



Exploring the acceptance for e-learning among higher education students in India: combining technology acceptance model with external variables

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Abstract

The concept of e-learning has now become fundamental in student learning process. This concept becomes even more relevant in situations of global crisis such as that arising from COVID-19. Since this pandemic there have been tectonic shifts in the education sector. Effective implementation of e-learning in higher education depends on students' adoption of this technology. So, this study aimed to identify the factors influencing the behavioral intentions and actual usage of students in adopting e-learning. Additionally, it also examined the mediation effects among different latent constructs. Based on technology acceptance model (TAM), an explanatory structural model of technology acceptance was tested along with introduction of three external variables. To do this, a quantitative investigation was conducted using an online survey of higher education students in India, obtaining 570 responses. The structural model was examined through the partial least square structural equation modeling. Results obtained make it possible to validate the proposed model as findings explains the 56.2% variance of actual usage. In addition, it shows the direct and indirect effect of all three selected external variables of personal innovativeness, social factors and self-efficacy on the main constructs of TAM. The findings of this study are relevant for the higher education management, administration, e-learning system developers, marketers and researchers for improving the effective usage of e-learning by developing more focused and customized learning solutions.

Keywords E-learning · Technology acceptance model (TAM) · Partial least square structural equation modeling (PLS-SEM)

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Introduction

The rapid advancement in information and communication technology (ICT) has changed the student's way of learning (Martin et al., 2011). The education sector in the entire world has evolved profoundly by electronic learning (e-learning) which grabbed the different techniques for improving the quality of the content (Sulcic & Lesjak, 2009). In continuation of information and service distribution, e-learning uses the help of the World Wide Web and the internet (Shareef et al., 2011). The concept of e-learning has gained popularity and seems the need of the hour. It has been explained according to the prevailing environment and context where it operates (Asabere & Enguah, 2012). The concept of e-learning could be defined in several ways. This study, however, uses Jenkins and Hanson's (2003) definition of e-learning, which is defined as learning facilitated and supported through the utilization of ICTs. Based on this definition, the e-learning concept is the use of ICTs (e.g., internet, computer, telephone, radio, video etc.) to support teaching and learning activities. It is defined as an information system that can integrate a wide variety of instructional material (via audio, video, and text mediums) conveyed through e-mail, live chat sessions, online discussions, forums, quizzes and assignments (Lee et al., 2011). It provides a new way of learning which enables the mentor to deliver learning instructions through multi forms as well as enables the students to learn regardless of time and place. The system of e-learning is considered an important part of the modern university scenario for delivering the curriculum (Paechter et al., 2010). Many research studies have proved the importance of e-learning and ICT for teachers as well as students in higher education (Bhuasiri et al., 2012; Kirkwood, 2009). The higher education system is aimed to create and disseminate knowledge for bringing innovative and creative development to the world (Escotet, 2012). The higher education system is one of the prominent tools to enrich a country in terms of value, knowledge & culture and also empower the economy by creating specialized knowledge and skilled manpower.

As far as the Indian higher education sector is concerned it has been upgrading with various universities since independence. The Indian higher education system is now one of the largest systems in the world with 51,649 institutions (Ravi, 2020) but the current scenario of the Indian education system is facing different challenges like lack of hands-on and aspect of practical experience, outdated syllabus, lack of infrastructure, increase in cost of education, and lack of highly skilled academician. To face these challenges, e-learning or an online education system is adopted along with the traditional way of learning or brick and mortar classes because these major issues like accessibility, quality, and affordability can be solved (Agarwal, 2018). Abdullah and Toycan (2018) has asserted that developing countries have been riddling with challenges regarding the adoption of e-learning technology due to professional as well as students' resistance and lack of proper facilitating conditions. For successful implementation of e-learning in the Indian education system, we need to identify the factors that formulate the behavior of students in favor of e-Learning. So, it is imperative to study

the various factors that influence student's actual usage of e-learning for making it more effective teaching and learning tool in education (Sharma & Chandel, 2013). In the time of this pandemic, e-learning has undoubtedly become the need of the hour and the future of India's higher education system as well. During the outbreak of COVID-19, most of the universities around the world adopted online teaching methods to achieve the goal of "no suspension of learning" (Wang et al., 2021). It is imperative for each student to get active involvement in e-learning technology. It is necessary to know how students' behavior for acceptance of e-learning is affected in the higher education.

Considering the above, this study had a dual objective. On the one hand, to extend an explanatory structural model of technology acceptance, analyzing the responsible factors for the actual usage of e-learning among higher education students. On the other hand, the study also aimed to test the mediation effects between the antecedent variables and latent constructs.

To do this, this study first used the basic constructs of 'Technological Acceptance Model' (TAM) and further proposed a research model by extend this TAM with three external variables suggested by Thompson (2008) namely self-efficacy, social factors, and personal innovativeness.

This paper is organized as follows. In the next section, we present the theoretical context and the context and the hypotheses to be tested in relation to the extended proposed model of TAM in the context of e-learning. We subsequently describe the proposed model as well as sample selection and data collection before reporting the main results. Finally, we conclude with a discussion of results, theoretical and practical implications, limitations and our main conclusion for further research.

