Adoption of Software-as-a-Service (SaaS) Applications in E-learning: Perception of the Management Undergraduates in a Selected State University of Sri Lanka

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Abstract

Software-as-a-Service applications immensely impact the success of e-learning with their ability of cost saving, scalability, and better collaboration. Identifying the factors influencing Software-as-a-Service applications' adoption and their impact on the adoption of e-learning by management undergraduates in Sri Lanka became the main objectives for this research. 116 responses obtained were analyzed adopting Partial Least Squares-Structural Equation Modelling in SmartPLS. Findings revealed that behavioral intention to adopt such software together with facilitating conditions has a significant impact on the SaaS applications' adoption by undergraduates in e-learning and factors such as performance expectancy, effort expectancy, and trust determine the intention towards adoption. This research is a value addition to the theoretical arena where studies are lacking regarding SaaS technology, specifically in the context of e-learning. Universities can focus on significant factors determined in this research when promoting the adoption of SaaS applications as an innovative tool to enhance the quality of education.

Keywords: *Software-as-a-Service; e-learning; UTAUT model; Partial Least Squares-Structural Equation Modelling*

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Introduction

Cloud computing began to emerge as a trend in Information Technology (IT) in 2007 when computing resources started to deliver using the internet and networking technologies (Kayali et al., 2016). "Software-as-a-Service (SaaS)" structure within cloud computing, where third-party software solutions are offered through the internet following a usage-based payment structure without downloading and installing them, is more popular among the models of cloud computing (Ahmad & Waheed, 2015; Palos-Sanchez et al., 2017).

The advancements in Information and Communication Technology (ICT) have replaced the traditional physical classroom-based teaching-learning process with the concept of online learning, which can also be termed as "E-learning", "distance learning", "remote learning", or "virtual learning". E-learning is the application of ICT and related technologies to facilitate the teaching-learning process where students and teachers are not physically present in the same location (Ansong et al., 2017; Wickramaarachchi et al., 2021). Previous studies have realized that there exists a growth in the adoption of E-learning for higher education since the current young generation is more effective and interested in using technologies such as computers, the internet, and smartphones for their day-to-day activities (Yadegaridehkordi et al., 2019).

During the COVID-19 pandemic, almost all the universities had to shift to the online mode of delivering lectures and conducting examinations (Garcia et al., 2020). Gracia et al. (2020) have identified that around 90% of students have adopted E-learning even with the challenges faced by developing countries such as connectivity issues, lack of devices, etc. through a survey conducted about E-learning in higher education settings in Sri Lanka during the COVID-19 pandemic. The findings of this study also reveal E-learning as an important mode of delivering higher education even after the COVID-19 pandemic.

SaaS applications can play a huge role within the context of E-learning by offering a lot of benefits to students as well as lecturers to achieve success in online learning such as cost saving, easy collaboration, scalability, less effort on system upgrades or maintenance, and most importantly non-existence of product licenses (Almazroi et al., 2016; Irshad, 2021). The study by Irshad

(2021) has identified that Sri Lankan state universities heavily rely on Microsoft 365 and Google Apps to facilitate their online learning process by forming contracts with those vendors.

Although several studies have been conducted in different sectors like SMEs, Accounting, IT industry, etc. regarding the cloud computing or SaaS applications usage in the Sri Lankan context (Asirvatham & Ayoobkhan, 2018; Assalaarachchi et al., 2022; Dakshina & Perera, 2018; Livera, 2017), however, there are not enough studies regarding the adoption of SaaS applications for e-learning within the higher education sector in Sri Lanka. The majority of the studies conducted about the higher education context in Sri Lanka have specifically focused on e-learning adoption during the pandemic of COVID-19 (Kamalasena & Sirisena, 2021; Gracia et al., 2020; Wickramaarachchi et al., 2021).

There is research carried out to observe the factors that influence the adoption of SaaS technology by state university undergraduates located within the North and Eastern parts of Sri Lanka, but not particularly within the context of e-learning (Irshad, 2021). They suggest further studies to be conducted in different contexts of Sri Lanka.

