Research article

Technology acceptance factors of e-commerce among young people: An integration of the technology acceptance model and theory of planned behavior

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ABSTRACT

This study aims to examine the factors involved in the technological acceptance of e-commerce among young university students. The research is focused on the articulation between the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB) by collecting secondary data and conducting a survey with 376 young university students, validated by using structural equations (SEM). The predominant factors and variables involved in the adoption of e-commerce by young university students in Medellín were identified. The results show that the attitude towards usage has a positive effect on usage intention because people consider a website to be useful and trust builds regarding usage intention, which will enable to make the transaction in an easier and safer way. In conclusion, perceived usefulness comes before attitude towards usage, and thus the main direct antecedent of the intention to use e-commerce is established.

1. Introduction

The advancement and development of the Internet has significantly changed the relationship with technology usage and the shopping habits of individuals that interact with online environments, compared to those traditionally used by consumers who purchase their products in brick and mortar stores [1,2]. Hence, the Internet clearly exerts control on the behavior of people who shop, sell and make transactions as well as consumers' decision making [3]. During the previous decades, people have tried different alternatives to purchase or shop for products. The possibility of online shopping came with the development of the Internet. Besides, online shopping is embraced by consumers because they can purchase products around the world without the need to go to a traditional store [4]. This results in a new way to commercialize goods and ser vices called electronic commerce or e-commerce. Although there are several definitions reported in the literature, e-commerce might be understood as any business activity that transforms internal and external relationships to create value and exploit market opportunities influenced by the new rules of online economics and enables the incorporation of all types of transactions of information, products, services and payments through electronic networks. It also

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integrates solutions to any type of Internet trans action, defined as the use of digital communication networks to facilitate the purchase or sale of any product or service [2,5–7].

In this context, identifying the factors that have an impact on the usage of e-commerce among users and the way the consumer behaves in the online environment is essential to strengthen the development and application of strategic marketing arbitrage that is efficient to commercialize goods and services through e-commerce. Therefore, the theories that detail the process of innovation adoption are an interesting research path to know why users buy online [8,9] among them, the Technology Acceptance Model (TAM) [9,10] and the Theory of Planned Behavior TPB [11] stand out. These models have been widely developed by research on Information and Communications Technology (ICT) and enable to forecast their usage. A literature review revealed that the works on technology acceptance by Refs. [2,10,12,13] are the most relevant.

In Colombia, authors such as Dakduk et al. (2017) have combined models like the TPB, the Theory of Reasoned Action (TRA), and the TAM to investigate the factors that influence consumers' intention to shop online. Likewise, in his study, Sánchez-Torres (2019) examined the effects of the digital divide on the technological factors that affect e-commerce adoption. Despite this, there is no research that particularly analyzes the factors involved in e-commerce acceptance, mainly among young university students. This study, thus, aims to fill in such research gap by proposing a framework that combines the TAM and the TPB.

More specifically, the objective of this research is to examine the factors involved in e-commerce usage by young university students aged 18 24 by articulating the Technology Acceptance Model [9,10] and the Theory of Planned Behavior (TPB) [11]. A sample of 376 young university students was used to conduct the research. This study used an exploratory, descriptive and conclusive technique by means of secondary data collection. This document presents several contributions. First, research work often studies the intentions but not the behavior [14,15]. However, intentions do not always translate into behavior. Second, although the TAM, in its original form, is regarded as an outdated model, its extension to other domains based on behavioral theories like the TPB enables a deeper understanding of technology adoption in, for instance, the field of e-commerce [16]. As a result, the meta-analysis of the factors that affect e-commerce adoption by Chen et al. (2012) is only focused on developed countries. Finally, as in the last case, a different meta-analytic review of mobile banking did not include any study conducted in Latin America [17,18]. It is thus evident that the predicting power of the Acceptance Model has been widely assessed. Likewise, this model is of the essence when research is conducted in the Latin American sociopolitical and sociocultural context because some authors suggest different results and influence of variables depending on the cultural context [19,20].

This study contributes to the discussion on e-commerce adoption by shedding light on the intentions behind using e-commerce as a channel to acquire any kind of product or service and providing guidance on important topics for company directors who work with or are considering offering products through e-commerce. More specifically, this article shows the way college students use e-commerce, for instance, to shop online from a wide range of options in multiple categories, such as food, travel, airplane tickets, and entertainment.

Developing countries have had a hard time strengthening their economies using online shopping because they have experienced financial crises due to the devaluation of their currencies. For these reasons, this paper examines college students' intention to use e-commerce, its ease of use, and their actual purchase intentions. The global economy has improved year after year, and an increasing number of individuals want to start an online business. Technology has helped countless entrepreneurs thanks to social networks. In Latin America, these technologies show great potential but also weaknesses in this region, such as the lack of internet access in locations far from cities and the limited availability of internet enabled devices. These conditions hinder electronic commerce from becoming the most common shopping method in Latin America. Consequently, national governments in that part of the world should pay more attention to their emerging markets because, due to a lack of social investment, they can be economically stuck or become less attractive to the global market.

In this study, the criteria for the selection of participants include aspects such as socioeconomic status, internet access, devices' ease of use, capabilities of the available architecture for internet use, and complexity of students' behavioral intentions. Moreover, the analysis focuses on young individuals enrolled in public higher education institutions. According to estimates, most internet users in Colombia are young people between the ages of 12 and 24 (84.1%), followed by adults between the ages of 24 and 54 (76.3%), which suggests that the country's adult population is definitely embracing technology [21]. This high percentage of young people who are increasingly using and adopting technology supports this study's choice of individuals between the ages of 18 and 24. Given the exploratory nature of this research—whose goal is to examine the relationships between variables in a setting where the manifest variables have already been identified through the gathering of secondary data—a sample size of 376 individuals is considered acceptable. Additionally, the results of the questionnaire administered to the young university students revealed gender differences.

The above facts explain why young university students were selected as the sample. As has been seen, research on e-commerce growth is not linked to studies that help understand the factors that support this growth and e-commerce usage by individuals. Hence, the need to implement technology acceptance models tailored to the sociocultural and economic contexts of emerging economies [22].

The article is divided into five sections: a) theoretical framework, which expands the content and concepts of diffusion of innovations, e-commerce definition, and acceptance models; b) methodological design of the research; c) analysis, results and validation of the measurement scales; d) discussion; and e) conclusions, limitations and future work.

2. Literature review and research hypotheses

The dynamics of technology and the acceptance of new technology present valuable features for predicting usage and user satisfaction. The need to diffuse technology and its impact on people have enabled the construction of theories and models that seek to explain the way users and technology interact. For this reason, technology acceptance models enable to describe the behavior of using

or not technology. Adoption has been defined as the process whereby individual adopters go from awareness to complete acceptance of a new product, process or idea [23,24]. The decision to adopt innovations is different from other types of decision making because of the relative novelty of innovations and the greater uncertainty associated with this type of decision.

There are models and theories that study the behaviors and factors involved in technology adoption, the most used are the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB). Particularly, the TAM has been widely used in different contexts, such as the adoption of several types of technology, the analysis of markets in the United States, Europe and Asia, as well as web systems and electronic commerce, among others [6,25,26]. Those theories will be explained later; but before that, it is important to define the meaningful contribution made by Rogers in 1962 with the Diffusion of Innovation Theory (DOI).

2.1. The diffusion of innovation and innovativeness

The Diffusion of Innovation Theory, proposed by Rogers in 1962, is the process that explains that an innovation is communicated through certain channels over time among the members of a social system [23,24]. Rogers defined five categories of individuals with different degrees of propensity to innovate: Innovators, Early Adopters, Early Majority, Late Majority and Laggards. Other authors have written about the basis proposed by Rogers. They further develop and discuss their own definition of the features of the evaluation of the technological qualities of innovation [27]. Likewise, different authors include external and internal factors of the organization [28], such as [29] propose the diffusion of service innovation, and the research conducted by[30] does so in the manufacturing sector. Finally, [31] proposes a change of method in innovation studies that enables to evaluate the different stages of an innovation process.

[32] define orientation towards innovation as the relative desire of an individual to try a new product or the intention to adopt it. According to [33], the orientation towards innovation involves the perception of novelty, which is subjective; therefore, what is new to an individual constitutes an innovation. The research conducted by [33] found that, regarding shopping for clothes, such orientation is an important predictor of online shopping, since people buy the garments more because they perceive the innovativeness in the e-commerce channel than because the items themselves are innovative. The following hypotheses are therefore proposed.

Hypothesis 3. Perceived usefulness has an influence on perceived safety.

Hypothesis.5. Perceived safety has an influence on perceived trust.

Hypothesis.7. Innovativeness has an influence on usage intention.

Hypothesis.8. Perceived trust has an influence on perceived ease of use.