Theoretical background and hypotheses development

The most common and widely used TAM is to verify the acceptance and adoption of a specific technology by people (Bagozzi, 2007; Tarhini et al., 2015). TAM is being followed among different technologies including various software, e-learning, LMS, multimedia task, computer technology, m-learning, and so on. Fred D. Davis developed TAM in the year 1986 for assessing the tendency of users to accept or actual use of new systems and technology. Originally it was invented for predicting the behavior of users towards the actual use of the computer and information technology. This model also predicts the adoption of a new kind of technology by organizations and groups of people (Davis et al., 1989). So, there are many studies in the recent period that have used this model to predict the acceptance of users towards biometric devices, mobile learning, LMS (Learning Management Software), e-learning, online learning, and online video usage (James et al., 2008; Fathema et al., 2018; Ratna & Mehra, 2015; A-Azwaei & Lundqvist, 2015; Nagy, 2018).

Various research studies have been conducted with "TAM" in assessing how people use and adopt e-learning. Punnoose (2012) considered individual differences, beliefs, and behavior along with TAM in his study and reported that behavioral intentions were significantly predicted by perceived usefulness, perceived ease of use and subjective norms however perceived enjoyment had not

any significant effect on behavioral intentions. Variables regarding extraversion, conscientiousness, and neuroticism have a positive, medium, and indirect effect on behavioral intentions. In the study, individual differences create beliefs that affect behavioral intentions to use e-learning mode because individual differences in behavior intentions were mediated solely through the belief variable of the selected model. Similarly, Adwan et al. (2013) reported that perceived usefulness has no significant influence on attitude but found significant on behavioral intentions whereas, perceived ease of use had a significant effect on attitude and perceived usefulness. Diminishing perceived ease of use, perceived usefulness, attitude and the social influence of student referent groups can reduce acceptance of online learning because these have a positive and significant influence on behavioral intentions (Farahat, 2012).

Similarly, Al-Azwai and Lundqvist (2015) pointed that perceived usefulness is the best predictor of perceived satisfaction however gender diversity and learning styles do not have a significant effect on them whereas online self-efficacy has a significant effect on perceived ease of use rather than perceived satisfaction. This effect was explained due to the individual experience of the learner and the maturity of a specific technology. Similarly, perceived usefulness and attitude is a strong influencer for video usage whereas perceived ease of use has an insignificant effect on it. Internet self-efficacy found a positive influencer for video usage (Nagy, 2018). Also, Ibrahim et al. (2018) found the significant effect of self-efficacy on perceived usefulness and perceived ease of use on intention to use e-learning by students. Also, in case of faculty, perceived self-efficacy has a significant on perceived usefulness and perceived ease of use. It revealed that faculty toward LMS use was significantly affected by system quality, perceived self-efficacy, and facilitating conditions. Perceived ease of use and perceived usefulness have a positive impact on attitude as well as behavioral intentions and which have a positive impact on actual usage (Fathema et al., 2018).

Besides, the study of Abdullah and Toycan (2018) added that among the five factors of technology readiness, only the factors related to human resource readiness had the lowest positive influence on e-learning implementation so there is a need for training programs for professionals. Further study supported the positive influence of perceived ease of use and perceived usefulness on and positively influences the behavioral intentions. The study suggested factors like technological readiness, perceived usefulness, and perceived ease of use are crucial for successful e-learning implementation.

Abdullah and Ward (2016) performed a meta-analysis for identifying the commonly used external factors of TAM in the case of e-learning adoption by covering 107 papers of the last 10 years. Results of the meta-analysis indicated self-efficacy, computer anxiety, subjective norms, enjoyment, and experience as the most used external factors for TAM. Secondly, the best predictor of perceived ease of use is self-efficacy followed by enjoyment, experience, computer anxiety, and subjective norms. Perceived usefulness of e-learning system is best predicted by enjoyment followed by subjective norms, self-efficacy and experience so this study proposes a new general TAM with these five external factors perceived ease of use, perceived usefulness, attitude, behavioral intentions and actual usage.

TAM is initially extended from the “Theory of Reasoned Action” (TRA) of Ajzen and Fishbein (1980). This explained the relationship among behaviors and actions which affect human action. This focused on the prediction of human behaviors according to their pre-existing and behavioral intentions. Various transformations have taken place in the areas of its variables. In our case, the relationships among different variables i.e. perceived ease of use, perceived usefulness, attitude, behavioral intentions and actual usage along with three external variables namely self-efficacy, social factors, and personal innovativeness are studied. Figure 1 depicts the proposed model used in this study:

Perceived ease of use (PEOU)

Perceived ease of use is defined as “the degree to which a person believes that using a particular technology would be free from effort” (Davis et al., 1989). Davis (1986), Venkatesh and Davis (2000) had explained that TAM pointed to the significant role of perceived ease of use in ascertaining perceived usefulness and attitude towards using technology. It cites the degree to which users feel that they can save or minimize their efforts by using explicit technology. In the context of perceived ease of use, many researchers i.e., Park (2009) and Chang et al. (2012) have highlighted perceived ease of use as a direct determinant for attitude. Additionally, in the area of online learning and e-learning, Abdullah and Toycan (2018) found perceived ease of use as a significant indirect mediator among