With the aim of facilitating the education activities of undergraduates, the majority of state universities in Sri Lanka offer free Microsoft365 accounts to all undergraduates (Information Technology Resource Centre - Faculty of Management Studies & Commerce, 2022). But the review of previous studies pointed out that it lacks studies among management undergraduates about SaaS applications' adoption, specifically in the context of e-learning. It has become a necessity to examine the contributing factors to the SaaS applications' adoption by management undergraduates to promote their use of them for the betterment of education.

Therefore, this study was undertaken with the purpose of examining the factors that influence the adoption of SaaS applications in e-learning by management undergraduates at a selected state university of Sri Lanka, with the motive of filling the knowledge gap in the literature within this context. Hence, the following two main objectives were identified to be achieved by undertaking this research.

- To identify the factors affecting the adoption of SaaS applications in e-learning.
- To determine the relationship between each discovered factor and the adoption of SaaS applications in e-learning.

As a theoretical implication, this study is a valuable contribution to the theoretical aspect where little literature is available regarding cloud computing and specifically on the adoption of SaaS applications for e-learning by management undergraduates. Practically, the findings of the study can be used by the university and the other relevant officials to identify the factors which they should focus on to enhance students' adoption of such applications to enhance the standard of higher education.

Literature Review

Concepts and Definitions in the Study

E-learning

E-learning can be defined as a replacement for the traditional classroom-based mode of delivering lectures and assessing students using the innovations of ICT such as computers and the internet. This has enabled students to learn any time anywhere without being physically present at the educational institute if they have access to computing devices and the internet (Ansong et al., 2017). A recent study conducted in Sri Lankan to identify the nature of E-learning in Higher Education Institutions during the COVID-19 pandemic has found that almost 90% of universities have adopted E-learning and it can be used as an effective mode of delivering higher education even after the COVID-19 pandemic (Garcia et al., 2020).

Software-as-a-Service (SaaS) Applications

SaaS applications are a pay-per-use subscription-based model made possible by cloud computing, allowing customers to use common software applications that are made available or hosted over the Internet in real time (Chou & Chou, 2008). Applications offered as a service (SaaS) have gained popularity for their capacity to boost organizational performance and competitiveness and for

offering new methods of distributing software solutions (Wu, 2011). If there is an internet connection, SaaS apps have the advantage of being accessible at any time from any location and requiring only payment for usage, as opposed to in-house applications that require license and storage capabilities (Livera, 2017).

SaaS applications have emerged as a new trend in practically all industries in the twenty-first century, mostly as a result of the emergence of high-speed internet and the increase in the use of mobile and computing devices (Słoniec, 2015). As cloud services continue to grow and integrate with many business vocations, several sectors are gradually migrating to the online space. According to the literature, these cloud services will soon be a common asset in both the business world and people's daily schedules (Livera, 2017).

Software-as-a-Service (SaaS) Applications Adoption in E-learning

Previous studies have pointed out that students and lecturers prefer face-to-face lectures rather than online lectures because it is challenging to conduct teamwork and facilitate interactions among peers as well as students and lecturers when learning online (Barrot et al., 2021; Garcia et al., 2020; Wickramaarachchi et al., 2021). SaaS applications can be adopted as an effective solution that caters to the problem of collaboration when learning online. Also, SaaS application reduces the cost for licenses and upgrades of software by offering accessibility to the latest versions of software via the cloud without the need for installations (Almazroi et al., 2016; Yadegaridehkordi et al., 2019). Specifically in the higher education sector, effective content creation, organizing lectures effectively, and knowledge monitoring has been identified as benefits of Cloud-based applications' adoption in e-learning (Wu & Plakhtii, 2021).

Theories Aligned with Adoption of Software-as-a-Service (SaaS) Applications in E-learning

A lot of technology adoption theories have been developed by previous researchers since they have identified the lack of acceptance or adoption as the main reason for the failure of implementing new technologies (Garima et al., 2018). Out of them, theories such as the Unified Theory of Acceptance and Use of Technology (UTAUT) introduced by Venkatesh et al. (2003) and the Technology Acceptance Model (TAM) of Davis (1989) have been widely used

to identify the factors affecting the SaaS applications' adoption in e-learning (Almazroi et al., 2016; Irshad, 2021; Kayali et al., 2016).

