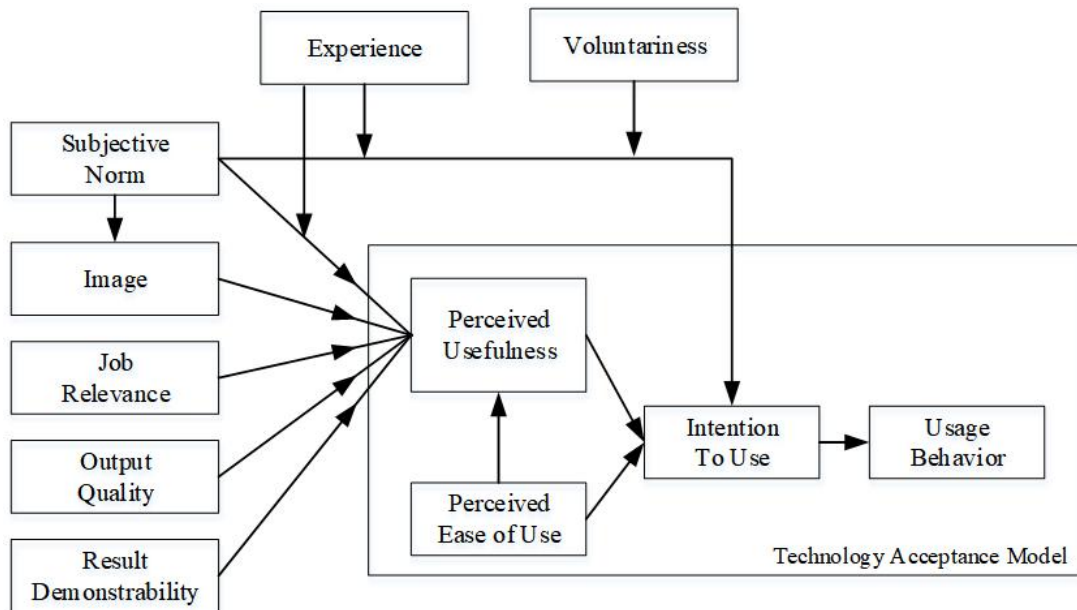
Figure 2.14 Extension of the technology acceptance model (TAM2)

Source: Venkatesh and Davis (2000)
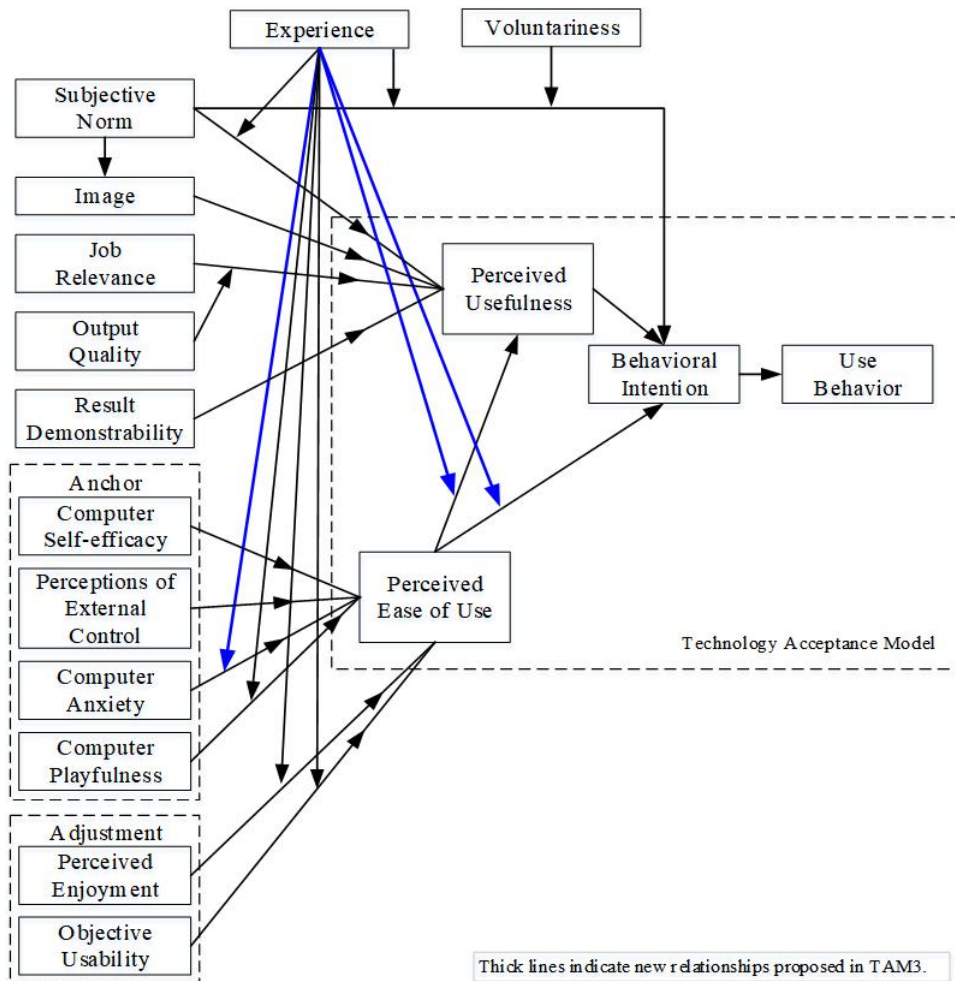


Figure 2.15 Technology acceptance model 3 (TAM3)

Source: Venkatesh and Bala (2008)
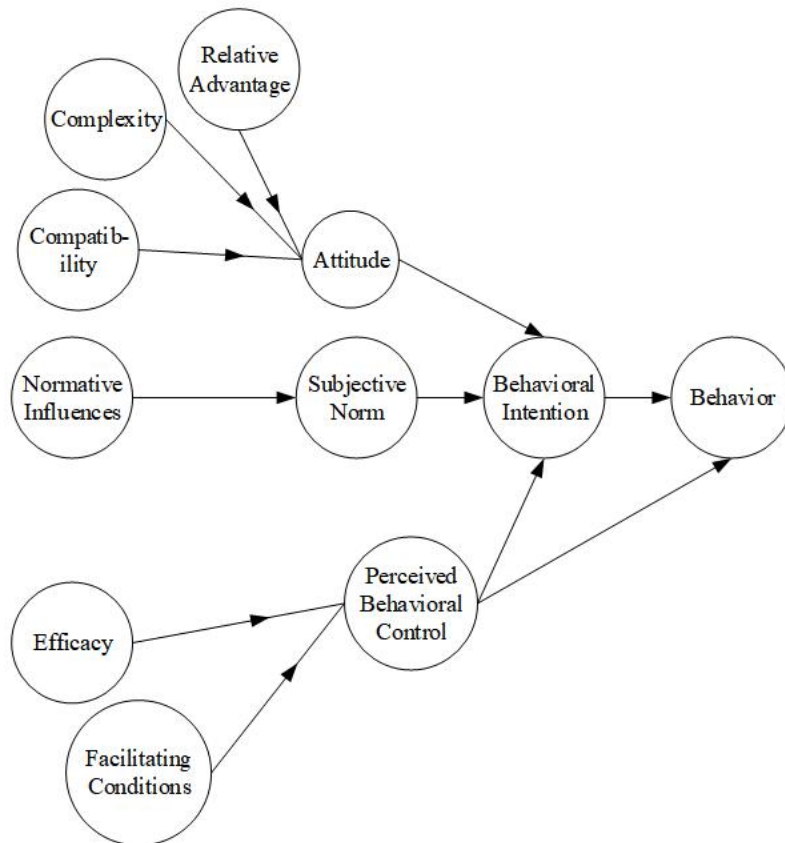
Figure 2.16 Combined TAM and TPB (C-TAM-TPB)

Source: Taylor and Todd (1995a)
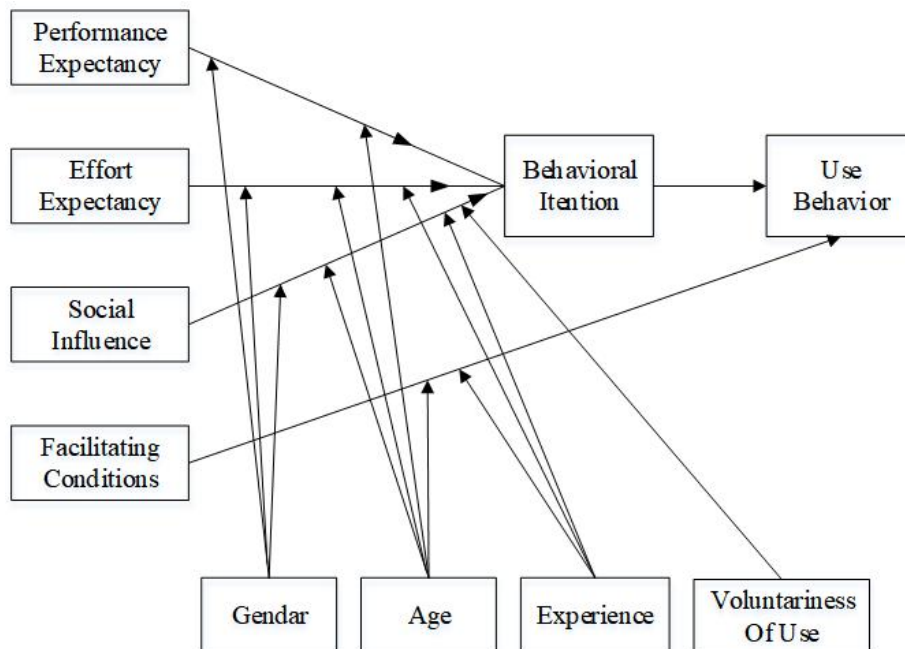


Figure 2.17 Unified Theory of acceptance and use of technology (UTAUT)