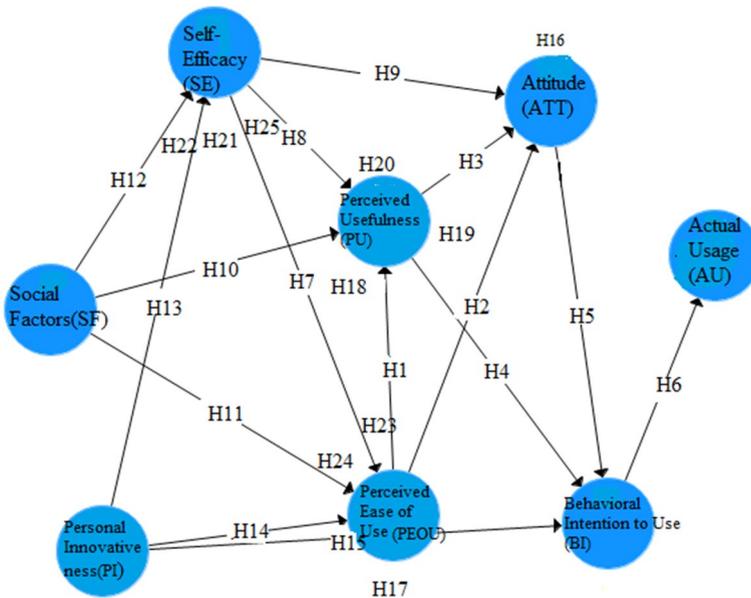


Fig. 1 Proposed model

intention to use through perceived usefulness. Further, Teo (2009) also revealed the mediation effect of perceived ease of use and attitude through perceived usefulness.

Perceived usefulness (PU)

It indicates the degree to which the users think that their job performance can be enhanced by using a specific technology or a system. It is defined as “the degree to which an individual believes that using a particular system would enhance his or her performance” (Davis, 1986). TAM expounds that perceived usefulness is being influenced by perceived ease of use users suppose that as much easy the technology is, it is likely to be more useful for them. Venkatesh and Davis (2000) supported that better performance and greater perception of usefulness could be achieved through enhanced ease of use. Previous studies in the context of e-learning, show a significant effect of perceived usefulness towards use (Adwan et al., 2013) and also influences the behavioral intention indirectly (Ratna & Mehra, 2015).

Attitude (ATT)

The attitude of the user is a prominent determinant to affect individual usage of technology (Davis et al., 1989). “It refers to the degree to which a person has a favorable or unfavorable evaluation or appraisal of the (usage) behavior” (Ajzen, 1991). It asserts that a positive aspect of the user toward any technology could be developed if that technology is found useful as well as easy to use. Attitude has been hypothesized as a direct determinant of behavioral intentions (Alharbi & Drew, 2014). Attitude had a significant positive impact on the continuance of intention to use in Taiwan on students ‘to use mobile in English Learning (Chang et al., 2012).

Behavioral intention to use (BI)

Behavior intention points out the efforts that an individual wants to accomplishing a particular behavior. TAM advocates actual usage of technology is being determined by their behavioral intentions. Individuals use a specific technology if they have intentions to use it (Davis et al., 1989). Venkatesh et al. (2003) had explained that TAM presumes behavioral intention is developed as an outcome of conscious decision making. Prior researches have reported that user’s behavioral has a significant positive effect on the actual use of e-learning and LMS (Abdullah & Toycan, 2018; Fathema et al., 2018).

Self-efficacy (SE)

Normally, self-efficacy refers to a person’s decision of how efficiently an individual can execute the course of action or behavior essential to face a critical circumstance. In the context of the adoption of e-learning technology among students, the present study uses self-efficacy which implies the student’s judgment

of his or her capability of operating the internet and e-learning. The results of empirical testing done by Venkatesh and Davis (1996), confirmed that individuals perceived the technology as easy to use who are more confident in their capabilities to learn how to use information technology as compared to individuals who have less confidence in their capabilities. In IT acceptance, a research study also found the computer self-efficacy plays a critical role in comprehending individual responses to information technology (Agarwal et al., 2000). Previous studies have confirmed users with high computer self-efficacy initiate a strong perception of perceived ease of use and perceived usefulness (Gong et al., 2014; Abdullah & Ward, 2016; Ibrahim et al., 2018). Self-efficacy is also an important factor in the use of e-learning (Punnoose, 2012).

Social factors (SF)

It refers to the belief by which an individual perceives to behave in a particular manner according to the most important person for him or her. It can be termed as perceived social pressure to approve or disapprove of certain behavior. On the ground of e-learning in the education system, students' behavior towards the use of e-learning is being influenced by the opinion of their peers, educators, and educational institution guidelines. In this regard, subjective norms are redefined by the Agudo-Peregrina et al. (2014) as "the extent to which a student perceives a pressure from members in his or her environment to use e-learning systems". The past study reported the significant relationship between social norms and students perceived ease of use in the case of online learning (Cheng, 2010; Raaji & Schepers, 2008; Farahat, 2012). Furthermore, the results of (Al-Ammari & Hamad, 2008; Lee, 2006; Al-Gahtani, 2016; Farahat, 2012) had confirmed that students' perceived usefulness in e-learning was significantly affected by social norms. In the case of the LMS context, the study of Binyamin et al. (2017) also advocated that students' perceived usefulness is positively influenced by subjective norms.