Technology Acceptance Model (TAM)

TAM has been developed by Davis (1989) with the use of the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) incorporating Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) as independent variables that affect the Attitude to Use, Behavioral Intention to Use and Actual Use of new technology. The extent to which consumers believe using the system is error-free and simple is referred to as PEOU while PU is the extent to which users think using the technology would improve their performance at work (Venkatesh & Davis, 2000).

The adoption of SaaS applications in several industries, including education, has been extensively studied using this model, either on its own or in combination with other theories (Irshad, 2021; Nassif, 2019; Yadegaridehkordi et al., 2019).

Unified Theory of Acceptance and Use of Technology (UTAUT)

By combining several technology adoption models, including the Technology Acceptance Model (TAM), Theory of Reasoned Action (TRA) model, Motivational Model (MM), Theory of Planned Behavior (TPB), combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Diffusion of Innovation Theory (DOI), and Social Cognitive Theory (SCT), Venkatesh et al. (2003) created the UTAUT model. The model includes the core variables of Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), Behavioral Intention (BI), and Use Behavior (UB), as well as the moderators of gender, age, experience, and voluntariness (Venkatesh et al., 2003).

The degree to which new technology can increase users' performance is defined by PE, similar to PU in TAM, while the degree of usability is defined by EE, similar to PEOU in TAM. SI demonstrates the extent to which the influence of others affects the usage of new technology, and FC will demonstrate the impact of having the required technical assistance and infrastructure on new technology adoption. BI and UB of new technologies are being influenced by the above-

defined independent variables as explained in the UTAUT model (Venkatesh et al., 2003).

The UTAUT model has become popular for its ability to overcome the limitations in previous models such as TAM and having a 70% exploratory power (Cao et al., 2013; Hashim & Hassan, 2015). It has been put forwarded by Venkatesh et al. (2003) including Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Conditions (FC), BI, and Use Behavior (UB) as main factors, and age, gender, experience, and voluntariness as moderators. A lot of similar previous studies have tested out extensions to the UTAUT model by combining various factors like Trust (Hashim & Hassan, 2015; Lian, 2015; Alharbi, 2017; Assalaarachchi et al., 2022).

Empirical Findings

TAM has been developed by Davis (1989) incorporating factors such as Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) as independent variables which affect the Attitude Towards Use (ATU) of new technologies that lead to Behavioral Intention (BI) to use and actual use of such technologies. Research has been undertaken in the Sri Lankan context to discover the factors that create an impact on the SaaS adoption by state university undergraduates within the North and Eastern parts of Sri Lanka, has found that PEOU, PU, and Perceived Enjoyment directly influence factors on the SaaS adoption with use of TAM theory (Irshad, 2021).

PEOU, PU, and Trust have been identified as factors affecting the BI to adopt cloud-based E-learning by University Students in Saudi Arabia (Almazroi et al., 2016). The same factors have been identified by a study conducted in Malaysia about the use of online collaborative learning tools for higher education (Yadegaridehkordi et al., 2019). PEOU and PU have been proven to significantly influence attitude toward adoption which then leads to BI and BI significantly influencing adoption by another recent study conducted in Malaysia to study SaaS adoption from the student perspective. They recommend similar studies be conducted in different contexts to validate the findings (Al-Madhagy Taufiq-Hail et al., 2021). Yadegaridehkordi et al. (2020) have presented a behavioral intention model for SaaS-based collaboration services in

