How to Cite:
Benmehdi, S., Chouali, A., Salima, T., & Fatiha, B. (2024). The smart university: a new way to promote the performance of the Algerian university (case of the PROGRES platform). *International Journal of Economic Perspectives*, 2311–2323. Retrieved from https://ijeponline.org/index.php/journal/article/view/721

The smart university: a new way to promote the performance of the Algerian university (case of the PROGRES platform)

Safia Benmehdi
Doctor, Department of Commercial Sciences, University of Bejaia, Algeria
Email: safia.benmehdi@univ-bejaia.dz

Ahlam Chouali
Doctor, Department of Commercial Sciences, University of 8 May 1945, Guelma, Algeria
Email: chouali.ahlam@univ-guelma.dz

Tebaibia Salima
Professor, Department of Commercial Sciences, University of 8 May 1945, Guelma, Algeria
Email: salima.tebaibia@univ-guelma.dz

Bouhrine Fatiha
Professor, Department of Economic Sciences, University of Constantine 2-Abdelhamid Mehri, Algeria
Email: fatiha.bouhrine@univ-constantine2.dz

***Abstract*---**The transition towards a smart university in Algeria represents a major advancement in modernizing the higher education sector. This study aims to assess student satisfaction with the PROGRES platform. The objective of our study is to evaluate student satisfaction with the PROGRES platform. To achieve this objective, we based on a literature review and the TAM model (technology acceptance model). To develop a conceptual model, then test the hypotheses with a random sample of 500 students. A conceptual model was developed and tested using a random sample of 500 students. The results of the structural equation modelling using the PLS approach (SEM-PLS) reveal that perceived usefulness and perceived ease of use, influenced by facilitating conditions, have a positive impact, on thebehavioural intention towards the actual use of the digital platform PROGRES and consequently on student satisfaction with it.

Submitted: 12 July 2024, Revised: 14 September 2024, Accepted: 10 November 2024

***Keywords*---**TAM model, Satisfaction, Algerian student, structural equation modelling, PLS approach, PROGRES.

1. Introduction:

The transition to the smart university is emerging as an unavoidable necessity in the contemporary educational sector. This transformation is imperative to keep pace with rapid technological advancements and meet the changing needs of students and society. By embracing emerging technologies such as artificial intelligence, data analytics and digital platforms, the smart university aspires to create a more dynamic, accessible and adaptive learning environment(Shishakly, R., et al. 2024). This not only optimizes administrative processes but also above all improve the quality of teaching by offering personalized resources and innovative teaching methods (Akkol, E., et al. 2023).

The Algerian University is one of the institutions that have sought and continue to seek to implement the digitalization project in light of the strategies respectively approved by the Ministries of Higher Education and Scientific Research, through which it aims to digitize the sector and lay the foundations of modern technology (Amel. M, et al., 2021).This process took place through the application of a set of electronic systems and services provided by the higher education sector with the aim to improve the sector, the most important of these services being the PROGRES system. The latter needs to be improved in terms of presentation and functionality in order to achieve a computer system providing a reliable database concerning all students and teachers of the Algerian university.The PROGRES platform facilitates the management of various tasks, including the orientation of new baccalaureate graduates, student transfers, timetables, teacher schedules, and deliberations. It also handles room management, tracks student history and academic progress, and provides the option to generate and publish various reports…, etc. (Official website of Algerian ministermesrs.dz, 2024).

The importance of our study is to analyse student satisfaction with digital platforms, this satisfaction not only ensures the relevance of the platform but also contributes to the broader objective of improving the quality of education and cultivating a satisfied and technologically expert student community in Algeria. In addition,the TAM model is a leading framework for studying the use of technological tools, focusing on how perceived usefulness and perceived ease of use influence actual usage and user satisfaction with technology (Namouni, M. 2020).

In addition, the importance of our contributionstems from the importance of the key concepts it explores, specifically: the transition to the smart university is a key factor in guaranteeing the success of higher education.It is in this context that this research study takes place, the objective of which is to highlight the opportunities provided by digital platforms in advancing the digitalization of universities, we thus seek to evaluate the perceived usefulness and perceived ease of use and their impact on student satisfaction. It is therefore a question of answering the following problem:*How does the PROGRES platform contribute to student satisfaction?*

To analyse our research question, we adopted a hypothetico-deductive approach. According to the following plan: the first part will concentrate on a literature review and the presentation of our conceptual model, which is grounded in the TAM model, along with the formulation of research hypotheses. The second part will be devoted to a quantitative study using a questionnaire intended for Algerian students, and the processing of data with structural equation modelling using the PLS approach. Finally, the presentation of our results, our contributions as well as some recommendations.