Personal innovativeness (PI)

Agarwal et al. (2000) found a rational support that personal innovativeness had a significant impact on computer self-efficacy and this rationale was based on social cognitive theory developed by Bandura (1986). He found the indirect impact of individual personality on performance through self-efficacy so a corresponding hypothesis regarding the impact of personal innovativeness on self-efficacy in the use of e-learning is formulated. The second hypothesis is formed regarding the influence of personal innovativeness on perceived ease of use of e-learning. Thompson (2008) reported a significant influence of personal innovativeness on self-efficacy, intention to use, and extent on perceived ease of use. So here individuals who consider new sources of learning also have resources and skills of using it will consider it easy to use and will also affect intention to use.

Research hypotheses

Therefore, the research hypotheses based on the above discussion on constructs for proposed model in the context of the e-learning are:

H1 Perceived ease of use has a significant influence on the perceived usefulness of e-Learning.

H2 Perceived ease of use has a significant influence on attitude towards using e-learning.

H3 Perceived usefulness has a significant influence on attitude towards using e-learning.

H4 Perceived usefulness has a significant influence on the behavioral intentions to use e-learning.

H5 Attitude towards using e-learning has a significant influence on behavioral intentions to use e-learning.

H6 Students' behavioral intentions for using e-learning has a significant influence on students' actual usage of e-learning.

H7 Self-efficacy has a positive influence on the perceived ease of use of e-learning.

H8 Self-efficacy has a positive influence on the perceived usefulness of e-learning.

H9 Self-efficacy has a positive influence on attitude towards e-learning.

H10 Social factors have a positive influence on perceived usefulness of e-learning.

H11 Social factors have a positive influence on the perceived ease of use of e-learning.

H12 Social factors has a positive influence on self-efficacy of using e-learning.

H13 Personal innovativeness has a positive influence on self-efficacy.

H14 Personal innovativeness has a positive influence on perceived ease of use of e-learning.

H15 Personal innovativeness has a positive influence on behavioral intentions to use e-learning.

Mediation hypothesis

Based on the literature review, it was proposed to check the mediation effect between different constructs of the model. The different hypothesis regarding mediation is:

H16 Attitude mediates the relationship between perceived usefulness and behavioral intentions.

H17 Perceived ease of use mediates the relationship between self-efficacy and attitude.

H18 Perceived ease of use mediates the relationship between Self-efficacy and ATT through Perceived Usefulness.

H19 Perceived usefulness mediates the relationship between perceived ease of use and attitude.

H20 Perceived usefulness mediates the relationship between self-efficacy and attitude.

H21 Self-efficacy mediates the relationship between personal innovativeness and perceived ease of use.

H22 Self-efficacy mediates the relationship between social factors and perceived ease of use.

H23 Perceived ease of use mediates the relationship between self-efficacy and perceived usefulness.

H24 Perceived ease of use mediates the relationship between social factors and perceived usefulness.

H25 Self-efficacy mediates the relationship between social factors and perceived usefulness.

Research methodology

Population and sampling

The target population in this study is higher education students of different Government and Private Aided colleges situated in the state of Haryana. The non-probability convenience and judgmental technique of sampling were used for this study.

Instrumentation and construct description

This study used a survey questionnaire to collect data from students who belong to higher education. The questionnaire comprises two sections. The first section is related to the demographic information of the students. The second section of the questionnaire comprises the 17 statements for the constructs of TAM and 12 statements for three selected external variables namely social factors, personal innovativeness and self-efficacy. The number of items for each construct varied from one to four items. The questionnaire included 4 items of perceived ease of use, 4 items on perceived usefulness, 4 items on students' attitude, 4 items on behavioral intentions, 1 item on actual usage, 4 items on social factors, 4 items on personal innovativeness and 4 items on self-efficacy. All items were evaluated by using a five-point Likert scale ranging from 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree to 5 = Strongly Agree. The origin of each of these items has been outlined in Table 1.

Data collection

Data collection was accomplished by an online survey. The online questionnaire complied with the help of Google Survey. Questionnaires were sent out to different students of the state at the end of the academic session 2019–2020. The period was important in turns of lockdown due to the pandemic of Covid-19 as most of the education institutions felt the need for e-learning in their education system. After preliminary analysis of outlier, unengaged responses, and normality, 570 responses were used for data analysis out of the collected 585 responses. In the total responses, there was the majority of female students (83.9%) over male students (16.1%). Most of the students (88.2%) were in their Undergraduate Programme while rest belonged to post-graduate program. Further, most of students were from government colleges.

Table 1 Proposed model constructs

Variable	Items	Source
Perceived Ease of Use (PEOU)	4	Davis et al. (1989), Venkatesh et al. (2003), Ratna and Mehra (2015)
Perceived Usefulness (PU)	4	Davis et al. (1989), Venkatesh et al. (2003), Ratna and Mehra (2015)
Attitude (ATT)	4	Fisbein and Ajzen (1975), Ratna and Mehra (2015)
Social Factors (SF)	4	Fisbein and Ajzen (1975), Thompson et al. (2008), Park (2009)
Personal Innovativeness (PI)	4	Thompson et al. (2008)
Self-Efficacy (SE)	4	Thompson et al. (2008), Park (2009)
Behavioral Intention to Use (BI)	4	Davis et al. (1989), Venkatesh et al. (2003), Ratna and Mehra (2015)
Actual Usage (AU)	1	Davis et al. (1989), Venkatesh et al. (2003), Ratna and Mehra (2015)

Data analysis

SPSS 21 was used in preliminary examination collected data i.e., missing data, identification of outliers, and unengaged responses. The data was imported into the Smart PLS version3 to do further analysis and model testing.