2.2. Theories of Planned Behavior

The Theory of Planned Behavior (TPB) is a product of the Theory of Reasoned Action [11], to overcome the limitations of the latter in situations of unconscious or involuntary behavior beyond the individual's control [34–36]. The TPB led to the incorporation of the control of perceived behavior. This approach considers human action to be caused by three types of considerations: a) behavior beliefs—probable consequences of behavior; b) regulatory beliefs—related to others' regulatory expectations); and c) controlled beliefs—presence of facts that may facilitate or hinder the development of the behavior. Such considerations are decisive to decide on how to change the behavior of the individual [34,36]. Finally, the Theory of Planned Behavior has been used to model the acceptance behavior of different types of technology, virtual environments and systems [23,24,37,38], which efficiently demonstrates the prediction of the intention to adopt e-commerce [4].

Indeed, a study conducted at Isfahan University in Iran—Analysis of the Effective Factors on Online Purchase Intention through Theory of Planned Behavior—found support for all the relationships between the variables proposed by the TPB, as well as the social influence of friends over subjective and perceived credibility norms regarding the attitude towards e-commerce [39]. As a consequence, a study was conducted in an emerging Latin American economy, Bogotá. It was titled Customer Behavior in Electronic Commerce: A Bayesian Approach and confirms that the intention to shop online is more greatly determined by the attitudes towards electronic commerce than the perceived ease of use and the subjective norm related to online shopping [4].

Concerning the latter, research carried out with users in Medellín (Colombia) found that the adoption behavior of e-commerce users confirms that the subjective norm and the perceived control are decisive factors for usage intention in the acceptance of a technology such as e-commerce [6]. Finally, the article "The Impact of Opinion Leadership on Purchases through Social Networking Websites" shows that social norms and behavioral control are significantly associated with an increase in the purchase intention through the e-commerce channel if the perception of an opinion leader is positive [38]. The following hypotheses are therefore proposed.

Hypothesis.6. Innovativeness has an influence on attitude towards use.

Hypothesis.10. Perceived control has an influence on usage intention.

Hypothesis.11. Subjective norm has an influence on usage intention.

Hypothesis.12. Perceived control has an influence on perceived ease of use.

2.3. Technology acceptance model

The Technology Acceptance Model (TAM) is an adaptation of the Theory of Reasoned Action focused on the usage behavior of new technologies [10]. This theory pays special attention to the analysis of the effect of external factors on beliefs, attitudes and intentions [9]. The Technology Acceptance Model was developed to provide a valid measurement scale that predicted technology usage acceptance [9] by users [24,40]. This model considers the attitude towards technology usage as a direct antecedent of the intention to use it, in addition to constructs of perceived ease of use and perceived usefulness as preceding factors [9].

The latter is defined as the subjective probability that, in the future, the users perceive that their performance in the organization improves by using a specific system [9]. It presents the degree to which individuals believe that using a determined system will contribute to improve their professional performance [41]. If individuals perceive that the system is beneficial to carry out their tasks, whether in terms of performance improvement or efficiency increase, they will be more inclined to accept it, even overcoming the natural tendency to resist changes. Perceived ease of use refers to the degree to which a future user expects the usage of a specific system to be effortless [9]. The influence of perceived ease of use might be understood as the degree to which a user considers the tool easy to use while carrying out a process. This demonstrates the efficacy of the TAM to predict the intention to adopt e-commerce. In that sense, a meta-analysis applied to study contexts such as Internet use, electronic commerce and other technology systems found that the in fluence of perceived usefulness on behavioral intention is strong and significantly predicts the latter.

Besides, a research study that analyzed the factors that influence a live customer service chat in Kuwait revealed that aspects such as ease of use and attitude have a significant influence on the intention of customers to use the service, and thus the technology [42]. In this regard, a meta-analysis applied to the acceptation of mobile banking technology identified the best predictors of the intention to use such services: (i) attitude, (ii) initial trust, (iii) perceived risk, and (iv) performance expectation. In terms of usage of mobile banking, under the same assumptions, the best predictors are (i) intention and (ii) performance expectation, which positively and significantly influenced the attitude towards technology acceptance [17,18].

Additionally, among other studies about online shopping, a meta-analysis established relationships between the influential factors of personality traits, perceived risk and technology acceptance in connection with online shopping intention, which was positively influenced [43]. In addition, a study about the mobile telephony market (m commerce) revealed that: (1) Perceived ease of use, perceived enjoyment, convenience, perceived prestige and promotion have a significant and positive impact on attitude. (2) Brand loyalty has a significant and positive impact on consumer's attitude, intention, perceived ease of use, perceived enjoyment, convenience and perceived prestige. (3) Habits have a moderating effect on the relationship between attitude and usage intention [44,45].

Understanding the adoption of electronic commerce in different cultural contexts enables to show the benefits of the TAM in research into cultures, such as the United States, Canada and Pakistan. The researchers developed an expanded technology acceptance model that incorporates trust and perceived behavior control and examined it in environments out of the United States to better understand the differences in the adoption of electronic commerce from culture to culture. The proposal is validated for Pakistan and Canada, although there are noticeable differences between the two cultures. The importance of ease of use perception, perceived usefulness and the con sumers' intentions to shop online was validated in both cultures. The results highlight the complex relationships between ease of use, perceived usefulness and the intention to adopt in each country [46]. As a result, the following hypotheses are proposed.

Hypothesis.1. Perceived ease of use has an influence on perceived usefulness.

Hypothesis.2. Perceived ease of use has an influence on attitude towards usage.

Hypothesis.4. Perceived usefulness has an influence on attitude towards usage.

Hypothesis.9. Attitude towards usage has an influence on usage intention.

2.4. Electronic commerce: technology acceptance factors

Electronic commerce, or e-commerce, is the purchase, sale or exchange of products and/or services through networks such as Internet, where transactions are electronically made or facilitated on different handheld devices such as smartphones, tablets and personal computers, among others [2,6,26,45]. One of its features is that it enables the incorporation of information, products, services or payments through electronic networks by integrating solutions with any type of Internet transaction [47,48]. Furthermore, the impact of online purchases in e-commerce is significantly mediated by digital financial education [49,50].

E-commerce, in times of COVID 19, benefited, since many consumers migrated to this new ecosystem to acquire their goods and services without having contact with the outside [51,52]. There are more and more inclusive tools and alternatives for digital consumers, interaction with e-commerce may continue to increase in the coming years [53]. However, it will be essential that countries adopt policies that facilitate this growth [54,55].

Therefore, the scientific community has made an effort to explain, based on all the available literature, users' behavior when they make a purchase via e-commerce. This impulse has led to great academic contributions, which is confirmed by the combinations of different models and theories, such as the Theory of Reasoned Action (TRA) [11] the Technology Acceptance Model (TAM) [9,10], the Theory of Planned Behavior (TPB) [34,36], the Decomposed Theory of Planned Behavior (DTBP) [56] and the Diffusion of Innovation Model (DOI) [23], among other variables that enable to predict online purchase intention. Some studies related to the combination of TAM, TPB and other variables are listed below. Following, Table I dis plays some of the studies related to the combination of TAM, TPB, and other variables:

Thus, it can be noted that e-commerce adoption is an important aspect in scientific literature. Besides, different parameters are established depending on the sociocultural and political contexts. Once again, it was confirmed that the models that enable a highly accurate prediction of technology acceptance are the DOI, TAM, TRA and TPB.

Based on relevant literature and theories, this study integrates and expands TAM and TPB, as well as additional variables that were used in the research conducted by Tavera and Londoño, (2014). They studied the decisive factors for technology acceptance behavior of electronic commerce users by integrating the TAM and TPB models with security, trust and innovativeness variables.

Indeed, a combination of the Technology Acceptance Model and the Theory of Planned Behavior can explain the adoption of e-commerce in the proposed theoretical model. In the latter, perceived trust is the main direct antecedent of the intention to use e-commerce. Additionally, as said combination covers more factors that influence the decision to adopt e-commerce, it can produce a novel explanation of the reasons why this technology is used.

The study was conducted with users who lived in the urban area of Medellín, Colombia. The model they proposed was applied to young university students aged 18 24 in Medellín to explain the factors that play a role in their intention to purchase online. The hypothesis model is summarized in Fig. 1.

For the TAM analysis, it should be kept in mind that perceived usefulness and perceived ease of use are two specific determinants of user behavior that this model postulates, giving both significant weight in consumers' acceptance and use of a given technology. Although they are factors that influence individuals' usage intention, the impact of external factors on these two determinants is also crucial to understand how users perceive a technological innovation. This is why the proposed methodology considers not only the theoretical underpinnings of the TAM but also those of the TPB, according to which individuals' intention to engage in a particular behavior depends on their attitude, subjective norms, and perceived control.

3. Materials and methods

This section presents the method adopted for the research, which was exploratory, transversal, probabilistic and conclusive. It was exploratory because its objective was to examine the relationships between variables in a situation whose manifest variables had already been identified by the collection of secondary data. It was transversal because the data collection was carried out at a point in time and with one single observation. It was probabilistic because statistical techniques were used for estimation. The ethics committee is CE CIES with approval code (ACTA13072021). Additionally, informed consent was obtained from all participants prior to completing the survey.