Source: Venkatesh et al. (2003)
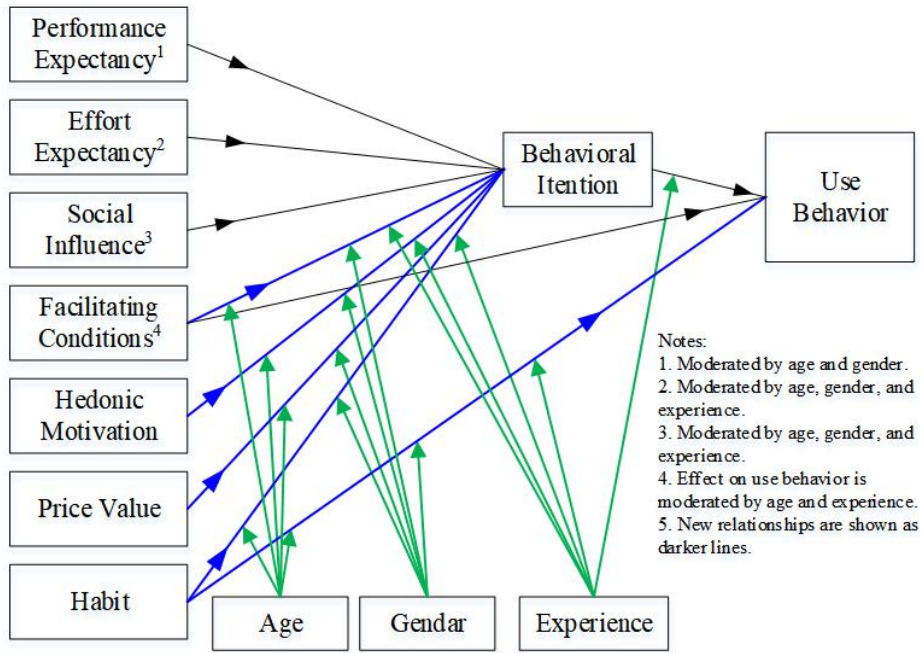
Figure 2.18 Unified theory of acceptance and use of technology 2 (UTAUT2)

Source: Venkatesh et al. (2012)
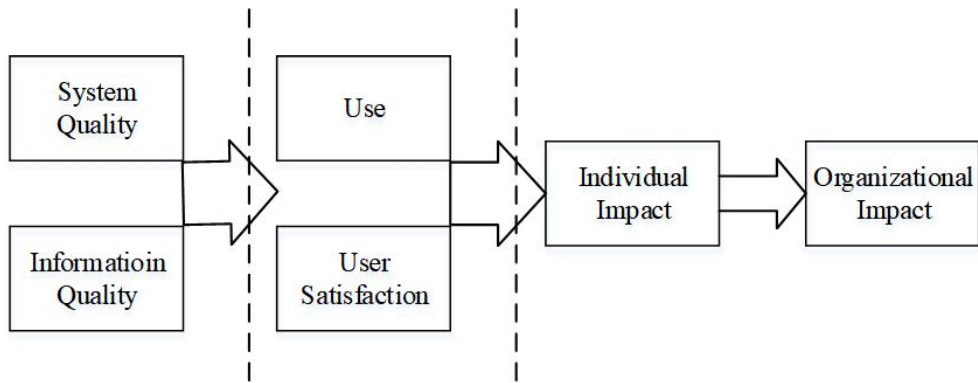


Figure 2.19 Model of information systems success (MISS)

Source: DeLone and McLean (1992)
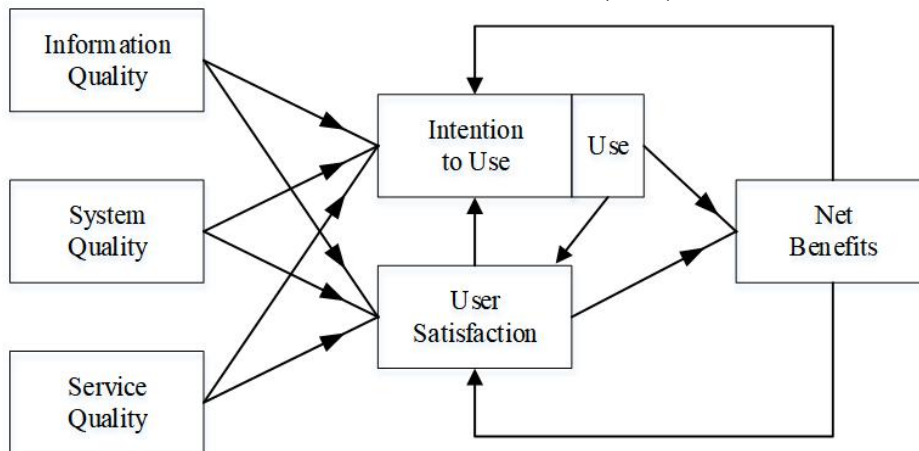


Figure 2.20 Updated model of information systems success (UMISS)

Source: DeLone and McLean (2003)

To me (object to be judged) is:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. important | | : | : | : | : | : | unimportant* |
| 2. boring | | : | : | : | : | : | interesting |
| 3. relevant | | : | : | : | : | : | irrelevant* |
| 4. exciting | | : | : | : | : | : | unexciting* |
| 5. means nothing | | : | : | : | : | : | means a lot to me |
| 6. appealing | | : | : | : | : | : | unappealing* |
| 7. fascinating | | : | : | : | : | : | mundane* |
| 8. worthless | | : | : | : | : | : | valuable |
| 9. involving | | : | : | : | : | : | uninvolving* |
| 10. not needed | | : | : | : | : | : | needed |

* indicates item is reverse scored.

Figure 2.21 Revised personal involvement inventory

Source: Zaichkowsky (1994)
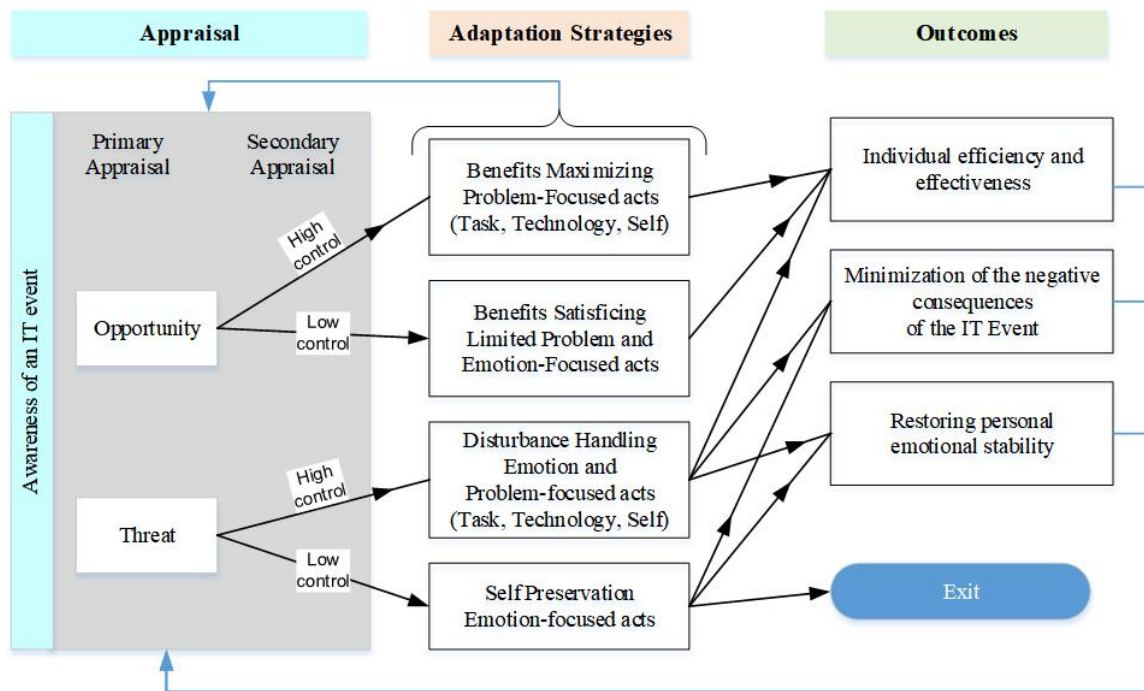


Figure 2.22 Coping model of user adaptation (CMUA)

Source: Beaudry and Pinsonneault (1994)