Model testing

Analysis of measurement model

Evaluation of measurement model includes the testing of validity and reliability of the association between latent constructs and their related (Hair et al., 2017). Checking of indicator reliability, internal consistency reliability, convergent and discriminant validity were used in the measurement model. The results show that the indicator reliability because most of the factor loadings were more than 0.7 other than three indicators PEOU1 (0.1419), ATT1 (0.3139), and BI2 (0.46). These three indicators did not meet the recommend threshold as well as also affect the AVE and CR of constructs so these were removed. Table 2 exhibits that CR and Cronbach alpha for each construct was greater than 0.8 so provides evidence of their internal consistency and reliability. For accepting convergent validity, the AVE of the construct should be more than 0.5, and Table 2 exhibits that all constructs had an AVE between 0.616 and 1 which demonstrates the acceptance of convergent validity of the latent constructs. Secondly, CR is greater than AVE which also shows constructs convergent validity. The HTMT ratio was used for checking discriminant validity and the value of HTMT ranged between 0.675 and 0.899 which indicates the acceptance of measurement model discriminant validity because all values were less than 0.90 (Henseler et al., 2015). Additionally, the approximate appropriateness of the model was tested through model fit in which the value of SRMR should be below 0.08 and NFI should be more than 0.90. Here, SRMR was 0.030 and NFI was 0.945 (As shown in Table 5) so the model was acceptable (Table 3).

Assessment of structural model

Different standard criteria i.e., the coefficient of determination (R^2), Path coefficient value and its statistical significance, effect size F , and redundancy measure Q^2 were used for the evaluation of the structural model. Before assessing the structural model, collinearity was checked through VIF values. As shown in Table 2, here all VIF were less than 5 so there was no issue of collinearity. Overall, the value of all endogenous R^2 lies between 0.562 and 0.865 so it reveals the acceptance of endogenous variables of the model. The R square value of the final construct AU was 0.562 which is substantial and indicates good explanatory power. Using (Geisser, 1974; Stone, 1974) high, medium, and small predictive relevance of the PLS path model were determined by Q^2 value more than 0.35, 0.15, and 0.02 respectively (Chin, 2010). As an exhibit in Table 4, Q^2 value of attitude, perceived ease of use,

Table 2 Indicators of convergent validity

Constructs	Items	Factor loading	VIF	CR	Cronbach's alpha	AVE
1. Perceived Ease of Use (PEOU)	1. "Learning how to use e-learning would be easy for me"	0.849	2.504	0.888	0.888	0.725
	2. "It would be easy for me to find the required information using e-learning"	0.828	2.573			
	3. "My interaction with e-learning is clear and understandable"	0.877	2.608			
2. Perceived Usefulness (PU)	1. "Using e-learning would improve my productivity in my courses"	0.877	3.762	0.937	0.937	0.787
	2. "E-Learning would improve my academic performance"	0.866	3.616			
	3. "E-Learning would enhance my effectiveness in learning"	0.894	3.394			
	4. "E-Learning is very useful for my studies"	0.912	3.662			
3. Self-Efficacy (SE)	1. "I feel confident in finding information in the e-learning system"	0.876	2.566	0.900	0.901	0.694
	2. "I have the necessary skills for using an e-learning system"	0.831	2.484			
	3. "I feel comfortable when I am using the internet"	0.799	2.523			
	4. "I can help others in using e-learning material"	0.824	2.595			
4. Social Factors (SF)	1. "Most people who are important to me think that I should study in e-learning mode"	0.821	2.517	0.908	0.908	0.712
	2. "People whose opinions I value approve of me in learning in e-learning mode"	0.880	2.606			
5. Personal Innovativeness (PI)	3. "My friends and colleagues think that e-learning is an appropriate mode of learning for my study"	0.855	2.898			
	4. "My Family considers e-learning to be an appropriate mode of learning and study for me"	0.817	2.899			
	1. "Among my colleagues and peers, I will be among the first to try new methods of e-learning"	0.819	2.334	0.864	0.864	0.616
	2. "I must see other people using new sources before I will consider using them myself"	0.783	2.263			
	3. "I use specific sources that fit a specific need; I seldom try new sources just for the fun of it"	0.674	1.758			
	4. "I have resources, knowledge, and skills to make effective use of e-learning"	0.853	2.016			

Table 2 (continued)

Constructs	Items	Factor loading	VIF	CR	Cronbach's alpha	AVE
6. Attitude (ATT)	1. "I have a positive towards using e-learning"	0.872	2.890	0.916	0.916	0.783
	2. "I believe it is a good idea to use e-learning for my course"	0.8882	3.588			
	3. "I really enjoy studying through e-learning"	0.901	3.328			
7. Behavioral Intentions to Use (BI)	1. "I expect that I will regularly use e-learning for my course"	0.836	2.311	0.875	0.875	0.700
	2. "I intend to use e-learning during the semester"	0.803	2.347			
	3. "I intend to use e-learning to improve my study performance as often as needed"	0.870	2.418			
8. Actual Usage (AU)	1. "I use e-learning frequently"	1.000	1.000	1.000	1.000	1.000

