Factors determining intention to adopt m-commerce in a group of College students in China

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ABSTRACT: Mobile commerce is especially attractive to Chinese college students since it offers the possibility of purchasing goods and services from anywhere at any time. Electronic commerce has produced increasing revenues since 1990. M-commerce represents a newer source of revenue with great potential as part of e-commerce. This research proposes to determine significant factors influencing the intention to adopt a new m-commerce application by a group of college students in Nanjing, China, using a formative Structural Equation Model. The model uses a set of 11 indicators to build the final construct. Results from this study identified the following factors as significantly influencing the intention to adopt a new m-commerce application by a group of college students in China: Perceived security, Perceived Ease of Use, Perceived Enjoyment and Perceived Compatibility. These results have some partial similarity with previous research. However, Perceived Compatibility appears as the single factor not common with previous results indicating an increased interest from Chinese college students to have an m-commerce application that is compatible with all their mobile devices. Significant factors identified in the present research according to the value of the coefficient of determination R^2 have substantial explanatory power. Explanatory power of the model presented in this research improves those from previous studies. However, further studies are needed with larger sample sizes to corroborate the results presented in this research.

KEYWORDS: Mobile commerce, formative model, technology acceptance model, intention to adopt, structural equation model.

1 INTRODUCTION

Mobile commerce is especially attractive to Chinese students since it offers the possibility of purchasing goods and services from anywhere at any time. Students buy things like books, clothes, food, and access to online movies and TV series without leaving campus. Increased interest in mobile commerce is motivated by social changes and technological innovations which are making much more appealing and convenient to switch from electronic commerce to mobile commerce [1]. Electronic commerce is a sector that has produced increased revenues since its inception in the mid 90's [2]. E-commerce offered the possibility to reach new markets at a relatively low cost and in a convenient way for both buyers and sellers. Advances in mobile devices and telecommunication networks are making it very easy and affordable to have access to smartphones with data plans that allow consumers to connect to the internet to conduct a variety of activities from the purchase of goods to the payment of services. In China alone the use of mobile phones has triple since year 2005 [3]. This represents a very desirable market for any new entrant in the m-commerce sector. Then it is important to determine relevant factors that could promote the adoption of mobile commerce applications [4]. Interest in m-commerce sector in developing countries has been growing in recent years ([5], [6]). There is an increasing interest in the study of mobile commerce adoption in different countries such as Bangladesh [7]; China ([5], [8], [9]); India ([10], [11], [12]); Iran [13]; Malaysia ([5], [6]); Spain [14] and the U.S. ([8], [9], [15]).

M-commerce has opportunities to achieve greater success than e-commerce since it can overcome some of the limitations of e-commerce such as accessibility [5]. Social changes are making consumers demand more from m-commerce applications so that these apps fit almost seamlessly with their social lifestyle. Then, affordability of smartphones and increased coverage of cellular networks satisfy the needs of consumers to be socially connected with friends and peers all the time. Then, m-commerce involves more than using mobile devices for buying and selling goods, services and entertainment [4]. It also implies

the creation of a platform where users could interact at various levels sharing experiences about products and life in general [16]. Sellers are also fully aware of the potential benefits that could result from free advertising from customers using social media. Chinese students use several different mobile applications on a daily base. They have high expectations regarding any new mobile application. Then, they compare any new comer application against the leading applications they are familiar with. Cultural issues regarding peer pressure or social ties are also important in terms of being connected with friends and avoid using unpopular m-commerce apps among their Chinese friends.

The research presented in this paper extends the work presented in [16] by adding two additional variables (i.e.: age group and education level) to the initial set of 9 indicators to determine which ones are significantly influencing the intention to adopt a new m-commerce application by a group of college students. Therefore, this study contributes in the area of mobile commerce by determining significant factors influencing the intention to adopt a new m-commerce application by a group of College students in Nanjing, China. This research studies the intention to adopt a new m-commerce application by means of a formative Structural Equation Model (SEM) using a set of 11 indicators. These indicators are: age group, education level, perceived benefits, innovativeness, perceived security, perceived ease of use, perceived cost, perceived enjoyment, perceived compatibility, perceived lack of critical mass or perceived subjective norm and perceived intention to adopt mobile commerce ([4], [5], [16]).