2. Literature review and hypotheses development

2.1 Previous studies:

Since the inception of the Technology Acceptance Model (TAM) by Davis in 1989, the study of technology adoption, usage, and acceptance has become a primary focus for various authors and researchers. This section will provide an overview of many of the previous studies that have addressed the topic of student satisfaction with online education using the TAM model:

Abdelkader, B., et al (2023):

In this pilot study, an investigation was conducted into student satisfaction with the quality of teaching and learning, aiming to understand its correlation with the overall performance of Saida University in Algeria. Data were collected from 97 questionnaires distributed among Saida University students. The analysis utilised the partial least squares structural equation modelling (PLS-SEM) technique to delve into student satisfaction regarding teaching and learning quality. SPSS and SmartPLS3 software were employed for data analysis. The results unveiled a positive relationship between the quality of education and learning, including its various dimensions.

Hamli, A., et al (2023):

The main goal of this study is to investigate the role of the Technology Acceptance Model (TAM) in promoting e-learning adoption among Algerian student, to fulfil the study's goals. An electronic questionnaire was crafted for data collection, targeting a sample of 225 university students spread across 56 institutions in Algeria. This sample was obtained from 16 institutes through Facebook. The analysis method used was partial least squares structural equation modelling (PLS-SEM), which was employed to assess and evaluate the proposed model. The results indicated that the TAM effectively explains the factors affecting e-learning adoption among Algerian students, showing a statistically significant relationship among the different underlying components of the model.

Amel, M., & Chadli, C (2021):

In this research, the authors directed their attention to the Moodle platform at the University of Ouargla in Algeria, specifically examining a sample comprising 98 management students. The study's framework account on the constructs of the Technology Acceptance Model (TAM) as its foundational theory. To validate the hypotheses derived from the TAM, the authors conducted statistical analyses, utilizing methods such as calculating arithmetic means and standard deviations. Statistical tools within SPSS 22.0 were employed for data analysis. The findings underscored that the influence of TAM factors, namely perceived usefulness and

usage intention, on students' utilization of the Moodle platform is contingent upon both primary and external factors. Furthermore, the results demonstrated a statistically significant and robust relationship among these factors.

Han, J. H., & Sa, H. J. (2022):
This study examines the current level of acceptance of online classes through the lens of the Technology Acceptance Model (TAM). The research is driven by the notable changes occurring in Korean education prompted by the COVID-19 pandemic and speculations surrounding the post-pandemic educational landscape. To assess the acceptance rate of online classes, a survey was administered to 313 university students enrolled in such courses. Structural equation modelling was employed to analyse the data. The findings of the study are as follows: First, the perceived ease of use of online classes had a positive effect on perceived usefulness. Second, both perceived ease of use and perceived usefulness of online classes positively influenced educational satisfaction. Third, perceived usefulness and satisfaction had a positive impact on the intention to accept online education; however, perceived ease of use did not directly affect acceptance intention. These results suggest that improving satisfaction with online education can be achieved by creating user-friendly online classes that emphasize features frequently used by university students. Additionally, universities should provide ongoing training and support to enhance students' perceptions of the usefulness of online classes.

Al-hawari, M. A., & Mouakket, S. (2010):
This paper highlights the importance of Technology Acceptance Model (TAM) factors alongside external factors in influencing student e-retention within the e-learning context in the United Arab Emirates (UAE). It examines the relative impact of TAM factors, enjoyment, and blackboard design on students' e-satisfaction and e-retention. Findings indicate that perceived usefulness has a direct positive relationship with both student e-satisfaction and e-retention, while perceived ease of use only directly affects e-retention. Design features and enjoyment significantly correlate with e-satisfaction but not directly with e-retention. Additionally, student e-satisfaction is directly linked to e-retention. However, the study's scope is limited to one university in the UAE, suggesting further research across diverse contexts is needed to validate findings. Nonetheless, the proposed model has the potential to aid UAE university managers in understanding factors influencing student behaviour towards e-learning systems, thus improving education quality in the UAE.