the higher education sector in Malaysia, adopting the UTAUT model's core variables with Task-Technology Fit (TTF), and collaboration-related constructs. They found out that the UTAUT model's core variables, PE, EE, and SI significantly affect the BI of adopting such software.
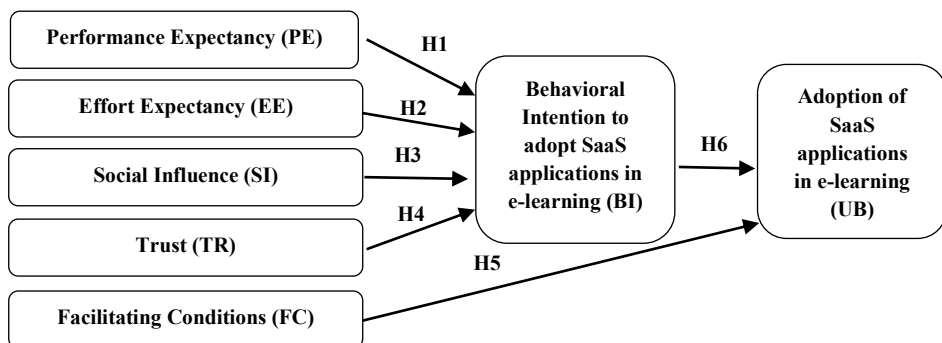
Research Gap

A survey of the relevant literature pointed out that it needs further studies on SaaS applications' adoption in e-learning in different contexts and there is a shortage of research done to recognize the factors which affect the adoption of SaaS applications in e-learning by management undergraduates specifically using an advanced framework such as UTAUT. Most of the previous studies suggest further research should be carried out using the UTAUT model combined with factors such as Trust (Kayali et al., 2016) Thus, this research aimed to fulfill the research gap of identifying the factors influencing the adoption of SaaS applications in e-learning by management undergraduates within a selected state university in Sri Lanka for their higher education by applying the UTAUT model.

Methodology

Conceptual Framework and Hypotheses

Following the quantitative research approach, the conceptual framework for the research was formulated by adopting the main variables in the UTAUT model combined with Trust (Figure 1), which have been extensively employed in similar literature and established as significant contributors to the adoption of SaaS technology (Hashim & Hassan, 2015; Venkatesh et al., 2003;

Figure 1: Conceptual Framework

Yadegaridehkordi et al., 2020).

Hypotheses particular to the research were developed as below with reference to the factors identified to be significant in SaaS applications' adoption using core variables of the UTAUT model (Hashim & Hassan, 2015; Venkatesh et al., 2003; Yadegaridehkordi et al., 2019):

- **H1:** Higher the Performance Expectancy will higher the users' behavioral intention to adopt SaaS applications in e-learning.
- **H2:** Higher the Effort Expectancy will higher the users' behavioral intention to adopt SaaS applications in e-learning.
- **H3:** Higher the Social Influence will higher the users' behavioral intention to adopt SaaS applications in e-learning.
- **H4:** Higher the Trust will higher the users' behavioral intention to adopt SaaS applications in e-learning.
- **H5:** Higher the Facilitating Conditions will higher the users' adoption of SaaS applications in e-learning.
- **H6:** Higher the Behavioral Intention will higher the users' adoption of SaaS applications in e-learning.

Sampling and Data Collection

A sample of undergraduates representing all four academic years in all departments of the management faculty in a leading state university in Sri Lanka was selected to avoid sample biasness following stratified random sampling. The minimum required size of the sample was calculated as 97 calculated using the Multiple Regression method in the sample size calculator of Daniel Sopher (Soper, 2022).

An online questionnaire created with "Google Forms" was shared to gather data for the research. It was able to collect 116 responses in total from the sample of undergraduates by sharing the form using WhatsApp and through other communication platforms.

Section one of the questionnaire targeted to gather demographic data about undergraduates such as age, gender, the field of study, year of study, experience in e-learning, and SaaS applications used during e-learning. The second section included questions having a Likert scale of five points (1- Strongly Disagree to

5 - Strongly Agree) structure to gather data for model testing using the questionnaire items tested in similar previous studies (Venkatesh et al., 2003; Cao et al., 2013; Kamalasena & Sirisena, 2021; Assalaarachchi et al., 2022).