This study was divided into three stages: (1) literature review, (2) building the conceptual model, and (3) testing the explanatory
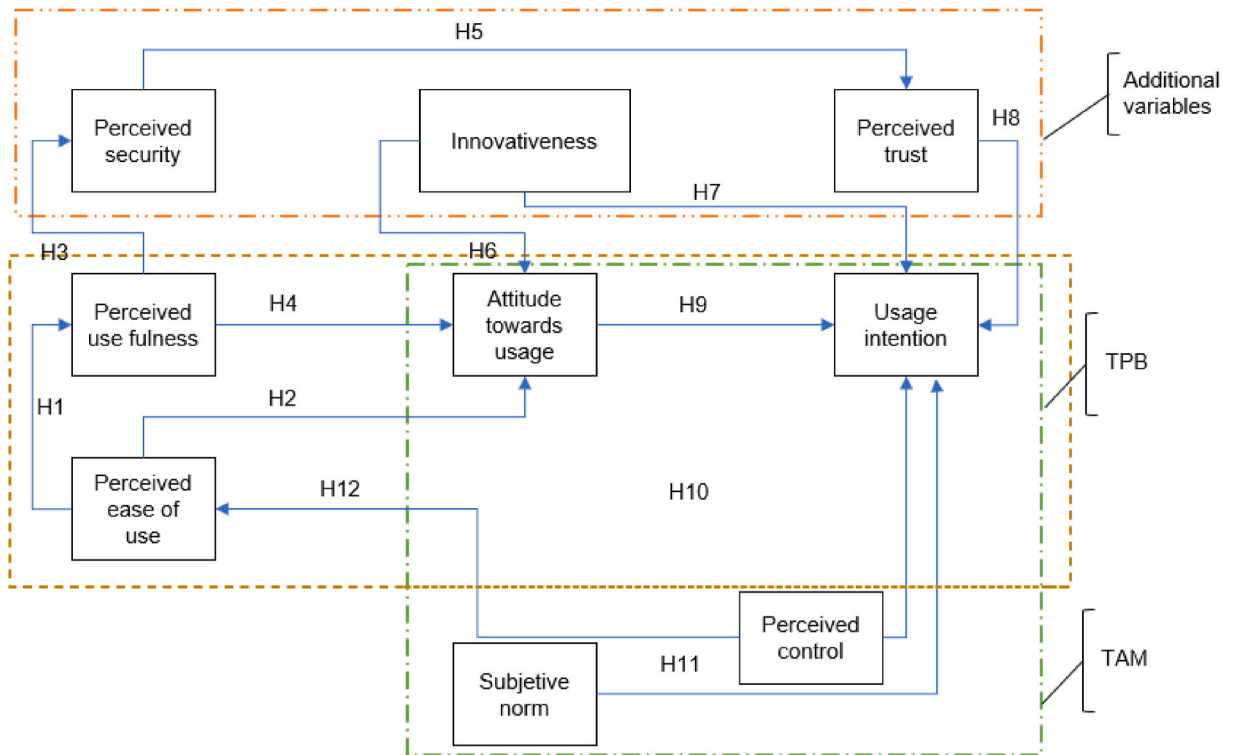

Fig. 1. Research hypothesis model. Green line indicates the TAM model, the brown line indicates the TPB model, and the orange line indicates additional variables included. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

power of the conceptual model. The entire process is described below.

a) Literature review: The authors searched research databases to find documents about the Technology Acceptance Model, the Theory of Planned Behavior, and e-commerce. As a result, all the important articles about the topic analyzed here were read, classified, and compiled. Then, the authors examined the constructs involved in the adoption and intention to use e-commerce, which was the basis to determine the factors and variables related to the TAM, the TPB, and e-commerce. The acceptance of e-commerce and technology as a channel to conduct online transactions is conditioned by intrinsic, extrinsic, and cultural factors. Therefore, the future intention to use this technology is directly determined by the consumer's attitude toward electronic commerce, the normative influence of third parties, and the control or mastery of this behavior. Such intention is also indirectly determined by a set of behavioral beliefs, norms, control, trust, and risk perceived in the purchase. In addition, culture influences the repurchase behavior because it represents a set of shared values that can inform consumer responses.

b) Building the conceptual model: At this stage, a conceptual model was created to explain the phenomenon under study using relationships between different factors that were identified in the literature. After said model was defined using elements and relationships to be measured, the authors selected a methodology for the analysis, listed the variables or relevant constructs to be examined in this study, and identified the existing relationships between the constructs in the theoretical model. As a result of this process, a questionnaire was prepared to validate the conceptual model and measure the relationships between constructs that have been established in the literature. Table 1 details the items in that questionnaire and the constructs in the model.

Based on the considerations above, non-probability sampling was used. This was because not all the elements in the sample could have a probability greater than zero of being selected, due to the research objectives of this study. At this stage, Cronbach's alpha [57] was used to corroborate the degree of reliability of the measurements of each one of the constructs in the models employed here.

Cronbach's alpha can be defined as the proportion of the total variance of a scale that can be attributed to the latent variable [58], as cited in Ref. [59]. Likewise, the composite reliability index, an indicator proposed by [60], can be used to analyze the influence of different constructs interrelated in a measurement scale on the reliability of said scale. It is interpreted similarly to Cronbach's Alpha, and its construction considers the influence of those interrelations. According to [61], Cronbach's alpha estimates the lower limit of the reliability coefficient.

Afterward, the interdependence between all the factors in the TAM and the TPB was evaluated considering the types of constructs established based on the literature review. In agreement with the reasoning so far in this study, Structural Equation Modeling (SEM) was applied to determine the degree to which a set of items measured latent variables.

Subsequently, the constructs were classified by type to establish the subpopulations whose acceptance of e-commerce is better explained by the factors in the model. This step was taken to detect explanatory differences between constructs in each model and between models. Therefore, Confirmatory Factor Analysis (CFA) was implemented in Statistical Product and Service Solutions (SPSS). SPSS was used here because it is one of the most widely known statistical analysis software platforms, can work with large databases,

Table 1
Items in the questionnaire and constructs in the conceptual model.

Item	Construct
I like the idea of online shopping.	Attitude
Making online purchases/transactions is a good idea.	
Buying on web pages is a good idea.	
The websites where purchases/transactions can be made are trustworthy.	Perceived trust
I trust websites to protect my security.	
The websites where purchases/transactions can be made seem to keep their promises and fulfil their commitments.	
Using the internet to make purchases/transactions saves time.	Perceived control
I have the intention to make online purchases/transactions.	
I have the resources, knowledge, and skills to use the internet to buy a product.	
Mi interaction with the internet when I make purchases/transactions is clear and understandable.	Perceived ease of use
Learning how to use the internet to make purchases/transactions is easy for me.	
It would be easy for me to acquire the skill to make online purchases/transactions.	
I like to take risks.	Innovation or innovativeness
I like to try new ways to do things.	
Usually, I'm one of the first people to try out a new product or service.	
I would like to purchase products and/or services online.	Usage intention
I would recommend others to make purchases/transactions online.	
I have the intention to make purchases/transactions online.	
The people who influence my behavior think I should make purchases/transactions online.	Subjective norm
I shop online if people close to me recommends it.	
It concerns me that e-commerce sites collect too much information about me.	Perceived security
I feel safe when I make transactions on websites.	
I think e-commerce suppliers implement the necessary security measures to protect consumers.	
I think e-commerce is useful.	Perceived usefulness
Using the internet to make purchases/transactions saves time.	
Using the internet enables me to make purchases/transactions in a more efficient way than in person.	
I think e-commerce saves money.	

and has a simple interface for most types of analyses according to the selected methodology.

The results obtained from the sample defined in the previous stage were analyzed in a process divided into four steps: (1) The data were collected and formatted for SPSS. (2) Incomplete or invalid data were discarded. (3) Irrelevant or erroneous data were filtered out using statistical software. These data were studied to observe their influence on the results obtained. And (4) the reliability of the data was analyzed; the convergent and discriminant validities of the proposed theoretical model were calculated; and the factors in the model were compared and validated. These steps resulted in a conceptual model that articulates the TAM and the TPB based on the predominant factors in e-commerce usage.

c) Testing the explanatory power of the proposed conceptual model: The results of the proposed conceptual model were reported, analyzed, and discussed considering the supported and rejected factors, as well as possible explanations for the phenomena that were investigated. This stage included a description of the implications of this study, its limitations, and significant consequences for future research. Finally, this stage showed the explanatory power of the constructs in the TAM and the TPB applied to e-commerce usage by college students.