Nagy, J. T. (2018):
The study aimed to investigate the factors influencing students' use of educational videos and their satisfaction with learning, particularly within a Business Mathematics Course using Moodle. The research model extended the Technology Acceptance Model (TAM), incorporating perceived usefulness, perceived ease of use, attitude, and internet self-efficacy as explanatory factors for video usage. Additionally, factors such as learning performance, learner-learner interaction, and learner-teacher interaction were examined as determinants of learning satisfaction. Data from 89 students were collected via questionnaire, and partial least squares structural equation modelling was employed to analyse the research model. Results revealed that perceived usefulness, attitude, and internet

self-efficacy directly affected video usage, while learning satisfaction was influenced by learner-learner interaction, perceived ease of use, and learning performance. Furthermore, video usage significantly affected both learning performance and learning satisfaction. Overall, the findings suggest that the extended TAM model is applicable in predicting university students' behaviours.

Estriegana, R., et al., (2019):
This experimental study sought to examine students' acceptance of technology and the adoption process of an online learning environment that incorporates web-based resources, such as virtual laboratories, interactive activities, educational videos, and a game-based learning approach. An online questionnaire with responses from 223 participants was analysed using structural equation modelling. Although the study is based on the Technology Acceptance Model (TAM), it expands on TAM by including additional factors such as perceived efficiency, playfulness, and satisfaction. The results confirmed that this expanded version of TAM provides a valuable theoretical framework for understanding users' acceptance of an online learning environment that includes virtual laboratories and practical exercises. Additionally, the findings revealed that efficiency, playfulness, and student satisfaction positively influence the original TAM variables and their acceptance of this technology. The study further explores the theoretical and practical implications for the educational use of these web-based resources.

2.2 Research hypotheses and Conceptual model:

2.2.1 External variables:
First, in the adoption phase of a new technology of the TAM model, we seek to determine whether external variables, notably Facilitating conditions influence the two primary dimensions of the TAM model: perceived usefulness and perceived ease of use. External variables are defined as "the factors explicitly included in the model that are expected to impact behavioural intention and the use of technology, mediated by perceived usefulness and perceived ease of use" (Davis et al., 1989, p. 987).
Indeed, the external variables represent "*the factors explicitly included in the model which have an expected impact on behavioural intention and use of technology, through the meditation of perceived usefulness and perceived ease of use*" (Davis et al., 1989, p.987).
External variables are not limited to certain ones, as they can include several characteristics (Tarhini et al., 2015), such as organizational characteristics, information and telecommunications technology (ICT) characteristics, personal characteristics as well as other types.
We chose to examine the impact of the external variable "facilitating conditions" which Venkatesh et al. (2003, p. 453) define as "the degree to which a person believes that an organizational and technical infrastructure exists to support the use of the system." In our study, facilitating conditions are specifically defined as the extent to which students perceive the quality of the system, the quality of information, and the quality of services that support the use of the "PROGRES" platform. Therefore, we have adopted the following hypotheses:
H.1: Facilitating Conditions FChas a significant influence on the Perceived Usefulness PU.

H.2: Facilitating Conditions FChas a significant influence on the Perceived Ease of Use PEU.

2.2.2Perceived Ease of Use PEU:
Perceived Ease of Use (PEU) According to the TAM, perceived ease of use is a major factor that affects the acceptance of a new technology (Davis et al., 1989). This variable refers to "*The degree to which an individual believes that using a specific system requires minimal effort.*" As indicated in the TAM, we consider the PEU as a determinant directly influencing the Behavioural Intention BI to use the "PROGRES" platform and indirectly via the perceived usefulness PU; many previous studies have shown that the PEU influences the PU of a technology (Davis et al., 1989; Venkatesh and Davis, 2000; Schillewaert et al., 2005).
In fact, the less effort students expend when using the "PROGRES" platform, the greater their perception of its usefulness will increase. Subsequently, we propose the following hypothesis:
H.3: Perceived Ease of Use PEU has a significant influence on Perceived Usefulness PU.
H.4: Perceived Ease of Use PEU has a significant influence on Behavioural Intention BI.

2.2.3 Perceived Usefulness PU:
Perceived usefulness is an important variable in TAM that affects the acceptance of a new technology. Davis (1989, p. 320) defined perceived usefulness in TAM as "*The degree to which an individual believes that using a specific system would enhance their job performance*",we propose:
H.5: Perceived Usefulness PU has a significant influence on Behavioural Intention BI.