Data Analysis

Statistical Package for the Social Sciences (SPSS) version 23 was utilized for the descriptive data analysis while SmartPLS version 3 was utilized to analyze the study's framework following the Partial Least Squares - Structural Equation Modelling (PLS-SEM) since the study involves a small sample size and a complex model which requires path analysis (Hair & Alamer, 2022).

Results and Discussion

Demographics and Descriptive Statistics

From the 116 responses received, the majority were female undergraduates (57.8%) of age level 20-22 years (51.7%) representing first and second years (70.6%) covering all the departments in the management faculty (Figure 2).
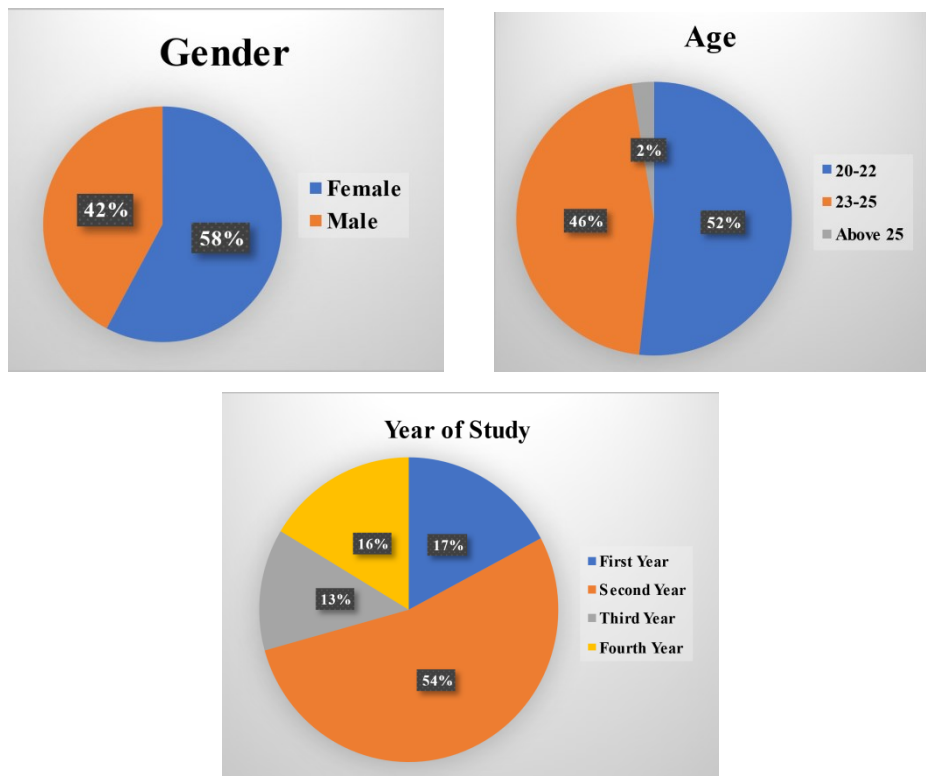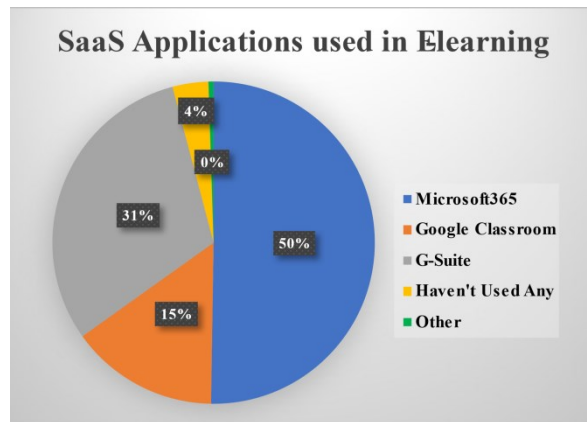

Figure 2: Demographics of Respondents - Age, Gender, Year of Study

Approximately 99% of undergraduates have experienced e-learning and Microsoft365, G-Suite was selected as the most used SaaS application for online learning by the majority of undergraduates (Figure 3), which is in agreement with the past research findings in Sri Lanka (Garcia et al., 2020; Irshad, 2021).