3.1. Participants and measurements

A total of 376 questionnaires were answered and collected between November 2021 and May 2022. All the questionnaires were answered by enrolled university students. To determine the sample size in a study that uses factor analysis and structural equations, [62]recommend having at least ten observations per indicator (observable variable). Since 376 answered questionnaires were collected and there were 27 items (observable variables), the sample size was adequate for this analysis.

The target population was 376 young university students aged 18–24 at three higher education institutions in Medellín who were interviewed face-to-face. The sample was composed of 38.03% women and 61.96% men. Additionally, the results of the administered questionnaire revealed gender differences. The invitation to take part in the questionnaire contained information about the main purpose of the study, the voluntary nature of the participation and the confidentiality of the provided information.

During that time, the questionnaire proposed 27 questions in the form of sentences adapted from the TAM and TPB, as well as other variables of electronic commerce adoption. All the questions were rated based on the degree of agreement or disagreement of the respondents by means of Likert scales: 1. "Strongly disagree", 2. "Disagree", 3. "Neutral", 4. "Agree" and 5. "Strongly agree". A pilot test was conducted by administering 15 random questionnaires to young university students to make sure that the instrument was understood by the target population and adjustments were made based on the collected observations.

The study population included 12,436 young university students between the ages of 18 and 24 from different public higher education institutions in Medellín (Colombia). A margin of error of 5% (how closely the results of the survey reflect the opinion of the general population) and a confidence level of 95% (how confident the authors can be that the chosen population will select a response

Table 2
Initial convergent validation of standardized factor loadings.

Construct	Item	Standardized factor loadings	Average of standardized factor loadings
Attitude	AE1	0.883	0.858
	AE2	0.841	
	AE3	0.851	
Perceived trust	PTE1	0.807	0.801
	PTE2	0.790	
	PTE3	0.806	
Perceived control	PCE1	0.683	0.815
	PCE2	0.880	
	PCE3	0.883	
Perceived ease of use	PEUE1	0.791	0.808
	PEUE2	0.829	
	PEUE3	0.804	
Innovativeness	INE1	0.794	0.742
	INE2	0.791	
	INE3	0.642	
Usage intention	UIE1	0.899	0.878
	UIE2	0.866	
	UIE3	0.870	
Subjective norm	SN1	0.839	0.839
	SN2	0.839	
Perceived security	PSE1	0.481	0.712
	PSE2	0.800	
	PSE3	0.856	
Perceived usefulness	PUE1	0.682	0.751
	PUE2	0.753	
	PUE3	0.771	
	PUE4	0.798	

within a given range) were used for the analysis. In this case, the estimated sample size was 376 individuals. For such calculation, the following formula was employed:

$$\frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)} \tag{1}$$

Equation (1) Sample size.where N denotes the population size; e, the margin of error (in decimals); and z, the z-score, which is the number of standard deviations that a given value is away from the mean.

4. Results

The results were statistically analyzed to validate the measurement scales by means of a confirmatory factor analysis. The factor loadings of each construct in the model were evaluated. Subsequently, the convergent validation of the KMO and Bartlett's sphericity test was measured. After that, the discriminant validity of the measurement model was calculated. Meanwhile, the reliability of the measurement model was identified; for that purpose, the Cronbach's alpha was measured. Therefore, the correlation levels between variables were measured and a discriminant validity was established for them. Likewise, the study compared the hypotheses to detect the factors, relations and conditions under which the phenomenon of e-commerce acceptance occurs.

4.1. Analysis, results and validation of measurement scales

The validity test of the measurement scales in this study was carried out by means of a confirmatory factor analysis (CFA) supported by SPSS statistical software [63,64] states that, in order to evaluate the validity and reliability above 0.5 is considered to be evidence of trustworthiness [65,66]; values exceeding 0.6 are considered to be evidence of low prob ability of error occurrence [67]. This research confirmed that the convergence of the model was appropriate for all the indicators, since most of the standardized factor loadings exceeded 0.6, following the recommendations by Bagozzi and Yi, (1988). Besides, the average obtained from the indicator loadings of each factor was above 0.7 for all the factors [66], which is an indicator of convergent validity (Table 2).

Table 3 presents the KMO measurement [66,68,69,70]. The coefficients of each factor meet the criteria. The p value should be below the critical levels (0.05 or 0.01) because, if the critical level p > 0.05, the null hypothesis of sphericity cannot be rejected. As a consequence, the factorial model might not be appropriate to explain the data. This indicates that it is possible to employ the data reduction technique—that is, to obtain the mini mum number of factors Kaiser, —that enable to shed light on the factors that are in volved in the acceptance and usage processes of electronic commerce among young university students.

4.2. Discriminant validity

The discriminant validity is one of the typical criteria to evaluate the measurement scales of latent factors in social sciences. It enables to measure the theoretical difference between different factors. At this stage, for the measurements to be valid, those in the same construct should be highly correlated to each other (convergent validity), more than to the measurements proposed for a different factor (discriminant validity) [71,72].

In this research, the discriminant validity analysis was conducted by confirming that the confidence interval in the estimation of the correlation between each pair of factors did not contain the value 1 [73]; therefore, it can be stated that there is discriminant validity. Table 4 demonstrates that all the cases satisfy such criterion.

Afterward, the reliability of the measurement model was identified. For that purpose, the Cronbach's alpha [71] was calculated, because this procedure measures the reliability of the internal consistency of a scale. In other words, it evaluates the magnitude to which the items in an instrument are correlated [71,74]. The reliability measurement by means of the Cronbach's alpha revealed that the items (in a Likert scale or also possibly dichotomous items) measure the same construct and are highly correlated to each other [74]. Consequently, the following values are recommended to evaluate the Cronbach's alpha coefficients: alpha coefficient >0.9 means excellent; >0.8, good; >0.7, acceptable; >0.6, questionable; >0.5, poor; and <0.5, unacceptable. However, a reliability value of 0.6 or 0.5 might be enough at the early stages of the research [75].

Table 3
Convergent validation of the KMO and Bartlett's sphericity test.

Factor	KMO value	Bartlett value	Meets the criteria
Attitude	0.710	0.00	Yes
Perceived trust	0.680	0.00	Yes
Perceived control	0.622	0.00	Yes
Perceived ease of use	0.682	0.00	Yes
Innovativeness	0.608	0.00	Yes
Usage intention	0.725	0.00	Yes
Subjective norm	0.500	0.00	Yes
Perceived security	0.526	0.00	Yes
Perceived usefulness	0.738	0.00	Yes

Table 4
Discriminatory validity of the measurement model.

	AE	PTE	PCE	PEUE	INE	UIE	SNE	PSE	PUE
AE	…								
PTE	[0.463; 0.629]	…							
PCE	[0.460; 0.619]	[0.456; 0.622]	…						
PEUE	[0.461; 0.626]	[0.457; 0.621]	[0.533; 0.670]	…					
INE	[0.236; 0.435]	[0.213; 0.419]	[0.092; 0.306]	[0.171; 0.374]	…				
UIE	[0.687; 0.789]	[0.548; 0.690]	[0.552; 0.695]	[0.529; 0.687]	[0.233; 0.436]	…			
SNE	[0.356; 0.529]	[0.404; 0.580]	[0.301; 0.485]	[0.299; 0.488]	[0.194; 0.387]	[0.435; 0.609]	…		
PSE	[0.417; 0.584]	[0.525; 0.666]	[0.359; 0.537]	[0.369; 0.546]	[0.198; 0.386]	[0.492; 0.641]	[0.331; 0.514]	…	
PUE	[0.595; 0.718]	[0.531; 0.667]	[0.433; 0.595]	[0.500; 0.665]	[0.239; 0.435]	[0.575; 0.702]	[0.381; 0.553]	[0.499; 0.655]	…

As can be observed in Table 5, the measurement instrument seems to have a complying reliability of the internal consistency of the measurement scale. According to Ref. [71], reliability is deemed acceptable when Cronbach's alpha values exceed 0.7. This proves that all the factors employed in this model achieve adequate reliability values, with Cronbach's alpha values above 0.7. Additionally, composite reliability is a measurement of the internal balance of the constructs [67] as a result, values exceeding 0.5 would confirm internal consistency. Therefore, all the Cronbach's alphas are above the recommended values.

The results of the confirmatory analysis reveal the existence of an appropriate factorial model for analyzing the acceptance and usage of e-commerce by the university population in Medellín. Besides, the presence of convergent and discriminant validity in the instrument—as well as acceptable trustworthiness—confirms that the instrument evaluates fundamental variables that directly or indirectly influence the adoption and use of electronic commerce in Medellín.

4.3. Results analysis and hypothesis testing

Structural Equation Modeling (SEM) was used to determine the extent to which a set of items measured latent variables. In Table 6, the lowest mean is 2.78; and the highest, 3.5. This indicates that there is a more pronounced inclination toward 5, i.e., "Strongly agree." In turn, the standard deviation in Table 6 oscillates around a value of 1.