172
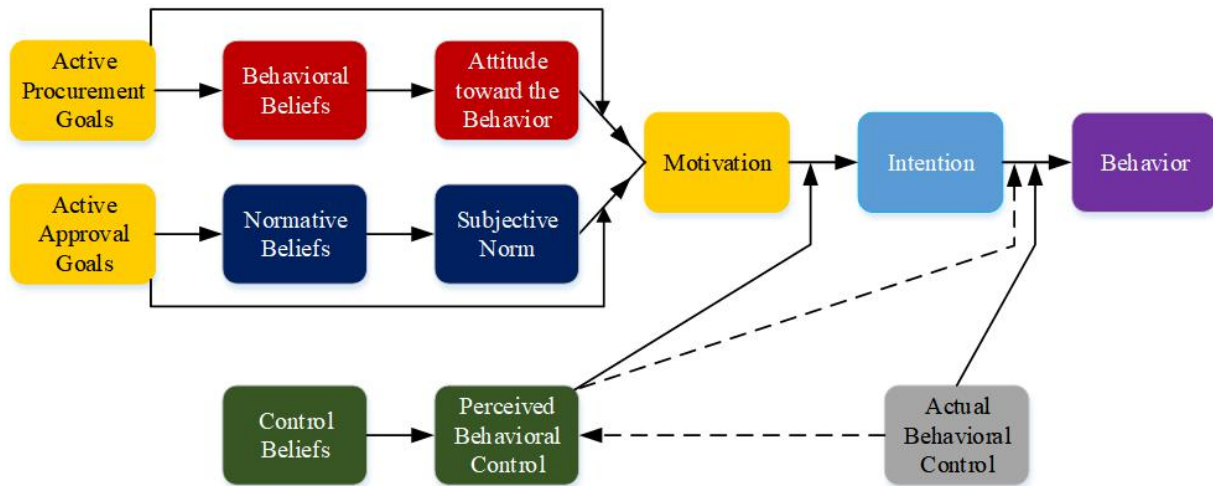
Figure 2.23 Theory of reasoned goal pursuit (TRGP)

Source: Ajzen and Kruglanski (2019)
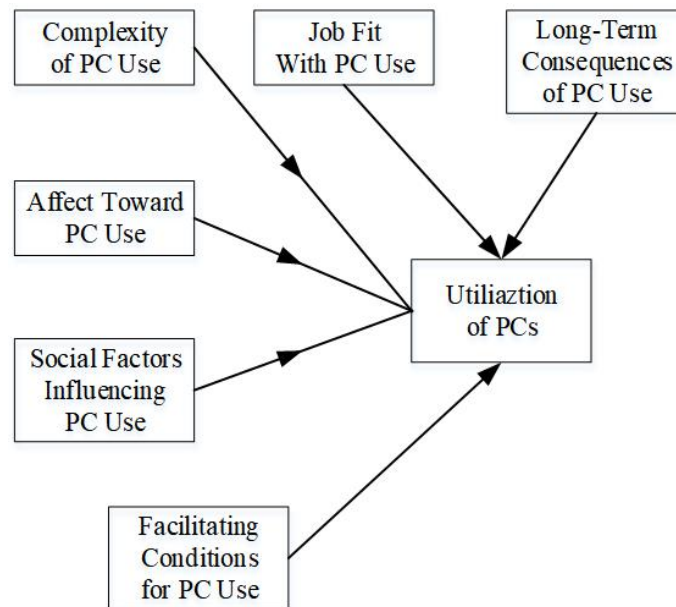


Figure 2.24 Model of personal computer utilization (MPCU)

Source: Thompson et al. (1991)
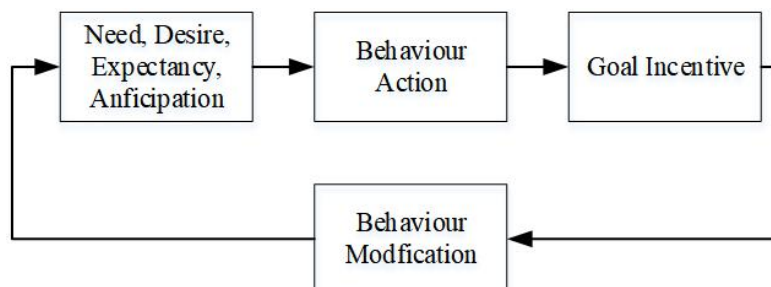


Figure 2.25 Motivational model (MM)

Source: Davis et al. (1992)
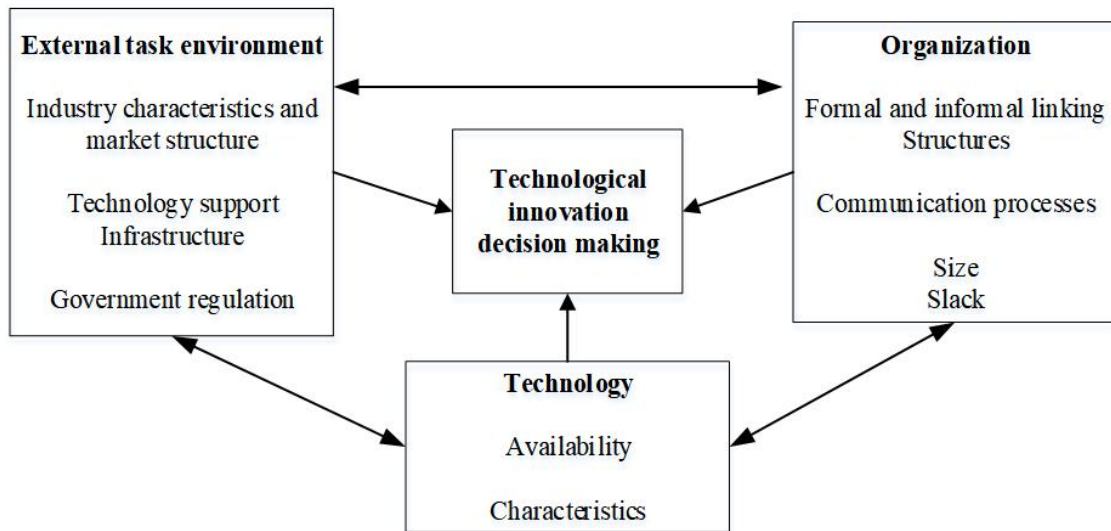
Figure 2.26 Technology organization and environment (TOE) framework

Source: Tornatzky and Fleischer (1990)
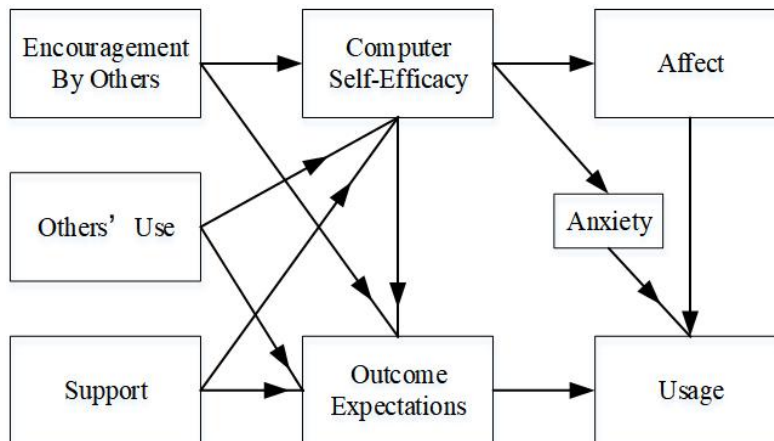


Figure 2.27 Social cognitive theory (SCT)

Source: Compeau and Higgins (1995a)
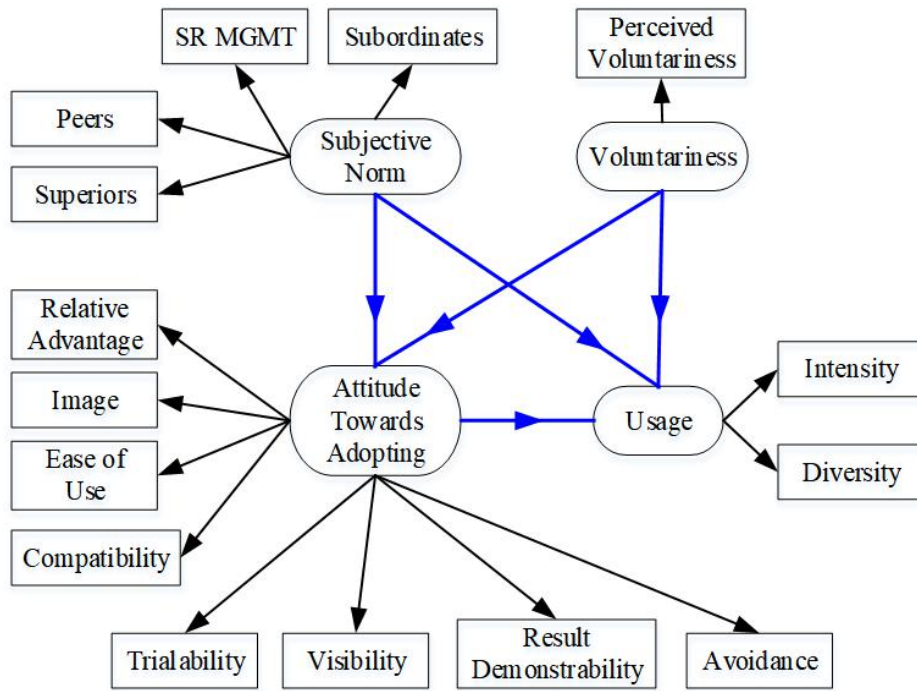
Figure 2.28 Innovation diffusion theory (IDT)