Figure 3: SaaS Applications used in e-learning

After removing the missing values and responses that were unengaged, only 100 responses were qualified for the model testing. Table 1 indicates the descriptive statistics for each variable tested in this study. PE has the highest mean value (3.6925) while all variables show a mean value within the range of 3 – 4. It means that for all the variables respondents have selected "Neutral" or "Agree" from the Likert scale. Having standard deviations of all the variables less than one denotes that deviation of responses from the average response value is less. Except for PE, all other variables represent lower negative skewness values around -0.2 to -0.4.

Table 1. Descriptive Statistics of the Factors

Factor	Mean	Std. Deviation	Skewness
Performance Expectancy (PE)	3.6925	.90861	-0.665
Effort Expectancy (EE)	3.6300	.91527	-0.368
Social Influence (SI)	3.4900	.75955	-0.257
Trust (TR)	3.4900	.84823	-0.356
Facilitating Conditions (FC)	3.4800	.90501	-0.235
Behavioral Intention (BI)	3.5475	.88670	-0.237
Use Behavior (UB)	3.4940	.92002	-0.278

Measurement Model Analysis

With the aim of ensuring indicator reliability, factor loadings were examined with the PLS algorithm in SmartPLS, and all questionnaire items satisfied the condition of having outer loadings more than the 0.7 threshold (Hair et al., 2011).

Having Cronbach's Alpha values above 0.7 indicates that all factors have fulfilled internal consistency and reliability (Hair et al., 2011). Convergent validity was also satisfied since all factors had an Average Variance Extracted (AVE) of more than 0.5 (

Table **2**) (Fornell & Larcker, 1981).

Table 2. Analysis of Reliability and Validity of Factors

Factor	Cronbach's Alpha Value	Composite Reliability	AVE Value
PE	0.888	0.923	0.749
EE	0.913	0.939	0.793
SI	0.831	0.887	0.662
TR	0.929	0.946	0.778
FC	0.878	0.917	0.736
BI	0.911	0.938	0.790
UB	0.937	0.952	0.799

Satisfying the Fornell-Larcker criterion, discriminant validity for all factors were established, since the square root value of the AVE for each factor being higher than the squared correlation between that factor and all other factors as depicted in Table 3.

Table 3. Discriminant Validity of Factors

	BI	EE	FC	PE	SI	TR	UB
BI	0.889						
EE	0.785	0.891					
FC	0.797	0.790	0.858				
PE	0.799	0.808	0.780	0.866			
SI	0.697	0.718	0.711	0.683	0.814		
TR	0.801	0.732	0.719	0.744	0.691	0.882	
UB	0.810	0.753	0.780	0.725	0.684	0.671	0.894