2.2.4Behavioural Intention BI:
In our study, there are three outcome variables of the TAM model: "Behavioral Intention" (BI), "Actual Use of PROGRES" (AUP), and "Student Satisfaction" (SS). BI is defined as the behavioural inclination to continue using technology in the future, and it serves as a key determinant of technology acceptance (Alharbi & Drew, 2014).
Previous studies have shown that BI is influenced by PU (Tarhini, Elyas, Akour, & Al-Salti, 2016), PEU (Wu & Zhang, 2014), and AT (Hussein, 2017).
Moreover, previous studies have confirmed that BI has a significant effect on actual use (Hussein, 2017; Letchumanan & Tarmizi, 2011; Sharma & Chandel, 2013; Taat & Francis, 2019). Subsequently, we propose:
H.6: Behavioural Intention BI has a significant influence on Actual Use of PROGRES AUP.

2.2.5Actual Use of PROGRES AUP:
Actual use of technologyfrom now on referred to as actual use of "PROGRES". In TAM, technology use is equivalent to the behavioural term in the theory of reasoned action, but for use in a technological context. PU, PU and BI directly influence this construct. Becausethe utilization of an online platform is contingent upon the intentions of its users, who are the students in our study (Harris, 2017). The interest and motivation of these students drive their engagement with the PROGRES platform,which is considered to bring benefits to

the learning process (Tao, 2009). Current usage here determines whether students are satisfied or not (Muntianah, Astuti, and Azizah, 2012). Then, we propose:
H.7: Actual Use of PROGRES AUP has a significant influence on Student Satisfaction SS.

2.2.6 Student Satisfaction:

According to (Malik, Danish, and Usman. 2010), satisfaction is characterized as a favourable outcome arising from performance, as noted by (Onditi and Wechuli. 2017). Recognizing the significant role of student satisfaction, educational institutions must diligently strive to attain it. This involves aligning the perceived quality of educational services with students' preferences and expectations. The more benefits students perceive from the offered services, the greater their level of satisfaction. Hence, bridging the gap between anticipated service quality and students' preferences is paramount in ensuring overall satisfaction.

3. Materials and Methods

In our study, we have adopted a quantitative methodology to investigate Algerian students' perceptions of the PROGRES platform. To validate our hypotheses, we designed a questionnaire administered to 500 respondents (students) over two months period. The questionnaire was disseminated through various channels including social networks, email, and face-to-face interactions. We employed a non-probability sampling method, specifically convenience sampling, to select participants for our study.

Subsequently, we will analyse the collected data using the Partial Least Squares (PLS) approach to model structural equations. PLS is a robust technique utilised for estimating dependence relationships among a set of concepts and constructs. We will utilise SMART software -PLS for this analysis. Structural equation modelling (SEM) has emerged as a fundamental tool in contemporary research due to its multivariate nature, offering a conceptually appealing framework for evaluating theories (Iacobucci, 2009). Our focus on PLS-SEM stems from its capability to simultaneously measure relationships between dependent and independent variables within the model (Safitri, S. et al., 2022), allowing us to assess the relevance of our theoretical model within the specific context of our study (Memon et al., 2021).

4. Results and Discussion

In structural equation modelling, the model consists of two sub-models: the measurement model, which assesses the reliability and validity of measurements, and the structural model, which tests the hypothesized relationships. During the analysis, we first evaluate the measurement model, which defines the relationship between manifest variables and latent variables essentially between the items and their corresponding variables. Subsequently, we analyse the structural model to investigate the relationships among the various unobserved (latent) variables (Hair, 2010):