This research proposes a formative model to determine significant factors influencing the intention to adopt a new m-commerce application by sellers in Nanjing, China. In formative models the final construct is built from a set of indicators representing different dimensions of the construct. Therefore, indicators in a formative model are not interchangeable as is the case with reflective models ([17], [18]). Reflective models use a series of indicators to represent the same dimension of the construct. Then, reflective models are characterized by a set of highly correlated items. These aspects allow the use of traditional reliability and goodness of fit techniques to determine the quality of the model [18]. However, this is not the case with formative models in which there is still ample controversy about how to determine the reliability and quality of the model ([18], [19]). For instance, traditional reliability indicators such as Cronbach Alpha ([17], [18]) may not be appropriate to use in formative models, despite its use in similar studies ([5], [8], [10]) in which there are multiple items measuring the same indicator. Highly correlated items in a formative model are likely to be indicators of the same dimension of the construct. Then, in formative models it is important to check for collinearity using Variance Inflation Factors (VIF). Collinearity measures the degree of correlation among indicators. In the study presented here to facilitate the application of the survey, there are no duplicate items measuring the same indicator, therefore it is expected correlation among indicators not to be high. Indicators in a well-defined formative model are likely to be unrelated to each other [18]. This has important implications to determine significant factors influencing the adoption of the final construct since there are no duplicate items. In reflective models, it is easy to drop non-significant indicators since there are multiple manifestations of the same dimension of the construct. However, in formative models, indicators cannot be dropped from the models without affecting the meaning of the final construct [18]. In this paper the Structural Equation Model (SEM) variance based Partial Least Squares (PLS) technique ([18], [19], [20], [21]) is used to determine significant factors affecting the intention to adopt this new m-commerce app.

Research presented in this paper and in ([1], [16], [22], [23]) differ from previous studies([5], [6] , [8], [9], [14], [15], [24]) since the intention to adopt mobile commerce is based on a real existing application which is seeking to increase market share capturing new markets in China. The new mobile commerce application studied in this paper is developed by "JiuYao Pintuan" (91拼团). This m-commerce application is used mainly in Beijing to some extent, but it is relatively unknown in the Nanjing market. M-commerce market in China is dominated by big players such as Taobao and Pinduoduo. One of the most popular platforms for m-commerce is WeChat which can be used for social media marketing or directly to buy products and services. Then, any new comer in the Chinese m-commerce market has to offer more than the incumbents. Then, when students answered the survey used in this paper, they are rating the new m-commerce application against the popular incumbents. New m-commerce app uses a novel concept of group buying in which unrelated buyers put together orders for the same product benefiting on the economies of scale that produce buying a larger quantity of the same product. As indicated by [20] mobile commerce applications that promote group buying present issues of trust and security. Organizers of group buying may not be known by all members of the group. Group members only share the common interest of buying the same product at a cheaper price. Reference [20] proposes a method to increase security of group buying transactions based on logic of mutual authentication. The mobile commerce application studied in this paper adds additional features that increase the security of the group buying transactions by not releasing the financial incentive to the group organizer until all participants in the group have received their complete orders. Application offers the possibility to organize parties for things like wine or coffee tasting. Participants will enjoy price discounts resulting from buying large quantities as a group (of unrelated buyers), while sellers will benefit from high sales during a short period of time. M-commerce application also offers the possibility to broadcast live feeds that customers can use to buy products. This increases the convenience of using m-commerce applications by Chinese students since they can interact with sellers to select and buy products.