Then the hypotheses were tested using the bootstrapping in SmartPLS at 0.05 two-tailed significance level following the structural equation modeling approach. Except for H3, all hypotheses were supported which shows the linkage of SI and BI to adopt SaaS applications in e-learning by management undergraduates since its path-coefficient value having more than 0.05 (Figure 4) (J. F. Hair et al., 2011). Table 4 shows the summary of this study's findings after the hypotheses testing.
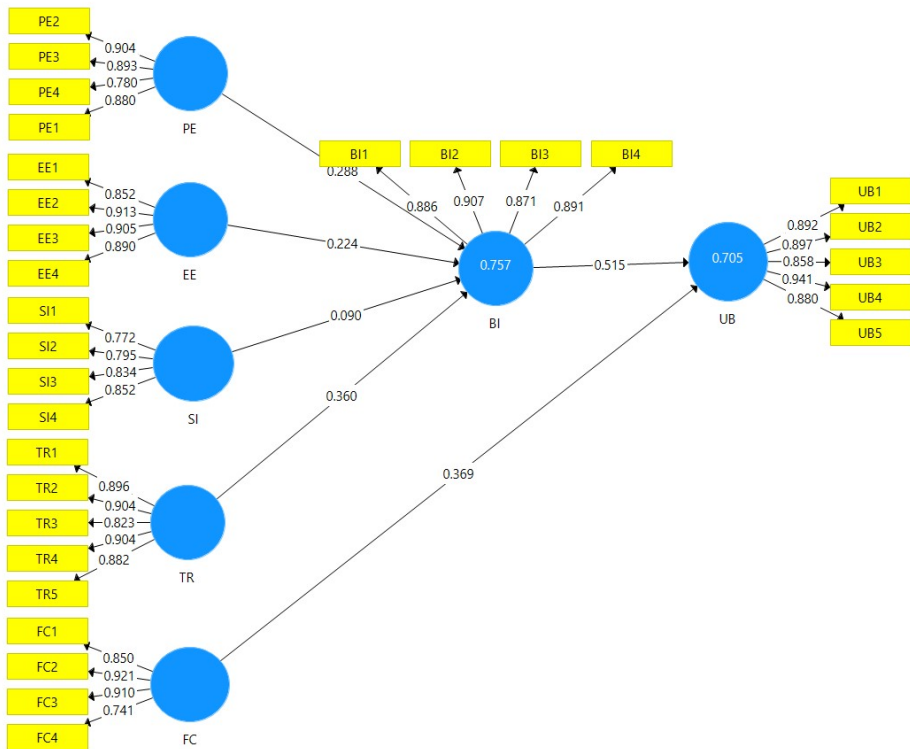
Figure 4: Path Diagram of the Study

Table 4. Testing Hypotheses of the Study

Hypotheses		Path Co-efficient	T Statistics Value	P Value	Supported/Not Supported
H1	PE ⟶ BI	0.288	2.554	0.011	Supported
H2	EE ⟶ BI	0.224	2.060	0.040	Supported
H3	SI ⟶ BI	0.090	0.909	0.364	Not Supported
H4	TR ⟶ BI	0.360	3.051	0.002	Supported
H5	FC ⟶ UB	0.369	2.886	0.004	Supported
H6	BI ⟶ UB	0.515	4.847	0.000	Supported

The findings of the research demonstrate that BI as a significantly affecting factor on the UB and PE, EE, and TR will influence significantly on BI. Also, FC was determined to create a significant influence on UB of SaaS applications

in e-learning by management undergraduates (Figure 5). All hypotheses except H3 were proven to be supported and have a positive influence on BI and UB at a 5% level of significance since their P values were less than 0.05 and have positive coefficient values. The conceptual model of the study showed a capability to explain the variability of UB with BI at nearly 71% and the variability of BI by other variables at nearly 76% as per the adjusted R^2 values.
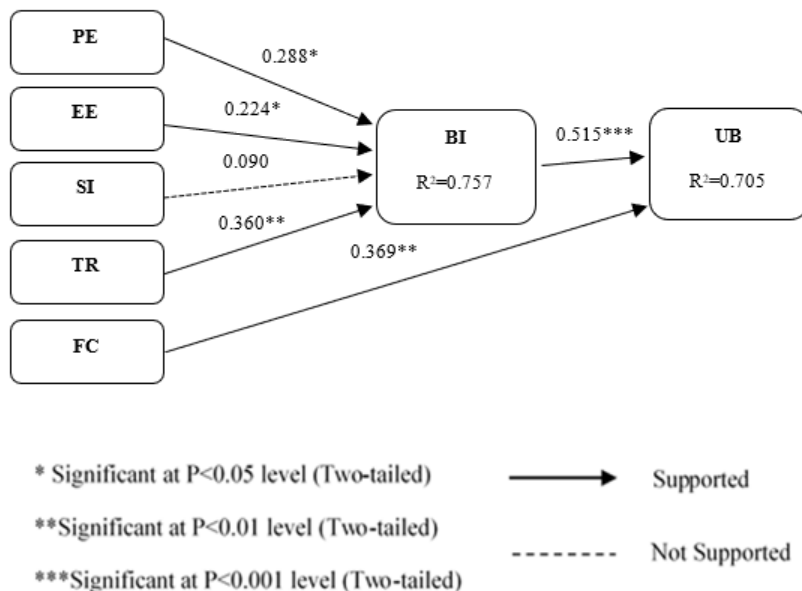
Figure 5: Summary of Findings