Table 3 Discriminant validity using heterotrait–monotrait ratio (HTMT)

	ATT	AU	BI	PEOU	PI	PU	SE	SF
ATT								
AU	0.710							
BI	0.899	0.749						
PEOU	0.856	0.681	0.822					
PI	0.784	0.691	0.806	0.781				
PU	0.896	0.675	0.865	0.898	0.784			
SE	0.880	0.754	0.886	0.865	0.890	0.880		
SF	0.869	0.741	0.890	0.837	0.853	0.874	0.885	

Table 4 Q² value for predictive relevance

	Q ² (= 1 – SSE/SSO)	R ²	Adjusted R ²
ATT	0.631	0.842	0.842
AU	0.489	0.562	0.561
BI	0.563	0.843	0.842
PEOU	0.526	0.773	0.772
PU	0.647	0.865	0.864
SE	0.548	0.852	0.851

Table 5 Model fit values

SRMR	0.030
NFI	0.945

perceived usefulness, behavioral intention, self-efficacy and actual usage was 0.631, 0.526, 0.647, 0.563, 0.647, and 0.489 respectively (Table 5). Here the model had high predictive relevance. Similarly, the f^2 values of 0.02, 0.15, and 0.35 represent a low, medium, and strong effect size (Cohen, 1988). The results of the effect size as shown by Table 6 suggested that overall behavioral intention (1.282) has a high effect size on actual usage of e-learning. Among all relations, the effect of perceived ease of use on attitude and perceived usefulness on perceived ease of use was zero. Other's relations have a weak, moderate, and high effect on the dependent variable as shown in Table 7.

Predictive relevance

After this, Bootstrapping methods with 5000 re-sampling methods as suggested by Hair et al. (2017) were used in this study for the evaluation of the structural model by assessing the path coefficients concerning the model's latent variables through the path coefficient's sign, magnitude, and significance. Table 6 and Fig. 2 show the result of 25 hypotheses and the significance of direct effect was measured through

Table 6 PLS results of structural model of hypothesis testing

Hypothesis	Path	Original sample (O)	T statistics (O/STDEV)	P values	Hypothesis result	F ²	Effect size
H1	PEOU → PU	0.459	5.401	0.000	Supported	0.355	Strong
H2	PEOU → ATT	0.128	1.269	0.205	Not Supported	0.017	Zero
H3	PU → ATT	0.461	4.510	0.000	Supported	0.204	Moderate
H4	PU → BI	0.220	2.417	0.016	Supported	0.056	Moderate
H5	ATT → BI	0.536	5.490	0.000	Supported	0.327	Moderate
H6	BI → AU	0.750	24.716	0.000	Supported	1.282	High
H7	SE → PEOU	0.603	3.714	0.000	Supported	0.238	High
H8	SE → PU	0.231	2.379	0.017	Supported	0.065	Weak
H9	SE → ATT	0.363	3.634	0.000	Supported	0.163	High
H10	SF → PU	0.285	3.589	0.000	Supported	0.118	Weak
H11	SF → PEOU	0.348	3.323	0.001	Supported	0.104	Weak
H12	SF → SE	0.461	6.086	0.000	Supported	0.388	Strong
H13	PI → SE	0.497	6.549	0.000	Supported	0.451	Strong
H14	PI → PEOU	-0.052	0.419	0.675	Not Supported	0.002	Zero
H15	PI → BI	0.211	3.340	0.001	Supported	0.099	Weak

T values and found that two hypothesis H3 regarding the effect of perceived ease of use on attitude and H6 personal innovativeness on perceived ease of use was rejected. All other hypotheses H1, H2, H4, H5, H7, H8, H9, H10, H11, H12, H13, H14, and H15 were accepted. Several trends were evident in the magnitude of the bivariate relationships proposed by the model. As depicted by Table 6, BI had a significant influence on actual usage ($\beta=0.750$, $P=0.000$). The value of R square was 0.562 which means that 56.2% variance of actual usage was explained by behavioral intention. In the context of behavioral intention, relationship with ($\beta=0.536$, $P=0.000$), PI ($\beta=0.211$, $P=0.001$), PU ($\beta=0.220$, $P=0.016$) was significant. The finding revealed that attitude, personal innovativeness and perceived usefulness explained 84.3% variance of behavioral intentions where attitude explained the most followed by perceived usefulness and personal innovativeness.

In the context of attitude except perceived ease of use construct, perceived usefulness ($\beta=0.461$, $P=0.0000$) and self-efficacy ($\beta=0.363$, $P=0.000$) had significant influence and 84.2% variance was explained by these constructs where perceived usefulness explained the most followed by self-efficacy.

In the context of perceived ease of use except for personal innovativeness, social factors ($\beta=0.348$, $P=0.001$) and self-efficacy ($\beta=0.603$, $P=0.000$) had significant influence. These constructs explained 77.3% variance of perceived ease of use, where self-efficacy explained the most compared to social factors.