Study presented here extends the work presented in ([1], [16], [22], [23]) by determining the intention to adopt a new m-commerce application by a group of college students in Nanjing, China. Reference [16] presents a formative structural equation model (SEM) to assess the intention to adopt this new m-commerce application by a group of sellers. A set of 9 indicators are used to build the final construct intention to adopt this new m-commerce application. It is found that perceived benefits, innovativeness and perceived enjoyment are significant factors influencing the adoption of a new mobile commerce application by a sample of sellers in Nanjing, China. Reference [22] presents a formative model to determine the intention to adopt a mobile commerce application by buyers in China based on a set of 13 indicators. It is found that Education level and Perceived Lack of Critical Mass or Perceived Subjective Norm are significant factors determining the intention to adopt a new m-commerce application by buyers. In [23] a formative structural equation model (SEM) is developed to assess the intention to adopt this new m-commerce application by a group of 98 buyers and sellers. A set of 12 indicators are used to build the final construct intention to adopt this new m-commerce application. It is found that when these groups are studied together issues of collinearity arise. Then, a modified research model determines the following as significant factors influencing the adoption of a new mobile commerce application for the sample studied in Nanjing, China: Age group, Perceived Benefits, Innovativeness, Perceived Cost and Perceived Enjoyment. Reference [1] proposes to determine significant factors influencing the intention to adopt a new mobile commerce application by the same group of sellers used in [23]. An additional objective of [1] is to study issues of collinearity presented in [23]. Results from [1] identified perceived benefits, perceived enjoyment and innovativeness as significantly influencing the intention to adopt a new mobile commerce application by sellers. Results presented above have more similarity when sellers are part of the study group. Previous results published in 2012 for a similar study in China indicated that trust, social influence, and cost have a significant relationship with the decision to adopt mobile commerce by consumers [5]. Earlier results published in 2009 [8] identified perceived usefulness, perceived ease of use, perceived cost and subjective norm as significant factors influencing the decision to adopt mobile commerce by consumers. Comparison of all these results, indicates that significant factors influencing the decision to adopt m-commerce depend upon the nature of the decision maker as a seller or as a buyer [1]. Results presented in this research also support this idea as it will be shown in a later section of the paper. An additional contribution of this research to this area is that explanatory power of the model presented in this research improves those presented in ([1], [8], [16], [22], [23]) which increases the confidence on the results obtained from the analysis conducted here.

2   MATERIALS AND METHODS

A survey questionnaire ([16], [22]) is used to gather information about a set of indicators to determine their significant influence over the final construct intention to adopt a new mobile commerce application by a group of college students in Nanjing, China. Survey questionnaire was designed using a Likert scale from 1 (disagree strongly) to 4 (agree strongly). Students received a brief introduction about the features of the m-commerce application. Convenience sampling is used to distribute the surveys in a similar way as in several other studies ([5], [8], [10]). This limitation can be overcome easily with additional financial resources to conduct the study using a random sample. Around 280 students enrolled in the School of Management, New York Institute of Technology, Nanjing, China, were invited to answer the surveys electronically using their mobile phones. Participation in the survey was completely voluntary. Students have no incentives to answer the surveys, as they were not enrolled in any course with the author. Students could answer the surveys remotely at any time over a period of three days before finals' week. A total of 28 surveys were collected over this period. The Structural Equation Model (SEM) variance based Partial Least Squares (PLS) technique used to analyze the data in this paper has the advantage of being able to handle small sample sizes like the one used in this research [18]. Participation in the survey was extremely low. This could indicate either lack of interest in the m-commerce application or just bad timing in the application of the survey. This last aspect could be removed from any additional study by carefully selecting the application period for the surveys. However, not answering the survey due to lack of interest in the new m-commerce app after students received the introduction to the app is a major caveat for this app since students have no interest in even considering adopting the new m-commerce app. This last aspect deserves additional consideration in separate research studies.

