# Algerian students' satisfaction with using ICT in higher education: the application of the technology satisfaction model

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**Abstract:** Research has shown that students have the potential to benefit from the incorporation of Information and Communication Technologies (ICTs) into their environment. However, there has been limited research on how students are actually using technologies and what factors influence their satisfaction with these technologies. This study aims to explore the use of ICT, with a focus on learning satisfaction, among Algerian students at a university. A field study was conducted to gain familiarity with quantitative data and information. A sample of the university's students was chosen and analysed using Structural Equation Modelling (SEM) to see how satisfied they were with using ICT facilities, and thus provide insight into the way other universities may take advantage of the results obtained through the Technology Satisfaction Model (TSM). This study concludes that students' satisfaction depends on their CSE, Perceived Ease of Use (PEU) and usefulness of ICT and then provides some recommendations. First, responsible authorities should implement new technology across all levels of education to offer training and capacity-building programs for students. They should also adopt and disseminate learning technologies for students' benefit as well as qualify management so that international standards can be met with regards to university outcomes.

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# 1    Introduction

The use of information technology in higher education in Algerian universities is at an early stage in terms of achieving academic and research goals spite a lack of information and digital literacy education and ICT training for students in academic institutions. The use of ICT modernises students' learning and increases interest in e-commerce, thereby improving skills and educational standards (Lumbantobing et al., 2023; Quines and Tubo, 2024). Apart from academic institutions, the economic sectors have not experienced any significant developments in terms of digitisation, with the exception of some sectors such as health, industry and services, where some activities are gradually shifting to new Information and Communication Technologies (ICTs) that bring added value to Algeria (Sabiha and Oualid, 2022). For many decades, the academic community believed that introducing the latest technologies and integrating them into the learning, teaching and research sector was necessary to expand students' and teachers' knowledge (Rafi et al., 2020; Islam et al., 2019; Bin et al., 2020; Islam et al., 2020; Chen et al., 2020; Xu et al., 2021; Du et al., 2022). This situation was further confirmed during the COVID-19 pandemic when all organisations, including academic and health, were closed and academic activities were managed online. This situation forced the education sectors to adopt ICT to sustain online learning and research, which eventually improved the use of technology and reshaped government and private institutions, necessitating their preparation for similar crises in the future. Likewise, people chose technology and used platforms such as social media, mobile devices, and computers to interact with customers in a digital environment and collaborate with others to develop digital skills such as ICT (Sakaya, 2022). In that context, developing countries always fell behind in the use of technology or innovation, such as Algeria, where students are not satisfied with the use of ICT due to the lack of technology-related training. ICT improves the learning process, such as internet search and browsing, social networking, data cloud storage, Google Classroom interaction and talking, etc., (Bakaul, 2018). To facilitate the Algerian public's and students' entry into the world of information technology, the government undertook several initiatives from 2004 to 2014 within the framework of internet projects under the Ministry of Education and Culture (Ghomari, 2015). Students pursuing a degree in Algeria are often reluctant to use technology as part of the learning process due to their below-average technology-related abilities and worry about how to use technology in learning, mainly when they first encounter it. Algerian universities need to carry out innovative reforms by investing more in the academic sector to improve teachers' and students' performance and ensure their satisfaction with learning through using the latest technologies. While most universities around the world are strengthening their ties with business, opting for excellence, supporting students in completing their projects, developing technologies, tools, regulations, etc., Algerian higher education faces several challenges that universities in other countries may not (Megnounif et al., 2013). It was found that in Algerian universities, students who used ICT after entering the classroom showed moderate results compared to those who did not show interest in using technology. Higher education authorities are assisting Algerian universities in the use of technology to improve teaching, learning and research, which requires careful study of the solid strategies of the world's developed countries. The academic community believes that many students entering universities need ICT training, as well as guidance in the utilisation of database resources to complete research and related

tasks. Rahman and Dar (2022) and López-Sánchez et al. (2023) disclosed that ICT training in higher education has proven to be an important factor.

Exposure to technology in daily life is the best way to embrace technology in the education system and to benefit students academically and professionally in a technology-centric age. As smart technology becomes ubiquitous, it is imperative that people of all ages understand how to use technology and develop the specific technical skills needed to use ICT in everyday activities, studies and work (Tsinonis, 2018).

Algeria has faced many challenges such as lack of infrastructure, power outages and other economic and financial crises that have directly affected the education system. Since the outbreak of COVID-19, policymakers in Algerian universities have been unable to manage online classes due to the lack of government collaboration and ICT skills among professors and students during the pandemic (Ghounane, 2022). Taking into account the current situation in Algerian universities, this study is conducted in accordance with the l TSM propounded by Islam (2014) for improving the ICT skills of teachers and students, which has proven to be a significant contribution to the deployment of technology in academic settings.

## 2    Literature review

The Ministry of Scientific Research and Higher Education of Algeria sought to allocate a budget for equipping universities with network technologies to improve educational activities. The application of ICTs in higher education is relatively new in Algeria in terms of the introduction of the latest technologies and their integration with teaching, learning, and research. Mohamed (2015) studied how, as in other developing countries, the Algerian academic administration has considerably delayed the use of ICT in various academic. Along with education, teaching, and learning, ICT also brings innovations in organisational structure and people's living standards to make them useful citizens of the state. The country is gradually moving towards the development of a learning culture in which ICT is used as an integral part of education, which has improved the use of ICT in academic institutions. Abdelkader (2015) insisted on the importance of integrating ICT into higher education and ensuring sound planning to support learning and research. Although the use of ICT has increased due to integration of modern technologies into the learning process, Algerian students are not satisfied with the use of ICT in Universities, as they have not been trained in modern technologies. Additionally, technology integration has important implications for teachers' learning and instructional strategies, performance and student engagement (Panakaje et al., 2024). We believe that ICT applications in academic institutions attract students using online resources that directly improve the quality of learning and novelty of thinking. Teachers and students are national assets who can bring about a national technological revolution through constructive and creative planning in the practical application of knowledge through ICT.