In context perceived usefulness, all factors perceived ease of use ($\beta=0.459$, $P=0.000$), social factors ($\beta=0.285$, $P=0.000$), and self-efficacy ($\beta=0.231$, $P=0.017$) had significant influence and these explained 86.5% variance of perceived

Table 7 Mediation test result

Hypothesis	Path	Indirect effect	Total effect	VAF %	T statistics (IO/ STDEVI)	P values
H16	PU → ATT → BI	0.247	0.468	52.78	3.499	0.000
H17	SE → PEOU → ATT	0.077	0.674	11.4	1.225	0.221
H18	SE → PEOU → PU → ATT	0.128	0.674	19	2.871	0.004
H19	PEOU → PU → ATT	0.212	0.340	62.35	3.345	0.001
H20	SE → PU → ATT	0.106	0.674	15.72	2.377	0.017
H21	PI → SE → PEOU	0.300	0.248	120.96	2.897	0.004
H22	SF → SE → PEOU	0.278	0.626	44.4	3.273	0.001
H23	SE → PEOU → PU	0.277	0.508	54.6	3.453	0.001
H24	SF → PEOU → PU	0.160	0.679	23.56	2.638	0.008
H25	SF → SE → PU	0.106	0.679	15.6	2.168	0.030

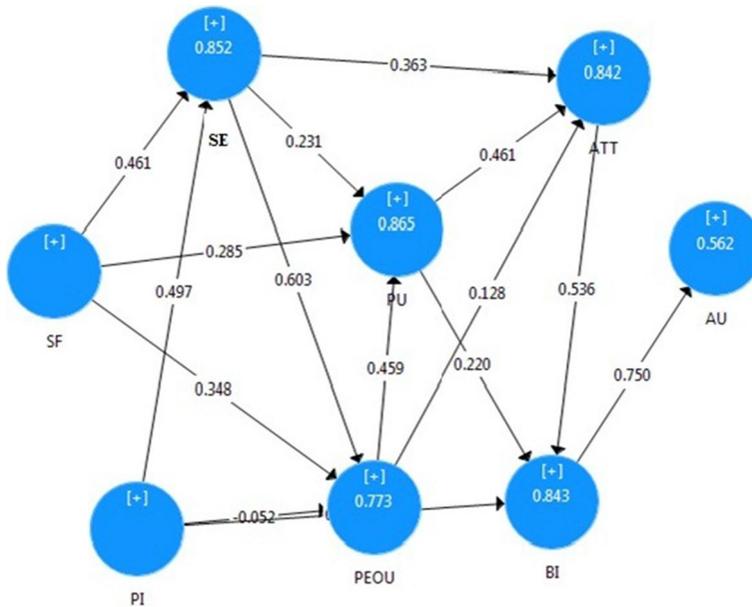


Fig. 2 Measurement model

usefulness where perceived ease of use explained the most followed by social factors and self-efficacy.

Similarly, self-efficacy was significantly influenced by personal innovativeness ($\beta=0.497$, $P=0.000$) and social factors ($\beta=0.461$, $P=0.000$). These explained 85.2 variance of self-efficacy where personal innovativeness explains the most followed by social factors.

The indirect effect hypothesis refers to mediation. Here using Nitzl et al. (2016) guidelines and decision tree, zero mediation, typical partial mediation, and full mediation were determined by VAF (Variance Accounted For) of less than 20%, 20–80%, and above 80% respectively. Using this approach, Hypothesis H16, H18, H19, H20, H21, H22, H23, H24, and H25 were supported by the findings of this study, and only one hypothesis H17 was rejected (as shown by Table 7) which means perceived ease of use was not mediating the impact of self-efficacy on attitude. The findings confirm the significant mediating role of attitude between perceived usefulness and behavioral intentions and had a medium partial mediation effect which is similar to the findings of Ratna and Mehra (2015). Perceived ease of use and perceived usefulness play a significant mediating role between self-efficacy and attitude but the effect was low. Perceived usefulness had a full mediation role between perceived ease of use and attitude because their direct effect was not significant. Perceived usefulness had a significant mediating role between self-efficacy and attitude but the effect was low. Self-efficacy has significant full mediation between personal innovativeness and perceived ease of use because their direct effect was not significant. Self-efficacy had a significant mediating role between social factors and perceived ease of use and the mediation effect was medium. Perceived ease of use had

a significant mediating role between self-efficacy and personal innovativeness and the mediation effect was medium. Perceived ease of use had a significant mediating role between social factors and perceived usefulness and the mediation effect was medium. Lastly, self-efficacy had a significant mediating role between social factors and perceived usefulness and the mediation effect was low.

Discussion

Similar to earlier studies by Davis et al. (1989), Ratna and Mehra (2015), Farahat (2012), etc., it is accepted that TAM is a very useful theoretical model in explaining the factor influencing the behavioral intentions and actual usage of e-learning in higher education of India. Result also concludes that the model is a well representation of the collected data according to the results of all indicators.