To determine the sample size in a study that uses factor analysis and structural equations, Bartlett et al. (2001) recommend having at least ten observations per indicator (observable variable). Since 376 answered questionnaires were collected and there were 27 items (observable variables), the sample size was adequate for this analysis. SEM can be used to determine the extent to which a set of items measures latent variables (i.e., the measurement model) and the relationships between those variables (i.e., the structural model). Unlike traditional regression models, SEM includes a measure of error of the latent variables because it is unrealistic to assume errorless measurements when said variables are involved.

Three of the indices of the initial model (which included nine constructs in total) did not meet the thresholds that are used to determine goodness of fit, as shown in Table 7. As a result, the initial model was modified by including correlations between the residuals of the following items: PCE2 and PCE3; PSE1 and PUE1; PCE2 and UIE2; PUE4 and PSE3; and AE1 and PCE1. In addition, the PTE construct was discarded along with all the hypotheses where it was included (see Table 7).

Table 8 details the goodness of fit of the modified model. There was a substantial improvement in its fit because this time only one of the indices (i.e., the RMSEA) did not meet the threshold. Therefore, the next step in this study was testing the hypotheses in the model.

Table 9 presents the results of the hypothesis testing, indicating which hypotheses were supported by the data. Two out of the three

Table 5
Reliability index – Cronbach's alpha.

Factor	Cronbach's Alpha
Attitude	0.904
Perceived trust	0.848
Perceived control	0.864
Perceived ease of use	0.854
Innovation or innovativeness	0.790
Usage intention	0.919
Subjective norm	0.848
Perceived security	0.755
Perceived usefulness	0.836

Table 6
Descriptive measurements of each construct.

	Mean	Standard deviation
AE	3.38	1.14
PTE	2.78	1.05
PCE	3.4	1.14
PEUE	3.5	1.13
INE	3.13	0.91
UIE	3.33	1.19
SNE	2.81	1.1
PSE	2.97	1.04
PUE	3.33	1.12

Table 7
Goodness of fit measurements of the initial model.

Index	Measured value	Threshold	Source	Does it meet the threshold?
RMSEA	0.069	≤ 0.06	[76]	No
χ^2 / df	2.8	<3		Yes
CFI	0.898	>0.9		No
TLI	0.881	>0.9		No
SRMR	0.052	<0.08		Yes

Table 8
Goodness of fit measurements of the modified model.

Index	Measured value	Threshold	Source	Does it meet the threshold?
RMSEA	0.071	≤ 0.06	[76]	No
χ^2 / df	2.68	<3		Yes
CFI	0.917	>0.9		Yes
TLI	0.921	>0.9		Yes
SRMR	0.051	<0.08		Yes

Table 9
Hypothesis testing.

HYPOTHESIS	Estimate	Std.Err	z value	P (>|z|)	Result
H1	0.798	0.104	7.654	0	Supported
H2	0.512	0.358	1.429	0.153	Not supported
H3	0.499	0.096	5.181	0	Supported
H4	1.762	0.536	3.284	0.001	Supported
H5	It did not fit well with Perceived trust. Therefore, it was discarded.				
H6	0.043	0.087	0.497	0.619	Not supported
H7	0.053	0.071	0.749	0.454	Not supported
H8	It did not fit well with Perceived trust. Therefore, it was discarded.				
H9	0.697	0.101	6.934	0	Supported
H10	0.339	0.093	3.655	0	Supported
H11	0.318	0.11	2.9	0.004	Supported
H12	1.239	0.134	9.223	0	Supported

Table 10
Univariate normality measured using the Kolmogorov–Smirnov test.

Construct	D	*p* value
AE	0.16469	$<$2.2e 16
PTE	0.15122	$<$2.2e 16
PCE	0.15166	$<$2.2e 16
PEUE	0.17424	$<$2.2e 16
INE	0.132	$<$2.2e 16
UIE	0.16383	$<$2.2e 16
SNE	0.14238	$<$2.2e 16
PSE	0.17047	$<$2.2e 16
PUE	0.13201	$<$2.2e 16

hypotheses that were not supported included the Innovation construct (H6 and H7). The third hypothesis that was not supported (H2) related Perceived ease of use to Attitude towards usage.

Based on the considerations above, to test for univariate normality, the authors used the Kolmogorov–Smirnov test, in which the null hypothesis is that the data follow a normal distribution. In Table 10, the significance calculated in the test (p value) is always below 2.2e 16. Therefore, the statistical evidence suggests that the assumption of normality should be rejected.

Since the constructs did not follow a normal distribution, as shown by the Kolmogorov–Smirnov test, the Diagonally Weighted Least Squares (DWLS) method was used as the estimator to fit the structural equation model aided by the sem function in the lavaan package in R statistical software. Multiple authors have supported the use of this method for situations of non-normality or when ordinal variables are fitted [77] and [78] are just some examples.

5. Discussion

The results in this study have several important implications for theory and practice. From a theoretical perspective, the results corroborate the findings of other researchers that have studied e-commerce acceptance among young university students in Medellín. One of the derivatives of this research showed that the articulation of TAM with TPB can be applied in the context of e-commerce and explain the factors involved in e-commerce usage. Besides, as expected, other studies found different factors [4,17,18,79,80]. Knowledge about those factors, how they can be measured and how they relate to each other is crucial to develop, implement and execute managerial strategies at companies that adopt the electronic commerce channel to sell their products successfully. This is because the decision to accept or reject a new technology is ultimately determined by the individual user. Additionally, the research conducted by [6] suggests that the subjective norm and perceived control stand out as good predictors of online purchase intention.

Nonetheless, it is necessary to identify the factors that affect users' decision to use e-commerce. H11 states that subjective norm influences usage intention. The results obtained reveal that the influence of a third party and the perception of a system's usefulness are the main decisive direct factors in the intention to use electronic commerce. Besides, on the contrary, behavior control does not affect the success of intention to purchase on the Internet in the future, which has been confirmed by several re searchers, such as [81]. Thus, the influence of third parties (relatives, friends or people who influence the media) is revealed; they make the subjective norm a predictor of the attitude and usage intention. Indeed, [82] states that the subjective norm is key to the success of Internet businesses and a valuable predictor of usage intention, considering that behavior control has a minimum impact on e-commerce acceptance and external influence greatly determines the subjective norm.

In relation to the key factors in the TAM, the study revealed that H9—attitude towards usage influences usage intention—presents the highest level of association and it is a decisive factor in e-commerce adoption. The relationship becomes stronger if people perceive the usefulness when they use e-commerce to buy products. In addition, the most significant advantages of this technology were found economy, time and avoiding transportation. This is in contrast with other works [83,84]. Another decisive factor is the usage of electronic devices, which enables a high level of electronic commerce adoption. This is because mobile devices are an essential component to make an electronic purchase and, due to their flexibility, users show a positive attitude towards using e-commerce, which directly influences their intention to use it to make their own purchases. Thus, these results are in line with research studies that hold that the use of mobile devices facilitates e-commerce usage intention, and it is decisive for the adoption of this technology [85].

In times of COVID 19, author Kala'lembang identified in research that three factors could be used to embrace e-commerce, including organizational characteristics, environmental characteristics, and leadership characteristics, this to test the benefits and ease of use E-commerce, while the study by [86] found that perceived ease of use had a negligible effect on consumers on their intention to adopt e-commerce.

H4 states that perceived usefulness influences "attitude towards usage, and a high positive impact was found because young university students perceived e-commerce as useful, particularly to purchase online. However, a certain resistance to use was identified, especially in those who had no previous experience, because they held some beliefs about the vulnerability of their personal information when making purchases on that channel, which does not build trust. Similarly, the literature reveals that perceived usefulness and attitude towards usage are adoption predictors, due to the ease of use of online platforms [18,87]. In the case of young university students, the perception of ease of use is directly linked to perceived control, which is influenced by usage intention. The results of this research lead to conclude that, if the user has control over the online purchase to make transactions, the usage intention will be high. Furthermore, if enough knowledge is available before using the Internet, the transaction will be easier. Likewise, control should be perceived on the platforms, because usage intention is influenced when users find aids such as live chat or phone numbers to contact the suppliers, which builds trust. Besides, other authors have found that control and trust are high incidence predictors that determine e-commerce usage intention [88–91].

Finally, perceived trust influences usage intention and young university students directly associate perceived trust with usage intention, which is a highly positive factor for e-commerce acceptance. Different expressions of the young university students lead to conclude that, if the websites give them the feeling of security, they will be able to successfully make transactions on the website. But that intention is conditioned by perceived security. Indeed, the latter is related to the personal information individuals provide, which is mandatory to make purchases over the Internet. Because of this, the users show a high degree of fear about the individuals or companies behind the interface. They think that such people can misuse personal information, which leads to establish that trust is a key factor to decide not to shop online. Studies such as [4,92] maintain that perceived trust is a factor with high influence on e-commerce usage intention.