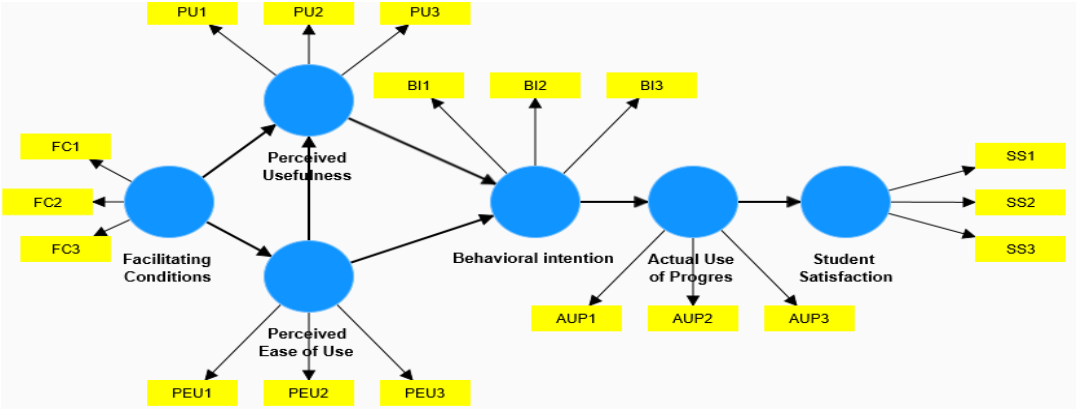

Fig. 1. Model research on Smart PLS

A. Measurement model analysis

1. Reliability and Convergent Validity:

- Reliability: This metric is defined by the extent to which the variance extracted by the construct outweighs measurement errors. As per Hair et al. (2017), reliability is deemed acceptable when both Cronbach's α and composite reliability exceed 0.7, indicating good reliability. The values of Cronbach's α and composite reliability (CR) obtained from our PLS-SEM measurement model are displayed in the Table below.
- Convergent validity: This assessment aims to ascertain whether manifest variables effectively measure their respective constructs. Following the criteria outlined by Fornell and Larcker (1981), strong convergence is indicated when the Average Variance Extracted (AVE) is greater than or equal to 0.5, signifying good convergent validity.

Table. 1 Reliability and validity of the construct

	Cronbach's alpha	*Composite reliability rh_a*	*Composite reliability rh_c*	*Average variance extracted AVE*
FC	0.835	0.904	0.895	0.685
PU	0.935	0.914	0.904	0.775
PEU	0.872	0.892	0.867	0.592
BI	0.831	0.803	0.874	0.614
AUP	0.901	0.892	0.913	0.654
SS	0.816	0.869	0.857	0.708

According to the findings presented in Table 1, it is evident that all reliability indices (Cronbach's α, Rho-A, and Composite Reliability) in our model exceed > 0.7, while the values of AVE for convergent validity surpass > 0.5. These results indicate highly satisfactory outcomes, demonstrating robust internal consistency of the scales and significant coherence among the items.

2. Discriminant Validity:

To assess discriminant validity, we employed the Fornell-Larcker test (1981), which examines whether the measurement indicators of a construct exhibit

higher correlations with each other than with indicators of other constructs. The results of our model are displayed in Table 2.

Table. 2 The Discriminant Validity of Constructs

	FC	*PU*	*PEU*	*BI*	*AUP*	*SS*
FC	0.822					
PU	0.378	0.757				
PEU	0.661	0.368	0.871			
BI	0.601	0.408	0.415	0.843		
AUP	0.742	0.647	0.388	0.398	0.867	
SS	0.544	0.332	0.569	0.447	0.501	0.711

The findings indicate that the manifest variables are more closely associated with their respective constructs than with other latent variables. As illustrated in the table above, each construct's Average Variance Extracted (AVE) was compared to the squared correlation with other constructs, and the AVE was consistently higher.

B. Structural model analysis:

As outlined by Hair et al. (2017), this examination centres on correlation coefficient values, analysis of the determination coefficient R^2, Cohen's effect size index F^2, and the predictive validity Q^2 according to Stone-Geisser.

1. Analysis of the determination coefficient R^2:

This tool is widely utilized for assessing the structural model, representing the proportion of variance in a dependent variable that is accounted for by one or more independent variables. As stated by Chin (1998), values of 0.67, 0.33, and 0.19 are indicative of substantial, moderate, and weak explanatory power, respectively.

Table 3. The determination coefficient R^2:

	R-square	*R-square adjusted*
PU	0.613	0.757
PEU	0.220	0.368
BI	0.513	0.408
AUP	0.711	0.647
SS	0.344	0.332

In our model according to table 3, the model explains 0.7 variance for AUP, 0.61 variance for PU, 0.5 variance for BI, 0.34 variance for SS and 0.22 variance for PEU. So our dependent variables are well explained by the independent variables.

2. Analysis of the size of the effect F^2

The analysis of effect size F^2 serves to gauge the magnitude of impact, as delineated by Cohen (1988): an F^2 greater than 35% indicates a large effect size, while values between 15% and 35% suggest a medium effect size. Effect sizes

falling between 2% and 15% indicate a small effect, whereas an F^2 below 2% signifies no discernible effect size, as per Hair et al. (2017).