In terms of the gender of the respondents, 86% of the respondents to the survey are female. Responses from freshman students represent 32%, from sophomore students 43% and from junior students 25%. 71% of respondents are less than 20 years old and 29% are between 21 and 25 years old. Sample is skewed towards females. Distribution of students at NYIT SoM is skewed towards females, but in a proportion closer to 70%. Then, proportion of females in the sample is higher than proportion of females at the school. Similarly, with previous studies [16], sample is skewed [25] towards female respondents and students younger than 20 years old. Proportion of students per academic year at NYIT SoM is homogenous at around 33.3%. At the moment of survey collection there were only freshman, sophomore and junior students enrolled at NYIT SoM. Then, sophomore students are overrepresented and junior students are underrepresented in the sample used in this study as compared with the distribution of students at NYIT SoM. However, there is no available data about the composition of the

population of interest for the m-commerce app studied here to determine whether or not sample is representative of the target market for the m-commerce app studied in this research. In this sense, results presented here are sample based and share the limitations of this type of study in terms of extending the results to larger samples in the general population.

Figure 1 presents the formative model used in this research to determine significant factors influencing the intention to adopt a new m-commerce application by a group of College students in Nanjing, China. The technique Structural Equation Model Partial Least Squares (SEM-PLS) ([18], [19], [20], [21]) is used to analyze the model. The final construct is built from a set of indicators representing different dimensions of the construct in formative models. Therefore, indicators in a formative model are not interchangeable as is the case with reflective models ([17], [18]). Reflective models use a series of indicators to represent the same dimension of the construct. Then, reflective models are characterized by a set of highly correlated items. These aspects allow the use of traditional reliability and goodness of fit techniques to determine the quality of reflective models [18]. However, this is not the case with formative models in which it is still controversial to determine reliability and quality of the model ([18], [19]). Traditional reliability indicators such as Cronbach Alpha ([17], [18]) may not be appropriate to use in formative models, despite its use in similar studies ([5], [8], [10]) in which there are multiple items measuring the same indicator. Highly correlated items in a formative model are likely to be indicators of the same dimension of the construct. Then, in formative models it is important to check for collinearity using Variance Inflation Factors (VIF). Collinearity measures the degree of correlation among indicators. In the study presented here to facilitate the application of the survey, there are no duplicate items measuring the same indicator, therefore it is expected correlation among indicators not to be high. Indicators in a well-defined formative model are likely to be unrelated to each other [18]. This has important implications to determine significant factors influencing the adoption of the final construct since there are no duplicate items. In reflective models, it is easy to drop non-significant indicators since there are multiple manifestations of the same dimension of the construct. However, in formative models, indicators cannot be dropped from the models without affecting the meaning of the final construct [18].

Similarly, with most of the studies on mobile commerce adoption, the study presented is this research is based on the Technology Acceptance Model (TAM) [26]. The survey used in this research consists of the items described below ([4], [5], [8], [10], [16], [22], [23], [24], [27]) in addition to age group and education level:
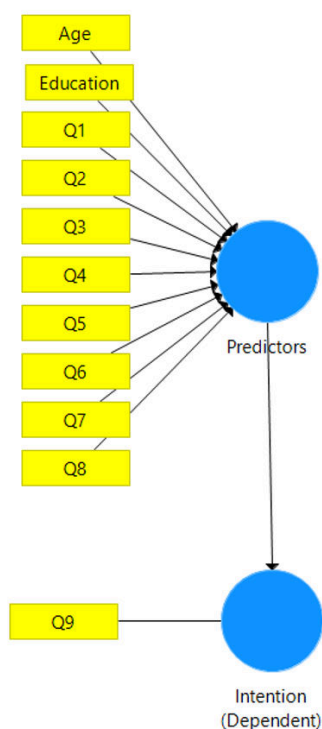

Fig. 1.   Research Model

Perceived Benefits (Q1): students are likely to use the new m-commerce app if they perceive it would bring them exposure to bigger markets giving them the possibility to buy new products at cheaper prices.

Innovativeness (Q2): In the Chinese m-commerce sector there are already some big players such as Taobao and Pinduoduo, then students would only switch to a new m-commerce application if they perceive this application offers a great deal of innovation, in things like interface and features.