6. Conclusions

The main objective of this research was to examine the factors involved in e-commerce technology acceptance among young university students by analyzing the articulation of TAM and TPB models. Such models, applied in an independent or integrated way, are important theoretical milestones in the study of behavior factors of technology acceptance. This study revealed the factors that contribute to explain the adoption of online shopping in the context of an emerging Latin American economy, Colombia.

The results and scientific literature show that attitude is still the main factor in the prediction of online shopping. The application of the research instrument enabled to conclude, based on the results of the variable association analysis, that perceived ease of use and perceived trust are the factors that exert a direct influence on attitude towards e-commerce usage. Ease of use has also turned out to be a relevant factor because it directly influences perceived usefulness and the attitude towards the usage of these platforms. The literature maintains that perceived usefulness results in satisfaction, which makes perceived ease of use and attitude favorable to e-commerce usage.

The level of association between perceived usefulness and perceived ease of use is 0.528. This means that, if the website offers users a benefit, they will feel empathy and satisfaction to assimilate the experience in a positive way, and this will later lead them to use the Internet portal. Besides, a high degree of association (0.486) was revealed between perceived ease of use and attitude. This indicates that, if the technology is simple, people will be more inclined to use the website. Thus, if the user considers the website easy to understand, no frustration or discouragement will be produced.

Finally, perceived control refers to the individual's perception. It was evident that users unmistakably show control over their shopping behavior. As a result, when they conduct previous product/service purchase practice and feel they are in control, it becomes a purpose to continue using e-commerce technology. The results reveal that perceived control has a direct and positive influence on the intention to purchase on the Internet again.

Importantly, this study has some limitations. Since the estimated sample size is considered acceptable, one must be careful when generalizing the results. Thus, in order to generalize the findings to the entire population, future studies in the field should use probability sampling. Additionally, the proposed model should include variables influencing perceived risk, which means that further research is required to identify additional factors that might explain both consumers' purchasing behavior and perceived risk. Also, it is recommended that future studies employ the Unified Theory of Acceptance and Use of Technology (UTAUT) model, as well as other variables to gather more data. The UTAUT model attempts to incorporate the key components of various models and theories and aims to explain the adoption and use of technology in organizations, mainly in terms of four constructs: 1) performance expectancy, 2) effort expectancy, 3) social influence, and 4) facilitating conditions. The first three constructs are direct determinants of usage intention and user behavior, and the fourth one is a direct determinant of user behavior. The impact of these four constructs could be moderated by using factors such as gender, age, experience, and voluntary use.

Author contribution statement

Alejandro Valencia-Arias: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Luis Germán Ruiz-Herrera: Conceived and designed the experiments; Performed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ada Lucia Gallegos-Ruiz: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Martha Benjumea-Arias: Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Evelyn Flores-Siapo: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

References

[1] M.K. Alrousan, E. Jones, A conceptual model of factors affecting e-commerce adoption by SME owner/managers in Jordan, Int. J. Bus. Inf. Syst. 21 (3) (2016) 269–308, https://doi.org/10.1504/IJBIS.2016.074762.

[2] N.P. García, El valor percibido y la confianza como antecedentes de la intención de compra online, el caso colombiano. Cuad. Adm 30 (51) (2014) 15–24, https://doi.org/10.25100/cdea.v30i51.39. Universidad Del Valle), ISSN electrónico N° 2256 5078.

[3] S. Pookulangara, K. Koesler, Cultural influence on consumers' usage of social networks and its' impact on online purchase intentions, J. Retailing Consum. Serv. 18 (4) (2021) 348–354, https://doi.org/10.1016/j.jretconser.2011.03.003.

[4] S. Dakduk, Ter H.E. Santalla, Z. Molina, G. Malavé, J. Customer behavior in electronic commerce: a bayesian approach, J. Theor. Appl. Electron. Commer. Res. 12 (2) (2017) 1–20, https://doi.org/10.4067/S0718 8762017000200002.

[5] C. Alderete Jones, M.V. Motta, J. Factores relacionados con la adopción del comercio electrónico en PyMEs comerciales y de servicios de Córdoba, 11vo Simposio Sobre La Sociedad de La Información 42 (2013) 199–221. ISSN: 1850 2830, https://bit.ly/3nODexx.

[6] J.F. Tavera, B.E. Londoño, Factores determinantes de la aceptación tecnológica del e-commerce en países emergentes, El III Congr. Int. Gest. Tecnol. e Innovación COGESTEC 22 (31) (2014) 101–119. Medellín 11 y 12 de Octubre de 2012. ISSN 2390 0024, https://repository.upb.edu.co/handle/20.500.11912/7843.

[7] J.M. Vallejo, Y.P. Redondo, A.U. Acerete, Las características del boca oído electrónico y su influencia en la intención de recompra online, Rev. Eur. Dir. Econ. Empres. 24 (2) (2015) 61–75, https://doi.org/10.1016/j.redee.2015.03.002.

[8] L.A. Caldito, Medición de las actitudes de los internautas respecto a la compra on line. Segmentación en base a actitudes y caracterización de los segmentos identificados, Atl. Rev. Econ 1 (9) (2005) 1–19. Published 15th March 2005. ISSN 1579 1475, https://goo.gl/4rsDcC.

[9] F.D. Davis, R.P. Bagozzi, P.R. Warshaw, User acceptance of computer technology: a comparison of two theoretical models, Manag. Sci. 35 (8) (1989) 982–1003, https://doi.org/10.1287/mnsc.35.8.982.

[10] M. Tavera, J.F. Sánchez G, J.C. B D, Aceptación del e-commerce en Colombia: un estudio para la ciudad de Medellín, Rev.fac.cienc.econ 19 (2) (2011) 9–23. ISSN 0121 6805, http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0121.

[11] M. Fishbein, I. Ajzen, Belief, attitude, intention and behavior: an introduction to theory and research, Proc. Natl. Acad. Sci. U.S.A. 84 (5) (1975) 888–918. https://bit.ly/3RN6odl.

[12] C.A.S.H. Song, E-commerce adoption within SME's in Ghana, a tool for growth, Int. J. Electron. Bus. 16 (1) (2021) 32–51, https://doi.org/10.1504/IJEB.2021.112764.

[13] J.A. Sánchez-Torres, Moderating effect of the digital divide to e-commerce, Int. J. Soc. Econ. 46 (12) (2019) 1387–1400, https://doi.org/10.1108/IJSE-11-2018-0622.

[14] S.S. Chen, Y.W. Chuang, P.Y. Chen, Behavioral intention formation in knowledge sharing: examining the roles of KMS quality, KMS self-efficacy, and organizational climate, KBS 31 (2012) 106–118, https://doi.org/10.1016/j.knosys.2012.02.001.

[15] Y.F. Chuang, Pull and suck effects in Taiwan mobile phone subscribers switching intentions, Telecommun. Pol. 35 (2) (2011) 124–140, https://doi.org/10.1016/j.telpol.2010.12.003.

[16] M. Al-Emran, A. Granić, Is it still valid or outdated? A bibliometric analysis of the technology acceptance model and its applications from 2010 to 2020, Recent Adv. Technol. Acceptance Models Theor. (2021) 1–12, https://doi.org/10.1007/978-3-030-64987-6_1.

[17] G.O.T. Baptista, A weight and a meta-analysis on mobile banking acceptance research, Comput. Hum. Behav. 63 (2016) 480–489, https://doi.org/10.1016/j.chb.2016.05.074.

[18] M.J. De Oliverira, R.M. Baptista, J.M. de Sousa, Advances in human factors, business management, training and education. In psychic distance, purchase intention and life satisfaction, Springer Sci. Rev. 498 (2016) 609–620, https://doi.org/10.1007/978 3 319 42070 7_57.

[19] J. Torrent-Sellens, C. Salazar-Concha, P. Ficapal-Cusí, F. Saigí-Rubió, Using digital platforms to promote blood donation: motivational and preliminary evidence from Latin America and Spain, Int. J. Environ. Res. Public Health 18 (8) (2021) 4270, https://doi.org/10.3390/ijerph18084270.

[20] A.A. Bailey, C.M. Bonifield, A. Arias, J. Villegas, Mobile payment adoption in Latin America, J. Serv. Market. 36 (8) (2022) 1058–1075, https://doi.org/10.1108/JSM-04-2021-0130.

[21] MINTIC, Colombia avanza en su meta de estar conectada en un 70 % en 2022: DANE, Ministerio de Tecnologías de la Información y las Comunicaciones, 2022. https://bit.ly/3LYyBxb.

[22] D. Goutam, B.V. Gopalakrishna, S. Ganguli, Determinants of customer satisfaction and loyalty in e-commerce settings: an emerging economy perspective, Int. J. Internet Market Advert. 15 (3) (2021) 81–105, https://doi.org/10.1504/IJIMA.2021.115437.

[23] E.M. Rogers, in: F. Press (Ed.), Diffusion of Innovations T, 1, Third Edit, 2010, p. 236. https://bit.ly/3IvMPQI.