Source: Moore and Benbasat (1996)
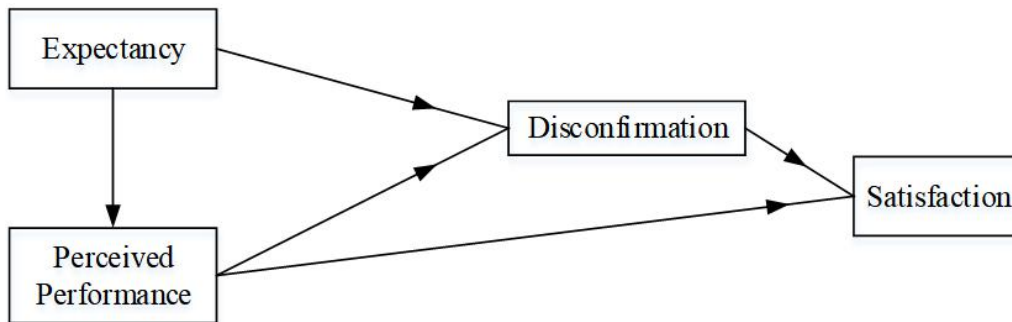


Figure 2.29 Expectation confirmation theory (ECT)

Source: Oliver (1997)
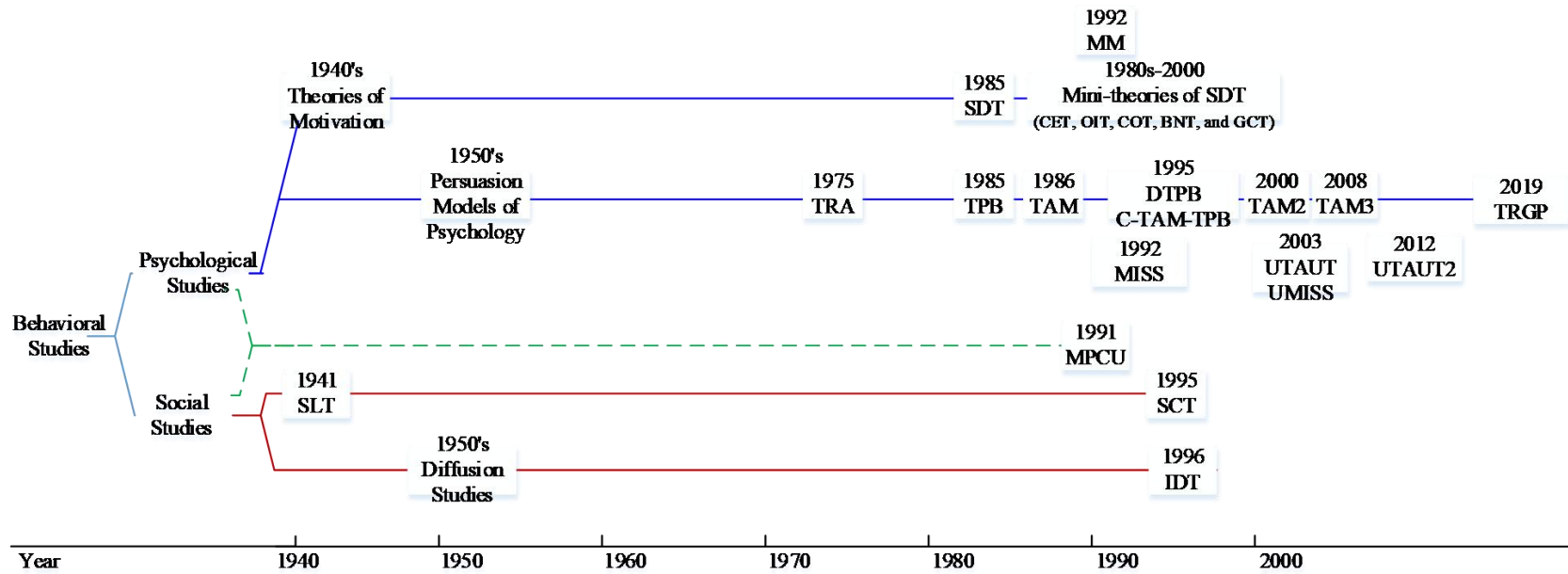
Figure 2.30 Chronological graph of technology acceptance theories
Source: Adapted from Momani and Jamous (2017)

# Annex C: Questionnaire 1

## The Adoption of mcs-App questionnaire

### Section A: Consent form

Dear Sir/Madam,

First of all, thank you very much for your attention and support for this survey.

The purpose of this questionnaire is to collect data for the factors facilitating Chinese college students to **adopt mobile campus service app** (mcs-App).

We promise you the following: this questionnaire survey is anonymous and the survey results will be kept strictly confidential. The information you provide will not be shared with or transferred to any third party. The data source of any organization or individual will not be revealed in our final report. Therefore, you do not need to have any concerns or worries.

The information you provide is very important for us to successfully achieve our research goals. Thank you for your time and help!

If you have any questions in completing the survey, please do not hesitate to contact us. If you would like to know the relevant research results, please contact the research team, and we will inform you as soon as we complete the data analysis.

Our contact information is as follows:

<div align="center">Tel: +86-188-5712-1776    Email: 1202065@qq.com</div>

*Note. **Adoption** is defined as the initial use, including three actions of download the app, install the app, and use the app. "Use" may be one or more times. **Acceptance** defines as the same as adoption.*
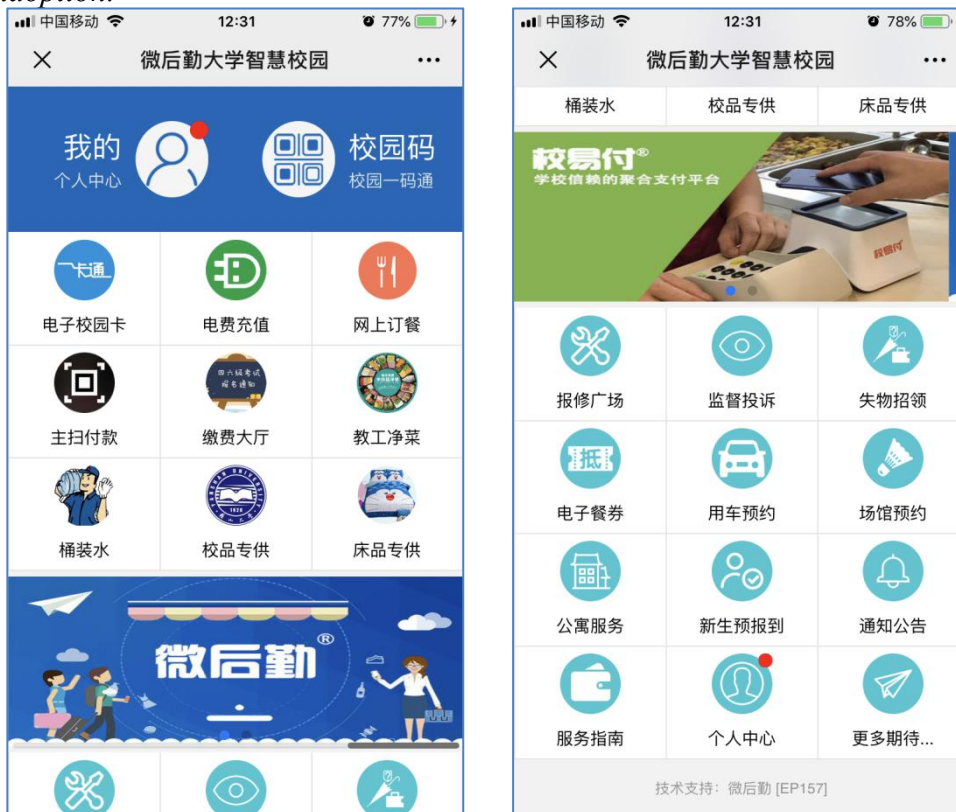


<div align="center">Figure 1 Example of mcs-App</div>

## Section B: Demographic information sheet

1. Gender: □ Male      □ Female

2. Major: _____

3. Education:   □ Junior college   □ Undergraduate   □ Graduate school (Master)   □ Graduate school (PhD)

4. City of residence: _____

5. Have you used any mcs-Apps before (such as WeChat, Alipay, Campushoy, Wanmei, and eCampus, etc.)?   □ Yes      □ No

6. Year of Usage: _____

7. ***IT Innovation*** (adapted from Agarwal & Prasad, 1998; 1-7 scale)

   ITI. I hope to try new information technology research results.

8. ***Inertia*** (adapted from Polites & Karahanna, 2012; 1-7 scale)

   INE. If there is a more ideal choice, I will continue to use the current system (that is, maintain the status quo).

## Section C: Measurement scales (Strongly Disagree/Agree, 1-7 scale)

*9. Perceived usefulness* (adapted from Davis, 1989; Wu, Kang, & Yang, 2015)

   PU1. In my opinion, this mcs-App is good for my campus life.

   PU2. In my opinion, it makes my life more relaxed and convenient.

   PU3. In my opinion, it improves my efficiency.

*10. Perceived ease of use* (adapted from Davis, 1989; L. Huang & Hsieh, 2012; Jung et al., 2012; Lu et al., 2014)

   PE1. This mcs-App is easy to use.

   PE2. In my opinion, it is not difficult to learn its operation method.

   PE3. In my opinion, most college students can quickly master its use.

*11. Personal motivation* (adapted from Davis, Bagozzi, & Warshaw, 1992; Wu, Kang, & Yang, 2015)

   PM1. I think using this mcs-App is enjoyable.

   PM2. I am willing to use it.

   PM3. I feel very relaxed and happy when using it.

*12. Self-efficacy* (adapted from Wang, Lin, & Luarn, 2006; Wu, Kang, & Yang, 2015)

   SE1. When I use it, I need to give full play to my personal ability.

   SE2. When I use it, I have strong independence.

   SE3. I would like to be considered a leader in using this mcs-App.

13. ***Mass influence*** (adapted from Bhattacherjee 2000; Wu, Kang, & Yang, 2015)

   MI1. This mcs-App's ranking is high.