Findings of the study implies that if undergraduates find SaaS applications usage can improve performance in academics, easy to use for e-learning, and can trust such applications, they will intend to adopt SaaS applications in e-learning. Also, when all necessary facilities to access such software are available together with undergraduates' behavioral intention, the adoption of SaaS applications in e-learning can be improved. Although it was proven to have a positive relationship, social influence seems to be an insignificant factor in the decision of adopting SaaS applications for e-learning when all other factors are in place.

Align with the findings of the previous studies, it was evident that e-learning has been adopted by most undergraduates, and the SaaS applications such as Microsoft365, and G-Suite have been used by most undergraduates during their online education (Garcia et al., 2020; Irshad, 2021). PEOU in the TAM model which is equivalent to EE in the UTAUT model and PU in the TAM model which is comparable to PE in the UTAUT model have been identified as significant factors which affect the BI were also identified similar to previous literature (Almazroi et al., 2016; Irshad, 2021; Venkatesh et al., 2003). In agreement with the literature which have adopted the UTAUT model, PE and EE were determined to be the factors affecting significantly the BI while BI and FC affect the adoption of SaaS applications in e-learning (Hashim & Hassan, 2015; Yadegaridehkordi et al., 2020).

However, SI which has been proven to be an important factor affecting the BI of adopting such applications in similar literature (Hashim & Hassan, 2015; Yadegaridehkordi et al., 2020), was not supported under the setting of this study. It implies that students do not consider the influence of people who are important to them such as lecturers, senior colleagues, or university officials when adopting the SaaS applications in their e-learning activities. This can be mainly with the fact that higher the performance expectancy, effort expectancy, trust, and facilitating conditions in such software, undergraduates will adopt them by themselves without any influence from important parties.

TR was incorporated together with core variables of the UTAUT model which has been significant in a lot of similar studies (Hashim & Hassan, 2015; Kayali et al., 2016). It was proven to be supported in the context of SaaS application adoption in e-learning also which implies that higher the undergraduates' trust in SaaS applications will higher their intention to use them for e-learning.

Conclusion

This research was conducted by having the primary objective of determining the factors affecting the adoption of SaaS applications in e-learning by management undergraduates of state universities in Sri Lanka. 116 responses were gathered from a sample of management undergraduates at a leading state university sharing an online survey. After analyzing the measurement model from the collected data, it was identified that behavioral intention together with

facilitating conditions has a significant positive impact towards the adoption of SaaS applications in e-learning by management undergraduates, and performance expectancy, effect expectancy and trust in SaaS applications have a significant positive effect on behavioral intention when adopting such applications in e-learning.

Implications of the Study

As the theoretical implication, this work addresses a theoretical gap in the literature by analyzing the factors causing the adoption of SaaS applications in e-learning based on the UTAUT model and Trust.

In practical aspects, the findings of the study can be used by universities to focus on the factors needed to increase the intention of undergraduates to adopt these applications by making them aware of how this software can improve their academic performance. Also, this study pointed out the need for universities to provide the necessary infrastructure and learning support to increase the adoption of SaaS applications in e-learning by undergraduates.

Thereby it contributes to promoting the adoption of SaaS technologies to facilitate e-learning productively by revealing the factors that should be significantly focused on when adopting those technologies specifically in the context of management undergraduates in state universities of Sri Lanka.

Limitations and Future Research

Since this study involves a limited sample size particular to a single case, future research could adopt the same model to a wider sample or to a different context such as covering all state universities in Sri Lanka. Also, this research is limited to the variables adopted from similar previous studies and there can be many other variables that are not covered because of that. In future studies, researchers can conduct an exploratory study to identify the potential factors and build up a framework based on them. Further studies can take the effect of moderating variables in the UTAUT model such as age, gender, and experience, and also the mediating impact of behavioral intention into consideration which was another limitation of this study.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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