Perceived security (Q3): students expect that mobile commerce transactions provide the same or greater security than electronic commerce transactions. M-commerce transactions need to be secure preserving the privacy of the transactions.

Perceived Ease of Use (Q4): students would be reluctant to adopt an m-commerce app that is too complex to use since spending too much time searching for products or completing the sale carries additional costs.

Perceived Cost (Q5): Transaction costs, maintenance costs and any other costs associated to use an m-commerce platform have to be kept to a minimum. Students prefer applications that are free to use with no transaction costs. Chinese students would even tolerate some targeted ads as long as the application remains free to use.

Perceived Enjoyment (Q6): M-commerce has to offer consumers a pleasant and gratifying buying experience. Students are more likely to use an application that is fun to use with additional features beyond buying and selling products.

Perceived Compatibility (Q7): M-commerce apps to stay in the market need to keep up with constant technological changes. Students would prefer an application that is compatible with all the different devices that they (and all their friends) use on a daily basis.

Perceived Lack of Critical Mass or Perceived Subjective Norm (Q8): in an era characterized by social networks, students do not want to commit to a mobile platform that is not a trend setting platform and that it has become obsolete. Chinese students are more likely to use an m-commerce app after some of their friends are already using it. This is perhaps one of the most difficult aspects to overcome by a new comer m-commerce app unknown by potential buyers and sellers.

Perceived Intention to adopt m-commerce due to overall advantages (Q9): Intention to adopt the new mobile platform is estimated as a proxy via this question [8].

3 RESULTS

The analysis presented here uses a variance-based SEM-PLS technique which offers advantages over other covariance-based SEM techniques in the ability to handle small samples and requiring fewer assumptions about the distribution of the data. Significant indicators for the formative model presented in Fig. 1 are determined using the program SmartPLS 3 [28]. Consistent Partial Least Squares (PLSc) is used to evaluate the significant relationship between the indicators and the final construct "Intention" (Q9) [17]. PLSc technique offers advantages over Partial Least Squares (PLS) [17] due to the fact that it produces asymptotically consistent estimators and it gives the theoretical possibility of derived goodness of fit estimators. Determining quality, reliability and goodness of fit indicators for formative models like the one presented in this study is still controversial ([18], [21]).

Results presented in Fig 2 indicate that 79.9% of the target endogenous variable "Intention" variance is explained by the predictors used in the model. According to [18] coefficient of determination values R^2 greater than 0.67 are considered substantial, values between 0.33 and 0.66 are considered moderate and values between 0.19 and 0.33 are considered week. Then, the research presented here has substantial explanatory power. This value improves R^2 presented in previous research ([1], [8], [16], [22], [23]). Differences in the explanatory power is due perhaps to the sample studied in this research being more homogenous as compared to the sample used in previous research. Model developed in [8] uses a larger sample size with multiple items for the same indicator and [22] uses a larger sample of buyers; whereas [23] uses a larger sample of buyers and sellers.