   MI2. This mcs-App's reviews is good.

   MI3. This mcs-App's reputation is good.

14. ***Peer influence*** (adapted from Kim, Shin, & Kim, 2011)

   PI1. In my friend's opinion, I need to use it.

   PI2. In my classmates' opinion, I need to use it.

   PI3. In the eyes of those who have an impact on my behavior, I need to use it.

15. ***Attitude toward apps*** (adapted from von Watzdorf, Ippisch, Skorna, & Thiesse, 2010)

   ATT1. In my opinion, using this mcs-App is a very good choice.

   ATT2. In my opinion, there is a certain reason to use it.

   ATT3. In my opinion, using it can bring more benefits.

   ATT4. In my opinion, it has some special features.

16. ***App adoption intention*** (adapted from Venkatesh, Morris, Davis, & Davis, 2003)

   INT1. I intend to use it in the next month.

   INT2. I expect to use it in the next month.

   INT3. I have planned to use it in the next month.

17. Some suggestion？ _____

**--- End ---**

# 移动校园服务 App 的采用的问卷

亲爱的先生/女士，

首先，非常感谢您对此项调查的关注和支持。

本次问卷调查的目的是收集促进中国大学生**采用**移动校园服务 App（moblie campus service app, mcs-App）的因素的数据。

我们向您保证：本次问卷调查是匿名的，调查结果将严格保密。您提供的数据不会透露给任何第三方。此外，这项研究将基于所有数据的统计结果。任何组织或个人的数据将不被报告。因此，您无需有任何顾虑或忧虑！请根据您所在的学校和您的情况，针对每个问项进行回答。您提供的所有信息仅用于学术研究，不会用于任何商业目的。所以根据您的真实感受，请回答所有的问题。

您提供的信息对取得科研成果具有重要意义。谢谢你的帮助！

如果您想了解相关研究成果，请联系研究团队，我们将在第一时间通知您。如果您在填写问卷过程中有任何疑问，请联系我们。

我们的联系方式如下：

电话：188-5712-1776　电邮：1202065@qq.com

*说明：**App 的采用**定义为初始使用，包括下载 App、安装 App 和使用 App 三个动作。App 的接受定义为与 app 的采用相同。*
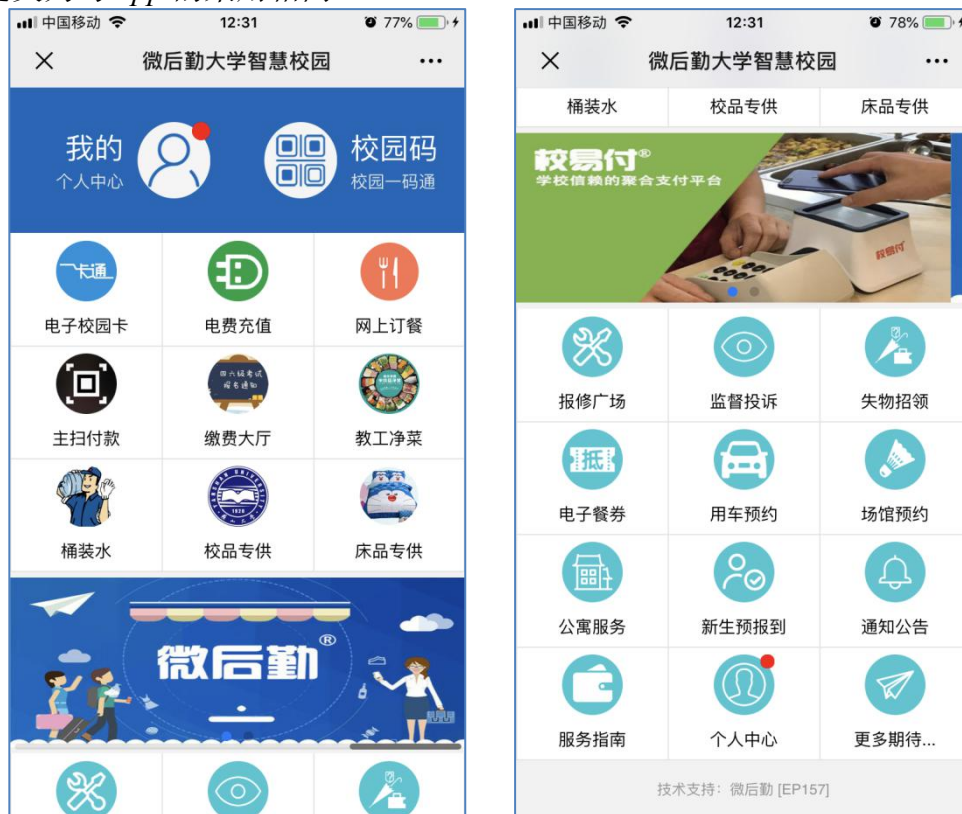


图 1 msc-App 实例

## Part Ⅰ: 基础信息

1. 性别：□ 男　　□ 女

2. 专业：＿＿＿＿＿＿＿＿＿

3. 年级：□ 专科　□ 本科　□ 硕士　□ 博士

4. 生源地（市）：＿＿＿＿＿＿＿＿

5. 您用过 msc-App (如微信、支付宝、今日校园、完美校园和易校园等)?　□ 用过

　　□ 没用过

6. 使用其他 msc-App 的年限（年）：＿＿＿

7. *IT 创新*(1-7 分)

我喜欢尝试新的信息技术(IT)。

8. *惰性* (1-7 分)

我会依附于并坚持使用现有系统（App），即使有更好的选择或激励去改变。

## Part Ⅱ: 量表(非常不赞同/赞同, 1-7 分)

### *9. 感知的有用性*

PU1. 我认为这个 mcs-App 在我的校园日常生活中很有用。

PU2. 我认为使用这个 mcs-App 使我的生活更轻松。

PU3. 我认为使用这个 mcs-App 可以让我更快地完成任务。

### *10. 感知的易用性*

PE1. 这个 mcs-App 易于使用。

PE2. 学习如何使用这个 mcs-App 对我来说很容易。

PE3. 我可以想象大多数学生会很快学会使用这个 mcs-App。

### *11. 个人动机*

PM1. 我认为使用这个 mcs-App 是一种享受。

PM2. 我想我会有乐趣使用这个 mcs-App。

PM3. 我认为使用这个 mcs-App 的实际过程是令人愉快的。

### *12. 自我效能*

SE1. 我想我有很多个人能力使用这个 mcs-App。

SE2. 我比其他人更独立地使用这个 mcs-App。

SE3. 我喜欢被认为是使用这个 mcs-App 的引领者。

### 13. *大众影响*

MI1. 这个 mcs-App 的排名很高。

MI2. 这个 mcs-App 的评价很好。

MI3. 这个 mcs-App 的声誉很好。

### 14. *同伴影响*

PI1. 我的朋友认为我应该使用这个 mcs-App。

PI2. 我的同学认为我应该使用这个 mcs-App。

PI3. 影响我行为的人认为我应该使用这个 mcs-App。

### 15. *对 App 态度*

ATT1. 我认为使用这个 mcs-App 是个好主意。

ATT2. 我认为使用这个 mcs-App 是有意义的。

ATT3. 对我来说，使用这个 mcs-App 是有益的。

ATT4. 我认为这个 mcs-App 很特别。

### 16. *App 采用意愿（若学校购买）*

INT1. 我打算在下个月使用这个 mcs-App。

INT2. 我预测在下个月使用这个 mcs-App。

INT3. 我计划在下个月使用这个 mcs-App。

### 17. *您的建议：* _____

**--- End ---**

# Annex D: Questionnaire 2

# The Engagement of mcs-App questionnaire

## Section A: Consent form

Dear Sir/Madam,

First of all, thank you very much for supporting this survey.

The purpose of this questionnaire survey is to collect data for the factors facilitating Chinese college students to **engage mobile campus service app** (mcs-App).

We promise the following: this questionnaire is anonymous and the results will be kept strictly confidential. All the information you provide will be used for academic research purpose only, and will not be used for any commercial purposes or disclosed to any third parties. In addition, the research will be based on the data collected from all participants. The information of any particular organization or individual will not be reported. Therefore, you do not need to have any concerns or worries! Please select the best item that describes your campus environment and suits your situation.

The information you provide is very important for us to successfully achieve our research goals. Thank you for your time and help!

If you have any questions in completing the survey, please do not hesitate to contact us. If you would like to know the research results, please contact the research team, and we will inform you as soon as we complete the data analysis.