[24] C.R. Mafe, S.S. Blas, J.F. Tavera-Mesias, A comparative study of mobile messaging services acceptance to participate in television programmes, J. Serv. Manag. 21 (1) (2010) 69–102, https://doi.org/10.1108/09564231011025128.

[25] H. Hassen, N.H.B.A. Rahim, A.H.A. Othman, A. Shah, A model for E-commerce adoption by SMEs in developing countries, in: Springer (Ed.), The Importance of New Technologies and Entrepreneurship in Business Development: in the Context of Economic Diversity in Developing Countries, Lecture Notes in Networks and Systems, vol. 194, ICBT, 2021, pp. 516–529, https://doi.org/10.1007/978 3 030 69221 6_39, 2020.

[26] M.R. Jalilvand, N. Samiei, The impact of electronic word of mouth on a tourism destination choice: testing the theory of planned behavior (TPB), Internet Res. 22 (5) (2012) 591–612, https://doi.org/10.1108/10662241211271563.

[27] R.L. Ochoa Urrego, J.I. Peña Reyes, Teoría de la Difusión de Innovaciones: evolución y uso en los Sistemas de Información, in: U.N. de Colombia (Ed.), III Congreso Internacional de Gestión Tecnológica e Innovación COGESTEC Medellín 11 y 12 de octubre de 2012, vols. 1–13, 2012. https://repositorio.unal.edu.co/handle/unal/56292.

[28] K. Zhu, K.L. Kraemer, Post adoption variations in usage and value of E business by organizations: cross country evidence from the retail industry, J. Inf. Syst. 16 (1) (2005) 61–84, https://doi.org/10.1287/isre.1050.0045.

[29] D. Corsaro, R. Sebastiani, C. Mele, Practices of service innovation diffusion, in: Innovation in Practices, Springer Sci. Rev., 2016, pp. 159–179, https://doi.org/10.1007/978-3-319-43380-6_8.

[30] M. Kim, S. Chai, The impact of supplier innovativeness, information sharing and strategic sourcing on improving supply chain agility: global supply chain perspective, Int. J. Prod. Econ. 187 (2017) 42–52, https://doi.org/10.1016/j.ijpe.2017.02.007.

[31] Echeverría, Evaluar las innovaciones y su difusión social, ISEGORÍA. Rev. de Filos. 48 (2013) 173–184, https://doi.org/10.3989/isegoria.2013.048.09.

[32] R.E. Goldsmith, L. Flynn, Psychological and behavioral drivers of online clothing purchase, J. Fash. Mark. 8 (1) (2004) 84–95, https://doi.org/10.1108/13612020410518718.

[33] E.C. Hirschman, Innovativeness, novelty seeking, and consumer creativity, J. Consum. Res. 7 (3) (1980) 283–295, https://doi.org/10.1086/208816.

[34] I. Ajzen, The theory of planned behavior, Organ. Behav. Hum. Decis. Process. 50 (2) (1991) 179–211, https://doi.org/10.1016/0749 5978(91)90020 T.

[35] A.H.H.S. Martín, Effects of the risk sources and user involvement on e-commerce adoption: application to tourist services, J. Risk Res. 15 (7) (2012) 841–855, https://doi.org/10.1080/13669877.2012.666758.

[36] Daniel E. Montaño, D. Kasprzyk, Theory of Reasoned Action, Theory of Planned Behavior, and the Integrated Behavioral Model, Ame. Psychol. Assoc. (2015) 95–124. https://bit.ly/3lqokOX.

[37] S. Sayago, El análisis del discurso como técnica de investigación cualitativa y cuantitativa en las ciencias sociales, Rev.Epist. sci. Soc. 49 (2014) 1–10, https://doi.org/10.4067/S0717 554X2014000100001.

[38] V. Raghupathi, J. Fogel, The impact of opinion leadership on purchases through social networking websites, J. Theor. Appl. Electron. Commer. Res. 10 (3) (2015) 19–29, https://doi.org/10.4067/S0718 18762015000300003.

[39] S.N. Ketabi, B. Ranjbarian, A. Ansari, Analysis of the effective factors on online purchase intention through theory of planned behavior, Int. J. Acad. Res. Bus. Soc. Sci. 4 (4) (2014) 374–382, https://doi.org/10.6007/IJARBSS/v4 i4/808.

[40] J. Zhang, E. Mao, Understanding the acceptance of mobile SMS advertising among young Chinese consumers, PSYCH 25 (8) (2008) 787–805, https://doi.org/10.1002/mar.20239.

[41] I.R. Del Bosque, Á.H. Crespo, Antecedentes de la utilidad percibida en la adopción del comercio electrónico entre particulares y empresas, Cuadernos Econ. Dirección Empres. 11 (34) (2008) 107–134, https://doi.org/10.1016/S1138 5758(08)70055 0.

[42] A. Elmorshidy, M. Mostafa, I. El Moughrabi, H. Al Mezen, Factors influencing live customer support chat services: an empirical investigation in Kuwait, J. Theor. Appl. Electron. Commer. Res. 10 (3) (2015) 63–76, https://doi.org/10.4067/S0718 18762015000300006.

[43] W.Y. Wu, C.C. Ke, An online shopping behavior model integrating personality traits, perceived risk, and technology acceptance, SBP (Soc. Behav. Pers.): Int. J. 43 (1) (2015) 85–93, https://doi.org/10.2224/sbp.2015.43.1.85.

[44] Y.C. Wong, Investigate the impact of Brand attachment and habit on the mobile shopping intention, in: National Sun Yat Sen University Electronic Theses and Dissertations Service, 2015. China, https://goo.gl/JjYPxC.

[45] K.M. Faqih, M.I.R.M. Jaradat, Assessing the moderating effect of gender differences and individualism collectivism at individual level on the adoption of mobile-commerce technology: TAM3 perspective, J. Retail. Consum. Serv. 22 (2015) 1–34, https://doi.org/10.1016/j.jretconser.2014.09.006.

[46] A.R. Ashraf, N. Thongpapanl, S. Auh, The application of the technology acceptance model under different cultural contexts: the case of online shopping adoption, J. Int. Market. 22 (3) (2014), https://doi.org/10.1509/jim.14.0065.

[47] L. Chyrun, The E-commerce systems modelling based on petri networks, in: COLINS 2021: 5th Int. Conf. Comput. Ling. Intell. Syst., 2021, pp. 1604–1631. April 22–23. 2021, https://bit.ly/3JkPg9Q.

[48] X. Li, H. Guo, S. Jin, W. Ma, Y. Zeng, Do farmers gain Internet dividends from E-commerce adoption? Evidence from China, Food Pol. 101 (2021) 1–13, https://doi.org/10.1016/j.foodpol.2021.102024.

[49] I.L.M. Bakeev, What determines the differentiation in the e-commerce adoption by consumers: evidence from Russia, J. Electron. Commer. Res. (2021) 1–17, https://doi.org/10.1007/s10660 021 09507 7.

[50] L. Peng Su, Y. Kong, R. Chen, Q. Impact of E-commerce adoption on farmers' participation in the digital financial market: evidence from rural China, J. Theor. Appl. Electron. Commer. Res. 16 (5) (2021) 1434–1454, https://doi.org/10.3390/jtaer16050081.

[51] M. Abdelrhim, A. Elsayed, The effect of COVID 19 spread on the E-commerce market, Case 5 Larg. E Commer. Co. World (2020) 1–14, https://doi.org/10.2139/ssrn.3621166.

[52] A. Bhatti, H. Akram, Khan Basit H.M, A.U. Mahwish, S. Naqvi, M. R. Bilal, E-commerce trends during COVID 19 Pandemic, Int. J. Future Gener. Commun. Netw. 13 (2) (2020) 1449–1452, https://doi.org/10.12691/ijbrm 4 1 2.

[53] K. Ariansyah, E.R.E. Sirait, B.A. Nugroho, M. Suryanegara, Drivers of and barriers to e-commerce adoption in Indonesia: individuals' perspectives and the implications, Telecommun. Pol. 45 (8) (2021), https://doi.org/10.1016/j.telpol.2021.102219.

[54] R.S. Al Tayyar, A.R.B. Abdullah, A. Abd Rahman, M.H. Ali, Challenges and obstacles facing SMEs in the adoption of e-commerce in developing countries; A case of Saudi Arabia, Appl. Econ. 39 (4) (2021) 472–480, https://doi.org/10.25115/eea.v39i4.4644.

[55] G. Cirac Claveras, Weather satellites: public, private and data sharing. The case of radio occultation data, Space Pol. 47 (2019) 94–106, https://doi.org/10.1016/j.spacepol.2018.08.002.

[56] S. Taylor, P.A. Todd, Understanding information technology usage: a test of competing models, Inf. Syst. 6 (2) (1995) 144–176, https://doi.org/10.1287/isre.6.2.144.