Consistent PLSc Bootstrapping [28] is used to determine statistical significance of inner model path coefficients and outer model weights. Outer model weights are considered an estimator of the relevant contribution of an indicator to build the final construct. Parameter estimation using bootstrapping technique is done by drawing a large number of random subsamples with replacement from the original sample used in the study. Therefore, this technique could produce results with small variations each time the algorithm is run for the same problem [18]. Then when Consistent PLSc Bootstrapping technique is employed parameters are estimated using the PLSc procedure. Consistent PLSc Bootstrapping algorithm for the study presented here uses 500 random samples considering individual sign changes, basic bootstrapping and Bias-Corrected and Accelerated (BCa) Bootstrap to determine the confidence intervals. Significant factors for values presented in Fig. 3 are those whose t-statistic is larger than 1.96 considering a significant level of 5% in a two-tailed test. Therefore, the inner model path coefficient linking the predictors with the intention to adopt m-commerce is significant. Similarly, Perceived Enjoyment (Q6) is also significant. However, the additional control variables added in this research age and education level are not significant.
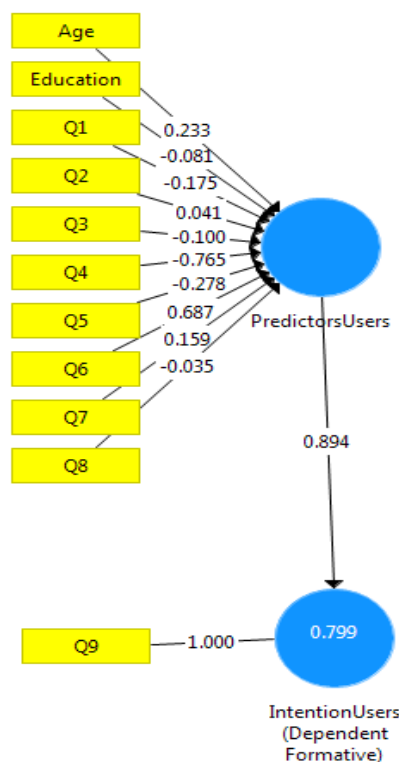
Fig. 2.   Outer Model Weights, inner model path coefficient and R² values

Indicators can be dropped in a reflective model since there is redundancy among them. This will not affect the meaning of the final construct [19]. However, this is not the case with formative models since all indicators help building the construct [18]. Reference [19] indicates that before dropping not significant indicators in a formative model based solely on Outer Model Weights significance it is important to check Outer Loadings significance before removing the indicator. According to this criterion only indicators that have no significant Outer Model Weights and Outer Loadings should be removed from the model. According to p-values for outer weights the following indicator is significant at the 5% level: Perceived Enjoyment (Q6, p-value = 0.007). According to p-values for outer loadings the following indicators are significant at the 5% level: Perceived security (Q3, p-value = 0.005), Perceived Ease of Use (Q4, p-value = 0.000), Perceived Enjoyment (Q6, p-value = 0.000) and Perceived Compatibility (Q7, p-value = 0.009). Then, significant factors included in the final model are: Perceived security (Q3), Perceived Ease of Use (Q4), Perceived Enjoyment (Q6) and Perceived Compatibility (Q7).

Reliability of the relationships in a model can be described using convergent validity and collinearity values. However, determining convergent validity remains a controversial issue in formative models [17] since convergent validity tests the degree of correlation among indicators. Indicators in well-defined formative models are likely to be uncorrelated, presenting no collinearity. As a result, in some formative models, researchers have decided not to report any values for convergent validity. Alternative methods to determine convergent validity are presented in ([17], [19], [26]) using redundancy analysis. Nonetheless, despite the used of these methods the problem of determining acceptable values for convergent validity still remains unsettled.
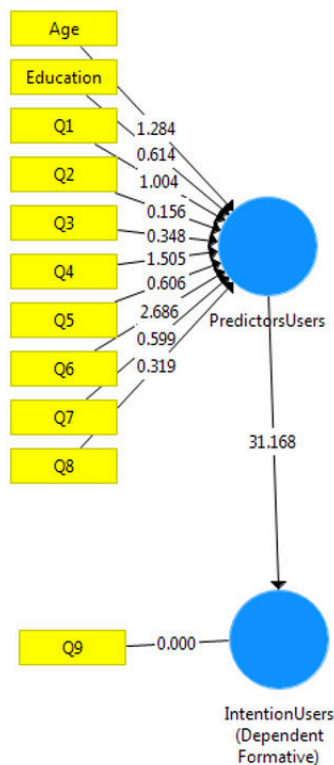
Fig. 3.   Inner Model and Outer Model Weights Significance

In a formative model problem of collinearity should not arise, since indicators are considered different dimensions of the construct. Collinearity is considered to happen when the variance inflation factor (VIF) excess a value of 5 and tolerance values are less than 0.2 [18]. These two measurements are considered to provide the same information [18]. Tolerance can be obtained by subtracting 1 from R^2. In the present case tolerance equals (1- 0.799) = 0.201. Tolerance values less than 0.20 signal issues with multicollinearity. In the present research values of the coefficient of determination and tolerance are very close to the limit signaling the need to study collinearity. However, VIF values presented in Table 1 indicate no issues with collinearity since all values are less than cutoff value of 5. Corresponding Inner VIF from predictors to Intention corresponds to 1. Then, collinearity is not present in the proposed model.