Our contact information is as follows:

Tel: +86-188-5712-1776    Email: 1202065@qq.com

*Note.* **Engagement** *is defined as continuance usage and involvement after the initial use, including two actions to interact with the app and use of the app. "Use" and "Interact" are continuous.*
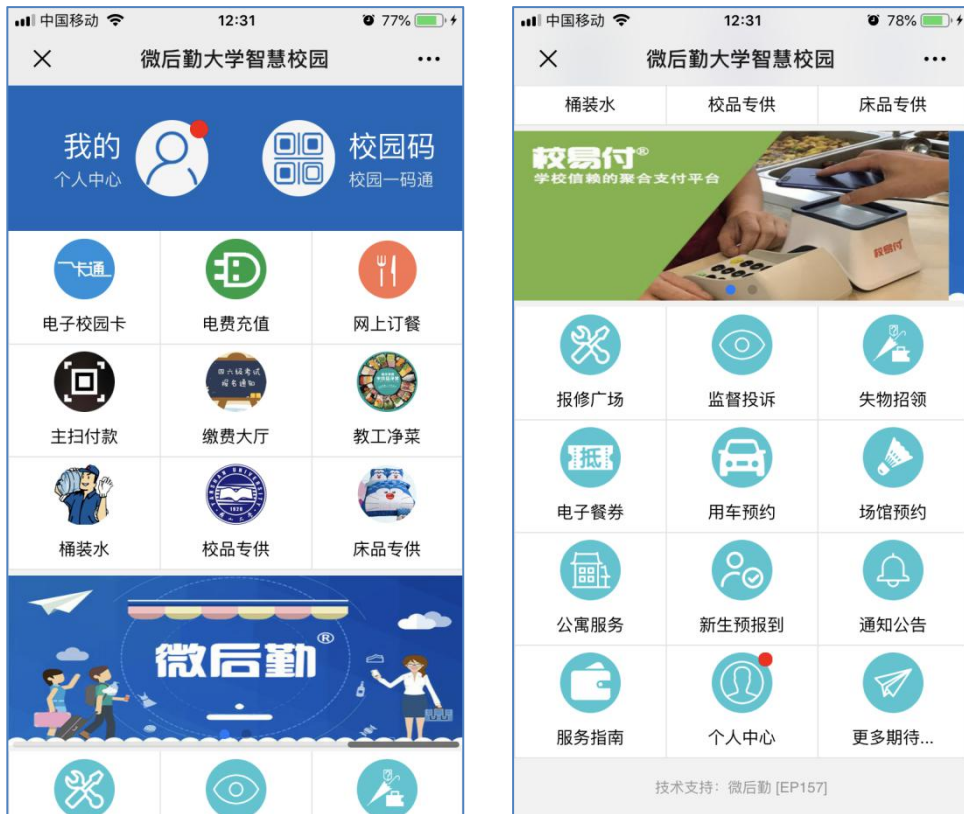
Figure 1 Example of mcs-App

## Section B: Demographic information sheet

1. Gender: □ Male          □ Female

2. Major: _____

3. Education:     □ Junior college     □ Undergraduate     □ Graduate school (Master)     □ Graduate school (PhD)

4. City of residence: _____

5. Do you often use mcs-Apps (such as WeChat, Alipay, Campushoy, Wanmei, and eCampus, etc.)?   □ Yes          □ No

6. Years of usage

7. **Alternative Attraction** (adapted from Kuo et al.,2013; 1-7 scale)

   Please rate the attractiveness of other products.

8. **Usage Habits** (adapted from Wilmer & Chein, 2016; 1-7 scale)

   I am used to using the current version system.

## Section C: Measurement scales (Strongly Disagree/Agree, 1-7 scale)

*9. Privacy and Security* (adapted from Nepomuceno, Laroche, & Richard, 2014)

   PS1. In my opinion, the security of using and installing this mcs-App is very high.

   PS2. In my opinion, this mcs-App can effectively protect my sensitive data.

   PS3. In my opinion, the related products provided by this mcs-App have high security.

   PS4. In my opinion, sending some sensitive information through this mcs-App has good security.

   PS5. In my opinion, this mcs-App has good security features and privacy.

*10. Portability* (adapted from Fang, Zhao, Wen, & Wang, 2017)

   PT1. In different mobile operating systems, the present mcs-App can run smoothly.

   PT2. Its operating system compatibility is very good.

   PT3. It can be applied to different operating systems.

*11. UI Attractiveness* (adapted from Cyr, Head, & Ivanov, 2006; Coursaris & van Osch, 2016)

   UI1. Its user interface design is very clean and concise.

   UI2. Its user interface design has high complexity.

   UI3. Its user interface design is very attractive.

   UI4. Its user interface design has high aesthetics.

   UI5. Its user interface design has a good visual effect.

   UI6. Its user interface design has a strong attraction.

**12. *Compatibility*** (adapted from L. Huang & Hsieh, 2012; Jung et al., 2012; Lu et al., 2015)

CP1. It has good compatibility with my campus preferences.

CP2. It is very consistent with my actual campus needs.

CP3. It can better meet the needs of the campus.

**13. *Effort Expectancy*** (adapted from Venkatesh, Morris, Davis, & Davis, 2003)

EE1. In my opinion, I have a clear interaction with it.

EE2. I can easily use this mcs-App.

EE3. In my opinion, this mcs-App has good ease of use.

EE4. I find this mcs-App easy to learn and use.

**14. *Interactivity*** (adapted from Lee, 2005; Kang, Mun, & Johnson, 2015)

IT1. It can provide me with all kinds of information packages in time.

IT2. It can provide me with information packages related to specific locations.

IT3. It can provide me with the most ideal service or basic information. The above services and information are closely related to my location and situation.

**15. *Time Convenience*** (adapted from Lee, 2005; Kang, Mun, & Johnson, 2015)

TC1. I can freely access it without time constraints and then get the required services or information.

TC2. I can freely access it without being restricted by location and then get the required services or information.

TC3. I can visit it at any time or place according to my actual needs.

TC4. For time-critical services, it is very applicable (this situation mainly includes order status tracking or last-minute reservation).

**16. *Affective Involvement*** (adapted from Hsieh et al., 2008; Wang et al., 2013; Kang, Mun, & Johnson, 2015)

AI1. Using this mcs-App is exciting.

AI2. I find it very attractive when using this mcs-App.

AI3. I find it very interesting to use this mcs-App.

**17. *Cognitive Involvement*** (adapted from Hsieh et al., 2008; Wang et al., 2013; Kang, Mun, & Johnson, 2015)

CI1. After I used it, my campus arrangement has significantly improved.

CI2. After I use it, I can arrange my campus time more efficiently.

CI3. Using this msc-App is needed for me.

CI4. In my opinion, it is very important to use this msc-App..

**18. *Behavioral Engagement Intention*** (adapted from Hall-Phillips et al., 2016; Verhagen et

al., 2015)

  BBEI1. I hope to use this msc-App in the future.

  BEI2. I hope to have the opportunity to participate in its various activities.

  BEI3. I hope to support more members through it.

  BEI4. I'd like to recommend it to others if I have the opportunity.

35. Some suggestion？ _____

<p align="center">--- End ---</p>

# 移动校园服务 **App** 的<u>融入</u>的问卷

亲爱的先生/女士，

首先，非常感谢您对此项调查的关注和支持。

本次问卷调查的目的是收集促进中国大学生**参与/融入**移动校园服务 App（moblie campus service app, mcs-App）的因素的数据。

我们向您保证：本次问卷调查是匿名的，调查结果将严格保密。您提供的数据不会透露给任何第三方。此外，这项研究将基于所有数据的统计结果。任何组织或个人的数据将不被报告。因此，您无需有任何顾虑或忧虑！请根据您所在的学校和您的情况，针对每个问项进行回答。您提供的所有信息仅用于学术研究，不会用于任何商业目的。所以根据您的真实感受，请回答所有的问题。

您提供的信息对取得科研成果具有重要意义。谢谢你的帮助！

如果您想了解相关研究成果，请联系研究团队，我们将在第一时间通知您。如果您在填写问卷过程中有任何疑问，请联系我们。

我们的联系方式如下：

电话：188-5712-1776　电邮：1202065@qq.com

*说明：App 的<u>融入</u>定义为初始使用后的持续使用和参与，包括与 App 的交互和 App 的使用。"使用"和"交互"是持续的。*
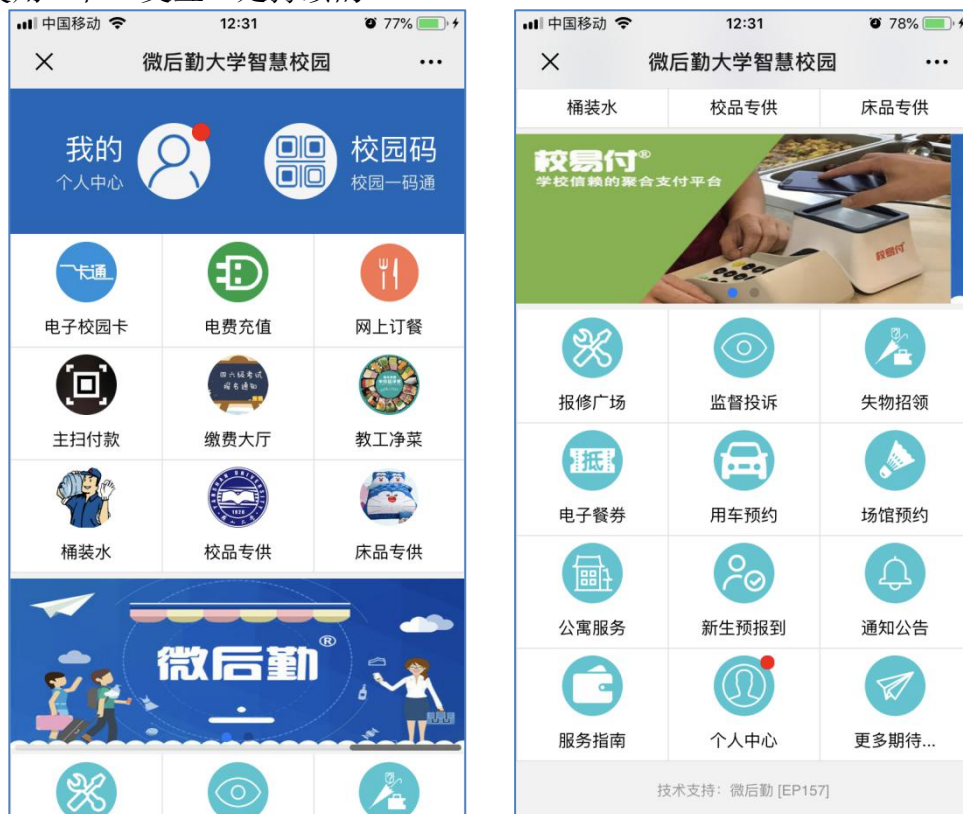