[57] J.A. Gliem, R.R. Gliem, Calculating, Interpreting, and Reporting Cronbach's Alpha Reliability Coefficient for Likert, Type Scales (2003) 82–88. https://hdl.handle.net/1805/344.

[58] J. Nunnally, Psychometric theory 3ed, McGraw Hill Humanit./Soc. Sci./Lang. 4 (10) (1994) 7–21, https://doi.org/10.3102/0013189X004010007. New York.

[59] S. Martin, R.H. Bender, A. Krasner, T. Marmon, M. Monahan, L. Nelson, Elaboración y evaluación del Diario de Síntomas de Acromegalia, Rev. Result. Informados Por Pacientes 7 (15) (2023) 4–14, https://doi.org/10.1186/s41687 023 00541 7.

[60] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, J. Market. Manag. 18 (1) (1981) 39–50, https://doi.org/10.1177/002224378101800104.

[61] R. Ledesma, G.M. Ibañez, P.V. Mora, Análisis de consistencia interna mediante Alfa de Cronbach, un programa basado en gráficos dinámicos 7 (2) (2002) 143–152. https://www.scielo.br/j/pusf/a/psJ44DfZRngHRYRp9C9PTKg/?format=pdf&lang.

[62] J.E. Bartlett, J.W. Kotrlik, C.C. Higgins, Organizational research: determining appropriate sample size in survey research, J. Inf. Technol. 19 (1) (2001) 43–50, https://doi.org/10.1109/LPT.2009.2020494.

[63] Q.M. Martín, Y.D. de Paz Santana, Tratamiento estadístico de datos con SPSS, Prácticas resueltas y comentadas. Int. Intl. 1 (2008) 165. https://goo.gl/cW6sRb.

[64] M.B. Castañeda, A. Cabrera, Y. Navarro, W. Vries, Procesamiento de datos y análisis estadísticos utilizando SPSS, Un libro práctico para investigadores y administradores educativos. EDIPURCS 1 (2010) 164. https://goo.gl/rm7r3h.

[65] P.Y.K. Chau, Reexamining a model for evaluating information center success using a structural equation modeling approach, Sci. J. Innov. Educ. 28 (2) (1997) 309 334, https://doi.org/10.1111/j.1540 5915.1997.tb01313.x.

[66] J.F. Hair, R.E. Anderson, B.J. Babin, W.C. Black, Multivariate Data Analysis: A Global Perspective, 2010. Consulted [11 October 2022], https://bit.ly/3nR92lp.

[67] R. Bagozzi, Y. Yi, On the evaluation of structure equation models, Acad. Market. Stud. J. 16 (1) (1988) 74–94, https://doi.org/10.1007/BF02723327.

[68] J. De la Fuente A., F. Justicia J, Escala de estrategias de aprendizaje ACRA Abreviada para alumnos universitario, Electron. J. Res. Educ. 1 (2) (2003) 139–158. E ISSN: 1696 2095, https://www.redalyc.org/pdf/2931/293152877008.pdf.

[69] C.L. Wang, P.K. Ahmed, M. Rafiq, Knowledge management orientation: construct development and empirical validation, Eur. J. Inf. Syst. 17 (3) (2008) 219–235, https://doi.org/10.1057/ejis.2008.12.

[70] V.J.C.Y.G. Wang, Mixed effects models in S and S plus, J. Am. Stat. Assoc. 96 (455) (2001) 1136, https://doi.org/10.1198/jasa.2001.s411, 1136.

[71] L.J. Cronbach, P.E. Meehl, Construct validity in psychological tests, Psychol. Bull. 52 (4) (1955) 281–302, https://doi.org/10.1037/h0040957.

[72] J.B.E. Steenkamp, H.C. Van Trijp, The use of lisrel in validating marketing constructs, Int. J. Res. Mark. 8 (4) (1991) 283–299, https://doi.org/10.1016/0167 8116(91)90027 5.

[73] D.T. Campbell, D.W. Fiske, Convergent and discriminant validation by the multitrait multimethod matrix, Psychol. Bull. 52 (6) (1959) 81–105, https://doi.org/10.1037/h0046016.

[74] N. Frías, D. Apuntes de Spss, working paper, Universidad de Valencia, España, 2014. https://bit.ly/3MUvep1.

[75] D.G. Bonett, T.A. Wright, Cronbach's alpha reliability: interval estimation, hypothesis testing, and sample size planning, J. Organ. Behav. (2014) 1–14, https://doi.org/10.1002/job.1960.

[76] L.T. Hu, P.M. Bentler, Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives, SEM 6 (1) (1999) 1–55, https://doi.org/10.1080/10705519909540118.

[77] C. DiStefano, G.B. Morgan, A comparison of diagonal weighted least squares robust estimation techniques for ordinal data, Struct. Equ. Model. 21 (3) (2014) 425 438, https://doi.org/10.1080/10705511.2014.915373.

[78] D. Mindrila, Maximum likelihood (ML) and diagonally weighted least squares (DWLS) estimation procedures: a comparison of estimation bias with ordinal and multivariate non normal data, Int J Digit Earth 1 (1) (2010) 60–66. https://bit.ly/3IRz1n8.

[79] M.J.N.K.T. Lee, An analysis of the relationship between quality and user acceptance in smartphone apps, Inf. Syst. e-Bus. Man 14 (2016) 273–291, https://doi.org/10.1007/s10257 015 0283 6.

[80] C. McLaughlin, L. Bradley, G. Prentice, E.J. Verner, S. Loane, Consumer to consumer (C2C) online auction transaction intentions: an application of the theory of planned behaviour, Int Bus Rev; INT BUS R. 1 (2017) 5–25. https://esource.dbs.ie/handle/10788/3372.

[81] J. Ingham, J. Cadieux, A.M. Berrada, e Shopping acceptance: a qualitative and meta analytic review, Inf. Manag. 52 (1) (2015) 44–60, https://doi.org/10.1016/j.im.2014.10.002.

[82] M. Alotaibi, Adaptable and adaptive E-commerce interfaces: an empirical investigation of user acceptance, J. Comput. 8 (8) (2013) 1923–1933, https://doi.org/10.4304/jcp.8.8.1923 1933.

[83] I. Butt, S. Tabassam, N. Chaudhry, K. Nusair, Using technology acceptance model to study adoption of online shopping in an emerging economy, J. Internet Commer. 21 (2) (2016) 1–19. https://bit.ly/3qdDS8h.

[84] De Marco, Stefano, Jose Manuel Robles, Mirko Antino, E. Ganuza Fernandez, Influence of abilities for searching commercial information online on e-shopping: when inequality affects business, J. Glob. Compet. Governability 10 (3) (2016) 136–152, https://doi.org/10.3232/GCG.2016.V10.N3.05.

[85] S. Gao, X. Zhang, S. Peng, Understanding the adoption of smart wearable devices to assist healthcare in China, in: C. Springer (Ed.), In Conference on E-Business, vol. 9844, e Services and e Society, 2016, pp. 280–291, https://doi.org/10.1007/978 3 319 45234 0_26.

[86] M.A. Salem, K.M. Nor, The effect of COVID 19 on consumer behaviour in Saudi arabia: switching from brick and mortar stores to E-commerce, Int. J. Sci. Technol. Res 9 (7) (2020) 15–28. https://bit.ly/3NiFHe3.

[87] G.R.M. Krithika, Online purchase: risk cognizance influencing intention, Indian J. Sci. Technol 9 (32) (2016) 1–4, https://doi.org/10.17485/ijst/2016/v9i32/98660.

[88] X. Dong, Y. Chang, Y. Wang, J. Yan, Understanding usage of Internet of Things (IOT) systems in China: cognitive experience and affect experience as moderator, Inf. Technol. People 30 (1) (2017) 117–138, https://doi.org/10.1108/ITP 11 2015 0272.

[89] A. Gurung, M.K. Raja, Online privacy and security concerns of consumers, Inf. Comput. Secur. 24 (4) (2016) 348–371, https://doi.org/10.1108/ICS 05 2015 0020.

[90] S.H.A. Kazmi, M.M. Abid, Online purchase intentions in E-commerce, in: U. from, I. Xplore (Eds.), Conference: 2016 8th International Conference on Intelligent Human Machine Systems and Cybernetics (IHMSC)At, Zhejiang University, 2016, pp. 570–573, https://doi.org/10.1109/IHMSC.2016.193.

[91] W.T. Wang, Y.S. Wang, E.R. Liu, The stickiness intention of group buying websites: the integration of the commitment–trust theory and e-commerce success model, Inf. Manag. 53 (5) (2016) 625–642, https://doi.org/10.1016/j.im.2016.01.006.

[92] S. Grabner Kräuter, R. Breitenecker, Factors influencing online banking adoption: evidence from the Austrian market, Int. J. Internet Market Advert. 6 (4) (2011) 333–351, https://doi.org/10.1504/IJIMA.2011.043655.