Table 1.   Variance Inflation Factor (VIF)

Indicator	VIF	Indicator	VIF
Age	2.037	Q4	4.230
Education	2.098	Q5	2.971
Q1	2.552	Q6	1.643
Q2	2.376	Q7	2.883
Q3	2.251	Q8	1.332

4   DISCUSSION

Mobile commerce is especially attractive to Chinese students since it offers the possibility of purchasing goods and services in a convenient way from anywhere at any time. Electronic commerce is a sector that has produced increased revenues since its inception in the mid 90's [2]. Mobile commerce, as a part of e-commerce, still has a lot of potential for generating revenues. Therefore, the increased interest in researching this topic in different markets across the globe. This research proposes a formative Structural Equation Model to determine significant factors influencing the intention to adopt a new mobile commerce application by a group of college students in Nanjing, China. The proposed model uses a set of 11 indicators to build the final construct. These indicators are: age group, education level, perceived benefits, innovativeness, perceived security, perceived ease of use, perceived cost, perceived enjoyment, perceived compatibility, perceived lack of critical mass or perceived subjective norm and perceived intention to adopt mobile commerce. Significant factors included in the final model

are: Perceived security [5], Perceived Ease of Use [8], Perceived Enjoyment ([1], [16], [23]) and Perceived Compatibility. These results have some partial similarity with previous research, as indicated above. But have no similarity with some previous results for another group of buyers [22]. Reference [16] identified perceived benefits, innovativeness and perceived enjoyment as significant factors influencing the adoption of a new mobile commerce application by a sample of sellers in Nanjing, China. Reference [22] identifies Education level and Perceived Lack of Critical Mass or Perceived Subjective Norm as significant factors determining the intention to adopt a new m-commerce application by buyers. Reference [23] presents issues of collinearity when a group of 98 buyers and sellers are studied together. A modified research model determines the following as significant factors: Age group, Perceived Benefits, Innovativeness, Perceived Cost and Perceived Enjoyment. Reference [1] identifies perceived benefits, perceived enjoyment and innovativeness as significantly influencing the intention to adopt a new mobile commerce application by sellers. Reference [5] identifies as significant factors influencing the decision to adopt mobile commerce by buyers: trust, social influence, and cost. Reference [8] identifies as significant factors influencing the decision to adopt mobile commerce by buyers: perceived usefulness, perceived ease of use, perceived cost and subjective norm. Comparison of the results from different research studies indicates that significant factors influencing the decision to adopt m-commerce depend upon the nature of the decision maker as a seller or as a buyer [1]. Perceived Compatibility is a factor not listed as significant in previous studies, indicating that for this sample group of college students it is important to have an m-commerce app that is compatible with their current and desired future phones. Then, m-commerce application developers need to design apps that are compatible with a vast range of mobile phones. This new m-commerce app needs to be easily upgradable to adapt to any new changes. Age and education level are not significant factors influencing the intention to adopt the new m-commerce app studied in this research. This is perhaps because there is not much difference in the subjects studied in the sample in terms of age and education level. It is important to mention that results reflect the issue that sample is composed of students who are very used to social media and mobile applications. Chinese students use mobile devices and mobile applications on a daily base. Then, there are features in the applications that they assume will come as standard features in all m-commerce applications. Therefore, Chinese college students in the sample studied in this research have the intention to adopt a new mobile commerce application that is secure, easy to use, provides enjoyment and that is compatible with all their mobile and internet devices. Results presented here have substantial explanatory power due to the value of the coefficient of determination R^2. However, further studies are needed with larger sample sizes to corroborate the results presented in this research.

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