图 1 移动校园服务 App(mcs-App)示例

## Part Ⅰ: 基本信息

1. 性别：□ 男　　□ 女

2. 专业（全称）：＿＿＿＿＿＿＿＿＿＿＿＿

3. 年级：□专科　□ 本科　□ 硕士　□ 博士

4. 生源地（市）：＿＿＿＿＿＿＿＿＿＿

5. 您经常使用其他 mcs-App (如微信、支付宝、今日校园、完美校园和易校园等)？　□ 是的　　　　□ 不是

6. 使用其他 msc-App 的年限：＿＿＿＿＿

7. **替代品吸引力** (1-7 分)

　　请对其他产品的吸引力打分。

8. **使用习惯** (1-7 分)

　　我习惯使用现用系统。

## Part Ⅱ: 量表(强烈反对/赞同, 1-7 分)

### *9. 隐私与安全*

　　PS1. 我觉得安装和使用这个 mcs-App 是安全的。

　　PS2. 我觉得我的个人敏感数据在这个 mcs-App 中得到了很好的保护。

　　PS3. 我对这个 mcs-App 提供的产品/服务的安全性有信心。

　　PS4. 我觉得通过这个 mcs-App 发送敏感信息是安全的。

　　PS5. 这个 mcs-App 有足够的隐私和安全功能。

### *10. 可跨平台*

　　PT1. 这个 mcs-App 在多个移动操作系统上运行良好。

　　PT2. 这个 mcs-App 具有良好的操作系统兼容性。

　　PT3. 这个 mcs-App 具有良好的多操作系统适用性。

### *11. 用户界面(UI)吸引力*

　　UI1. 这个 mcs-App 的用户界面设计看起来很干净。

　　UI2. 这个 mcs-App 的用户界面设计先进的。

　　UI3. 这个 mcs-App 的用户界面设计很吸引人。

　　UI4. 这个 mcs-App 的用户界面设计非常美观。

　　UI5. 这个 mcs-App 的用户界面设计在视觉上很吸引人。

UI6. 这个 mcs-App 的用户界面设计很有吸引力。

## 12. *相容性*

CP1. 这个 mcs-App 与我的校园偏好相符。

CP2. 这个 mcs-App 满足了我的校园需求。

CP3. 这个 mcs-App 与我的校园需求很一致。

## 13. *努力预期*

EE1. 我与这个 msc-App 的交互是清晰易懂的。

EE2. 熟练使用这个 msc-App 对我来说很容易。

EE3. 我发现这个 msc-App 易于使用。

EE4. 学习操作这个 msc-App 对我来说很容易。

## 14. *互动性*

IT1. 这个 msc-App 提供及时的信息包（如：午餐优惠券）。

IT2. 这个 msc-App 为我提供特定位置的信息包（如：当我进入餐厅时，食物的促销信息）。

IT3. 这个 msc-App 为我提供最佳的信息或服务，这是基于我在哪里和我感兴趣的相关的。

## 15. *时间便利*

TC1. 我可以随时访问这个 msc-App 获取必要的信息或服务。

TC2. 我可以随地访问这个 msc-App 获取必要的信息或服务。

TC3. 我可以在需要的时候"随时随地"使用这个 msc-App。

TC4. 这个 msc-App 特别适用于时间关键的服务（如：限时优惠、最后一分钟预订和订单状态跟踪等）。

## 16. *情感的卷入*

AI1. 使用此 mcs-App 是令人兴奋的。

AI2. 使用此 mcs-App 是有吸引力的。

AI3. 使用此 mcs-App 很有趣。

## 17. *认知的卷入*

CI1. 这个 mcs-App 可以改善我的校园安排。

CI2. 这个 mcs-App 可以更有效地安排学习/生活。

CI3. 使用这个 msc-App 对我来说是必要的。

CI4. 使用这个 msc-App 对我意义重大。

## 18. *行为的融入意愿*

BEN1. 我打算继续作为这个 mcs-App 的成员。

BEN2. 我愿意积极参与这个 mcs-App 的活动。

BEN3. 我愿意在这个 mcs-App 上支持其他成员。

BEN4. 我会向任何寻求移动校园 App 建议的人推荐这个 mcs-App。

19. *您的建议：* _____

--- End ---

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# Annex E: Suggestions of Respondent

## E-1 Original suggestion of adoption

1. 问卷的设计应该避免相似性很高的问题，涉及到具体的使用频率等。
2. 这个问卷设置的不够友好
3. 问卷做得不好，没用过的问卷用户还得填后面的用户体验，没用过怎么填？只能瞎填。
4. 不是很清晰这款 App 的功用是啥，是集合了微信、支付宝、易校园等 app 的一款新概念 app 还是啥？
5. 题目太多了。
6. 问题太多了。
7. 设计调查问卷应该用更生活化的语言风格，而不是准确性学术性强的。

### Summary

Avoid high similarity, friendly, features, too much items, life-like language style, avoid academic language style.

## E-2 Original suggestion of engagement

1. 问卷的很多问题是重复的，不理解
2. 我完全理解他们有保护隐私，我选择第四档代表；而且只作为微信小程序使用，怎么跨平台；另外好像提到我们用的最多的杭电助手小程序；我苹果手机，怎么知道跨系统运行效果如何呢？建议加入选项，因为很多题目简直匪夷所思。
3. 问题重复有点高，表格设计的是不是有一点不合理？不过加油鸭！
4. 提高解决问题的效率
5. 基本没用过，感觉问卷设置不合理
6. 是不是我的理解力的问题，我做到最后也很理解这个 app 是正在用的微信公众号，还是即将开发一款新的 app，是对已使用情况的反馈调查，还是预期希望达到的效果调查
7. *跨平台性的问题设置不好，考虑到大多数只有一种平台。*

### Summary

Too much items, portability items are unreasonable, items are repetitive and difficult to understand, simplify the questionnaire.

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# Annex F: Measurement Survey Example

The following measurement survey examples are based on Wenjuanxing (The website is https://www.wjx.cn).

## F.1 Peking University (Beijing)



**App features:**
- Campus eCard
- Quick pay
- QR code payment
- Pay cost
- Order meals
- Shopping
- Reservation (Repair, Venue, Piano room.)
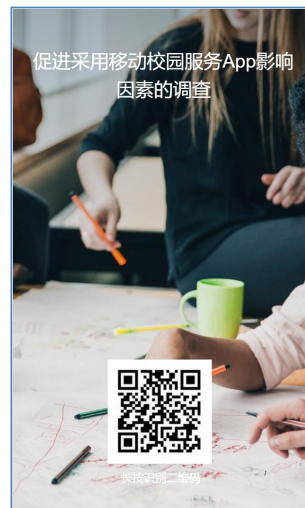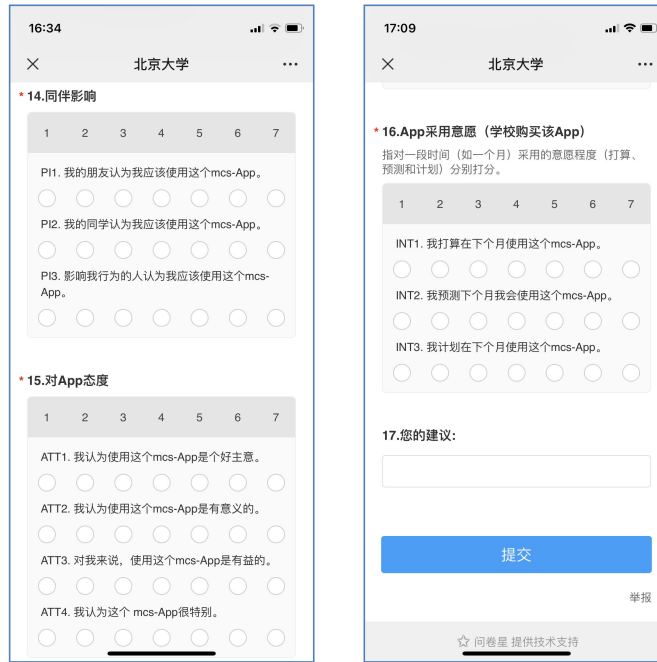


Figure F-1.1 Screenshot of app features     Figure F-1.2 Screenshot of QR code

Figure F-1.3 Screenshot of example (a), (b), (c)



(d), (e), (f)

(g), (h).