The finding of this study is that personal innovativeness has a significant influence on self-efficacy which is similar to the findings of (Thompson, 2008). Personal innovativeness has a positive influence on behavioral intentions to use e-learning which is consistent with the findings of (Thompson, 2008). So, Innovative students are more eager to use e-learning. Personal innovativeness does not have a significant influence on perceived ease of use directly but has an indirect effect through self-efficacy mediator consistent with the findings of (Ke et al., 2012) but inconsistent with the results of (Raaji & Schepers, 2008; Basak et al., 2015).

Social factors play an important role in influencing the self-efficacy of students which is opposite to the findings of (Thompson, 2008) So social persuasion can be considered a strong factor for improving the self-efficacy of students in using e-learning. Social factors play a direct impact on perceived usefulness and perceived ease of use also has an indirect impact through mediator PEOU, PU, and SE consistent with findings of (Farahat, 2012) but contrary to the findings of (Kanwal & Rehman, 2017). Self-efficacy of students has a significant influence on perceived ease of use, perceived usefulness and attitude of students which is consistent with the findings of (Thompson, 2008; Al-Azwari & Lundqvist, 2015; Fathema et al., Abdullah & Ward, 2016; Park, 2009; Ibrahim et al., 2018; Kanwal & Rehman, 2017). Self-efficacy of students also plays a mediator role in improving perceived ease of use and perceived usefulness through personal innovativeness and social factors. This could be justified by motivational theory under which intrinsic motivational factors like self-efficacy and extrinsic motivational factors like social factors could help students of higher education in regulating the motivation to use e-learning. So self-efficacy of students in using internet and computer play a significant role in enhancing intention to use e-learning. Therefore, higher education should ensure that students' training sessions should be organized for enhancing their capabilities to use technology.

Perceived ease of use does not have a direct influence on attitude but has an indirect effect through the mediating role of perceived usefulness and the indirect effect is supported by study (Ratna & Mehra, 2015). The results are not in harmony with the findings of (Fathema et al., 2018; Kanwal & Rehman, 2017). Perceived ease of use has a direct effect on perceived usefulness which is in line with the findings

(Farahat, 2012). So, an easy-to-use system will enhance productivity and performance in turn positively motivate the students in adopting online learning. Therefore, the designers and developers should prepare an easy-to-use system and its interface which may increase the intention to use e-learning.

Perceived usefulness has a significant influence on attitude and behavioral intentions to use which is in line with the findings of (Fathema et al., 2018; Punnoose, 2012; Abdullah & Toycan, 2018; Ratna & Mehra, 2015; Park, 2009; Ibrahim et al., 2018; Kanwal & Rehman, 2017). The results show that the adoption of e-learning will increase if students consider it useful as well as beneficial in improving performance in the future. Therefore, the practitioners should provide the students a clear vision to understand regarding the usage and benefits of using e-learning.

Lastly, attitude has a significant influence on behavioral intentions and further behavioral intentions has an influence on actual usage which is consistent with the findings of (Fathema et al., 2018; Abdullah & Toycan, 2018; Ratna & Mehra, 2015; Park, 2009) but contradict with findings of (Adwan et al., 2013). Therefore, usage of e-learning could be increased by the ease of use and usefulness including the external factors that may affect the intentions to use directly and indirectly.

Conclusion and implication for practice

Overall, this integrative model shows how perception regarding perceived usefulness and perceived ease of use could be created. Additionally, it also illustrates the several ways through which adoption of e-learning among higher education students by personal innovativeness, self-efficacy, and social factors. Because all these external variables have direct and indirect effects on perceived usefulness and perceived ease of use which have a further effect on attitude, behavioral intentions and actual usage of e-learning.

This integrated model demonstrates that the mechanisms through general beliefs of personal innovativeness of students, social factors, and self-efficacy influence student's adoption process of e-learning and also helps in understanding the TAM constructs like perceived usefulness and perceived ease of use. Higher education administration should concentrate on these factors in planning and assessing the practice of e-learning. The effect of social factors on different constructs suggests the deployment of e-learning culture among students' communities and should also make their families familiar with e-learning. Besides, the influence of personal innovativeness & self-efficacy on perceived ease of use & perceived usefulness that effective training programs should be organized for students to build a positive and behavioral intention towards the use of e-learning. Educators of higher education institutions should also make efforts to increase the self-efficacy of students in using e-learning resources & material for that online and offline support should be provided to them.

The study also has implications for improving user acceptance of e-learning. As per Bransscomb and Thomas (1985), the main barrier for user acceptance is being less user-friendly of the current system. So, making them more user-friendly interfaces would be the key element for increasing usability but like Davis et al. (1989), perceived usefulness is more significant than perceived ease of use because like all

users usefulness or output of e-learning is more important than the way of using them. So, ease of use will not be able to increase the use of e-learning sources if those are not useful for them. Higher education administrators should identify and evaluate strategies for improving the usefulness of e-learning for students to increase the behavioral intention and actual usage of e-learning.

Limitation and future directions of the study

Even though this research reveals meaningful information regarding factors affecting the behavioral intention and actual usage of e-learning by students. Still some limitations exist like data was collected from students of Haryana state only so a larger sample of respondents from different regions of the country can be used to generalize the results. The biasness of respondents also affects the study and the variables used may be subject to change over time so longitudinal studies can give more generalized results. In the future, more external variables could be added to examine their impact on the acceptance of technology, and also the effect of demographic variables on TAM in the Indian context could also be studied.

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