Table. 4 The size of the effect F^2

F-	*square*				
	PU	*PEU*	*BI*	*AUP*	*SS*
FC	0.478	0.359			
PU			0.758		
PEU	0.612		0.594		
BI				0.330	
AUP					0.299

In our model, as shown in Table 4, the values of F^2 indicate that the effect size ranges from medium to large: specifically, the effect of facilitating conditions (FC) on other variables (perceived usefulness (PU) and perceived ease of use (PEU). As well as the values of F^2 for PU on behavioural intention (BI); and the values of F^2 for PU on BI; and the values of F^2 for PEU on PU and BI are large size effect. Moreover, the values of F^2 for BI on AUP and AUP on SS are medium size effects.

3. Predictive Relevance Q^2Analysis:

The Stone-Geisser coefficient Q^2, referred to as the cross-validation redundancy index, indicates predictive validity when Q^2 is greater than > 0. Conversely, if Q^2 is less than > 0, it suggests that the model under examination is not acceptable, according to Hair et al. (2017).

Table 5. Predictive Relevance Q^2

	SSO	*SSE*	*Q-square*
FC	980.000	980.000	0.000
PU	1,225.000	966.089	0.187
PEU	1,970.000	1,254.683	
BI	980.000	655.764	0.331
AUP	1,369.000	1,200.000	
SS	1,960.000	1,334.683	0.319

In our model study, as outlined in the preceding table, the Q^2 values exceed 0. This signifies substantial predictive validity, indicating that the model can predict the dependent variables. It seems that the model effectively demonstrates its predictive ability to explain the dependent variables.

C. Hypothesis testing:

To test the hypotheses of the model, it is essential to check the values of P value which must be < 5% and T value which must be >2.

Table 6. Total effect

	Original sample (O)	*Sample mean (M)*	*Standard deviation (STDEV)*	*T statistics*	*P values*	*Hypothesis test*
FC=> PU	0.077	0.077	0.024	3.258	0.001	H.1 validated
PU=>BI	0.619	0.614	0.027	22.681	0.000	H.5 validated
PEU=> PU	0.662	0.461	0.023	14.979	0.000	H.3 validated
PEU=>BI	0.459	0.460	0.036	12.658	0.000	H.4 validated
BI=>AUP	0.370	0.371	0.036	10.201	0.000	H.6 validated
AUP=>SS	0.562	0.562	0.033	16.979	0.000	H.7 validated
FC=>PEA	0.416	0.469	0.057	12.708	0.000	H.2 validated

From the previous table, we were able to notice that all the values respect the required threshold, and therefore all the hypotheses are validated. All of our retained empirical results confirm the results of the literature review, namely:
Our results confirmed the essential role that facilitating conditions FC play in perceived usefulness PU and perceived ease of use PUE, we were able to confirm that FC has a large and positive influence on PU and PEU, therefore H1 and H2 are confirmed. The PEU influences theBehavioural intention BI in a direct way and an indirect way via the PU. The PU in turn positively influences the BI, therefore hypotheses H3; H4 and H5 are validated. BI has a direct influence on the actual use of PROGRES AUP, which confirms hypothesis H6.
All these results lead to student satisfaction with the PROGRES platform, and H7 is validated.

5. Conclusion

The objective of our study was to analyse student satisfaction with digital platforms in Algeria. The research followed the quantitative approach where a survey was distributed to Algerian students; the proposed hypotheses were tested using structural equations with SMART PLS software.The results confirmed the presence of strong positive relationships among the various variables of the TAM model. Consequently, the perceived ease of use and perceived usefulness, along with the presence of facilitating conditions, enhance the intention of Algerian university students to utilize the PROGRES digital platform, the results have shown that students are satisfied with PROGRES platform.

Our theoretical contribution enriches the theory of technology acceptance. In this sense, we used the TAM model, with some adaptations to the context of the research subject, adding a dependent variable, which is "satisfaction." Our methodological contribution is centred on employing structural equation modelling with the PLS approach to assess the relevance of the studied model. This entails examining the various relationships that exist between the variables.

We invite all universities to:Invest in robust digital infrastructure like the PROGRES platform: Strong IT infrastructure is essential to support digital systems and platforms. This includes high-speed Internet access, secure servers and reliable software.Adopt learning management tools: Learning management platforms offer features such as online course delivery, assignment and test

management, and communication between students and teachers. In addition, facilitate access and accessibility.

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