## F.2  Zhejiang Institute of Economics and Trade (Hangzhou)



Figure F-2.1 Screenshot of QR code       Figure F-2.2 Screenshot of example (a), (b)
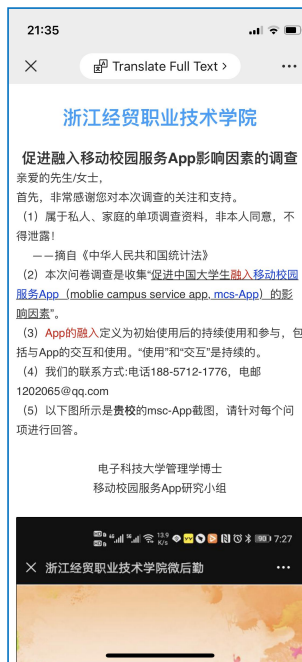
**(c), (d), (e)** — 21:36 浙江经贸职业技术学院

Part I: 基础信息

* 1.性别:
○ 男　　○ 女

* 2.专业（全称）:

* 3.年级:
○ 专科　　○ 本科
○ 硕士　　○ 博士

* 4.生源地（省）:

* 生源地（市）:

---

21:36 浙江经贸职业技术学院

○ ○ ○ ○ ○ ○ ○

Part II: 量表(非常不赞同/赞同, 1-7分)

分值说明:1-非常不赞同; 2-不赞同;3-不太赞同; 4-中立;5-基本赞同;6-赞同;7-非常赞同

* 9.隐私安全

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

PS1. 我觉得安装和使用这个mcs-App是安全的。

PS2. 我觉得我的个人敏感数据在这个mcs-App中得到了很好的保护。

PS3. 我对这个mcs-App提供的产品/服务的安全性有信心。

PS4. 我觉得通过这个mcs-App发送敏感信息是安全的。

PS5. 这个mcs-App有足够的隐私和安全功能。

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21:36 浙江经贸职业技术学院

* 5.您经常使用其他mcs-App (如微信、支付宝、今日校园、完美校园和易校园等)?
○ 是　　○ 不是

* 6.使用msc-App的年限（年）:
如：3年、1.5年。

* 7.替代品吸引力 (1-7分)
请对其他mcs-App产品的吸引力打分。
非常无吸引力　　　　非常有吸引力
○ ○ ○ ○ ○ ○ ○

* 8.使用习惯 (1-7 分)
我习惯使用现用系统
非常不赞同　　　　非常赞同
○ ○ ○ ○ ○ ○ ○

**(c), (d), (e)**

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21:37 浙江经贸职业技术学院

UI4. 这个mcs-App的用户界面设计非常美观。

UI5. 这个mcs-App的用户界面设计在视觉上很吸引力。

UI6. 这个mcs-App的用户界面设计很有吸引人。

* 12.相容性

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

CP1. 这个mcs-App与我的校园偏好相符。

CP2. 这个mcs-App满足了我的校园需求。

CP3. 这个mcs-App与我的校园需求很一致。

* 13.努力预期

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

EE1. 我与这个msc-App的交互是清晰易懂的。

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* 10.可跨平台

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

PT1. 这个 mcs-App在多个移动操作系统上运行良好。

PT2. 这个mcs-App具有良好的操作系统兼容性。

PT3. 这个mcs-App具有良好的多操作系统适用性。

* 11.用户界面(UI)吸引力

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

UI1. 这个mcs-App的用户界面设计看起来很干净。

UI2. 这个mcs-App的用户界面设计先进的。

UI3. 这个mcs-App的用户界面设计令人着迷。

UI4. 这个mcs-App的用户界面设计非常美观。

**(c), (d), (e)**

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EE1. 我与这个msc-App的交互是清晰易懂的。

EE2. 熟练使用这个msc-App对我来说很容易。

EE3. 我发现这个msc-App易于使用。

EE4. 学习操作这个msc-App对我来说很容易。

* 14.互动性

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

IT1. 这个msc-App提供及时的信息包（如:午餐优惠券）。

IT2. 这个msc-App为我提供特定位置的信息包（如:当我进入餐厅时，食物的促销信息）。

IT3. 这个msc-App为我提供最佳的信息或服务，这是基于我在哪里和我感兴趣的相关的。

* 15.时间便利

(f), (g), (h)

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# Annex G: Major Information of Respondent

The following wgd.ord frequency analysis is based on Weiciyun (The website is https://www.weiciyun.com).

## G.1 Adoption

The top five majors of the respondents are computer science and technology, mechanical engineering, intelligent science and Technology, metallurgical engineering and network engineering.
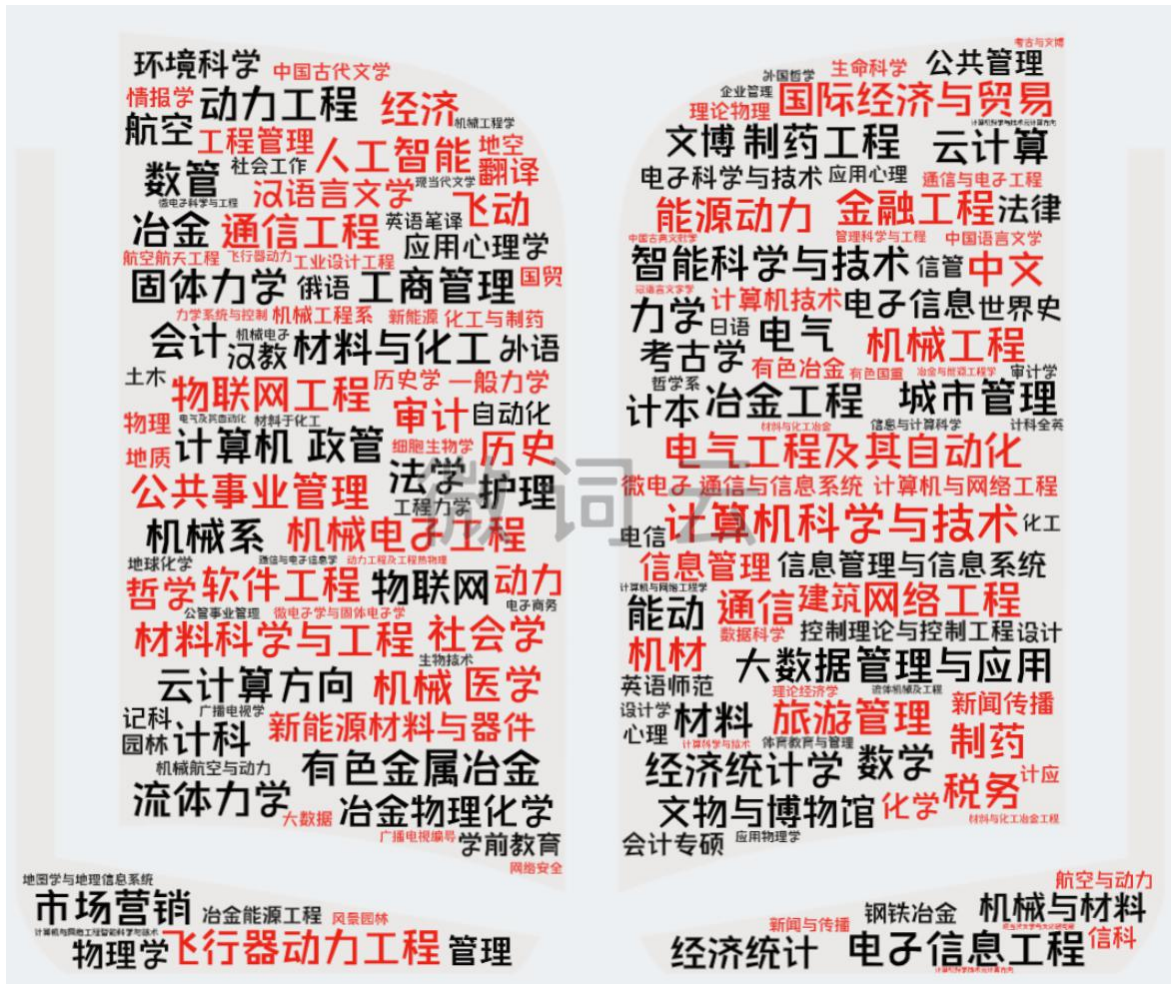
被调查者前 5 的专业是计算机科学与技术、机械工程、智能科学与技术、冶金工程网络工程。



Figure E-1 The word frequency of major

## G.2 Engagement

The top five majors were accounting, software engineering, English, computer science and

technology, and automation.

被调查者前 5 的专业是会计、软件工程、英语、计算机科学与技术、自动化。



Figure E-2 The word frequency of major

# Annex H: Acronyms

| | |
|---|---|
| CFA | Confirmatory Factor Analysis |
| CMUA | Coping Model of User Adaptation |
| CNNIC | China Internet Network Information Center |
| C-TAM-TPB | Combined TAM and TPB |
| DTPB | Decomposed Theory of Planned Behavior |
| ECT | Expectations Confirmation Theory |
| EFA | Exploratory Factor Analysis |
| GST | Goal Systems Theory |
| IDC | International Data Corporation |
| IDT | Innovation Diffusion Theory |
| IM | Instant Messaging |
| mcs-App | mobile campus service App |
| MIIT | Ministry of Industry and Information Technology of the People's Republic of China |
| MISS | Model of Information Systems Success |
| MM | Motivational Model |
| MOE | Ministry of Education of the People's Republic of China |
| MPCU | Model of Personal Computer Utilization |
| PII | Personal Involvement Inventory |
| SCT | Social Cognitive Theory |
| S-O-R | Stimulus-Organism-Response model |
| TAM | Technology Acceptance Model |
| TAM2 | Extension of the Technology Acceptance Model |
| TAM3 | Technology Acceptance Model 3 |
| TOE | Technology Organization and Environment framework |
| TPB | Theory of Planned Behavior |
| TRA | Theory of Reasoned Action |
| TRGP | Theory of Reasoned Goal Pursuit |
| UMISS | Updated Model of Information Systems Success |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| UTAUT2 | Unified theory of Acceptance and Use of Technology 2 |
| VAM | Value-based Adoption Model |