However, identifying factors that influence sustainable use of ICT in university settings is challenging due to limited engagement with technology. Abad-Segura et al. (2020) investigated how the digital transformation of the education sector involves sustainable management to adapt to the changes brought about by new technologies. In this regard, several impediments to significant progress in teaching and learning using ICTs have been identified. On the other hand, a major barrier to the integration of

technology is university faculty's lack of understanding of how to use technology in teaching, mainly due to the lack of training in ICT (Islam et al., 2022). Modern academic institutions operate effectively, with more transparent accountability and more efficient teaching and research. In light of the technological dynamism and the high involvement of most organisations in the use of ICTs after the COVID-19 pandemic, the passive approach of Algerian students to the use of technology needs to be explored. Now, given the current post-COVID-19 situation, higher education authorities are providing ICTs to Algerian universities to ensure that students use these tools to improve the quality of instruction, learning, and research. The TSM (Islam, 2014) can be validated to examine students' satisfaction with ICT use, and come to an understanding of the TSM model. This research aimed to explore the extent to which ICTs play an important role in teaching/learning or research enhancement and to develop new strategies based on the use of the TSM to modernise the learning environment in universities. Rafi et al. (2019) recommend the latest information and digital literacy training for students entering universities, as well as for teachers, on the use of database resources and distance learning. The most important part of this process is the use of technology in the first and second stages; students need to become familiar with technologies to increase their efficiency and increase satisfaction with ICT. The use of ICT in Algeria has changed significantly over the past decade, which has played a key role in the development of higher education.

## 2.1   The technology satisfaction model (TSM)

Over time, various researchers have developed a number of theories in the information technology field, such as the Technology Acceptance Model (TAM) (Davis et al., 1989), the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003) and the Diffusion of Innovation Theory (Rogers, 2003). Among these theories, perhaps the most popular has been the TAM in terms of efficiency and quality in working with technologies and their deployment in various organisations. These three models focus on technology acceptance rather than satisfaction, without shedding light on the adaptation of the TSM as suggested by (Islam, 2014), which refers to the TAM and social cognitive theory (Bandura, 1986), as shown in Figure 1. The TSM seems to be an important model for explaining student satisfaction with Asian higher education institutions. It is worth emphasising that Islam (2014) defined this model, which combines two psychological factors – computer satisfaction and self-efficacy – with two driving variables from the TAM, namely (PU) and (PEU) – a broad theoretical principle that has been widely used to predict human behaviour in various contexts. In other words, a high level of implementation can lead to a satisfying experience. The TAM is one of the most widespread and versatile models for predicting a person's intention to use a technology. It includes two defining factors: PEU and usefulness relevant to a particular technology. Despite the TAM's explanatory power in determining what might elicit acceptance among teachers and students, some critics argue that it ignores psychological factors such as Computer Self-Efficacy (CSE) in predicting ICT adoption as well as usage intentions among high school teachers (Scherer and Teo, 2019; Eraslan and Kutlu, 2019). Established on the foundation of the TSM, the TSM measures the use of ICT and student satisfaction with them (Islam et al., 2018). They argued that most studies were conducted to assess the use of technology or the adoption of ICTs by university students for tutoring, literacy and investigation purposes. In addition, it is important to explore the

manner in which students may be dependent on the use of technology, as it is difficult to guarantee the extent to which students will be satisfied with the use of ICTs in higher education. The three factors that determine user satisfaction with technology in higher education according to the TSM are PU, PEU and CSE. These three variables make up one external variable and two mediating variables in determining student satisfaction with ICT. In the research, satisfaction refers to whether the learner feels the technology is in line with their existing values, needs and experiences (Islam et al., 2018). TSM includes an exogenous variable known as CSE along with PEU and PEU as proxy variables, while SAT is an endogenous outcome measure for this study. In the future, more universities from other regions should be included to increase its validity. However, such measures need to be constantly tested and will henceforth be emphasised given all the data indicating how central higher education institutions are performing in terms of comparative scores across different countries (Islam et al., 2019).

**Figure 1**　TSM adapted from Islam (2014) (see online version for colours)
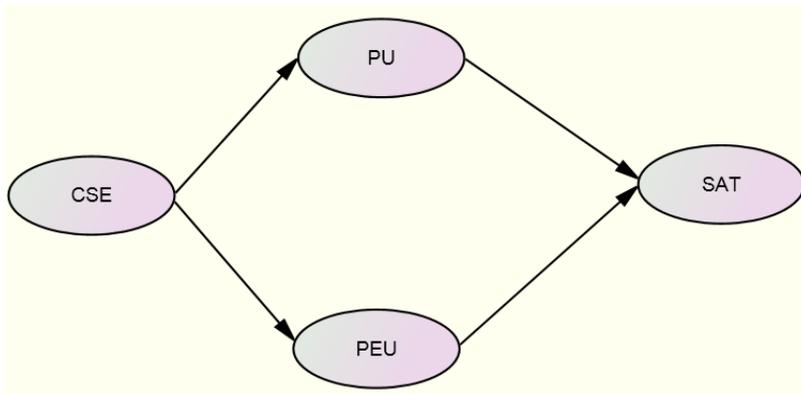


## 2.2   Research hypotheses

This study follows the TSM; a conceptual framework used to measure and understands user satisfaction with technology. It provides information about the factors that influence user satisfaction and how they interact with each other using ICT. The model can help academic management develop the best technological solutions that meet users' needs and expectations. Considering the highly technological implication of this model as discussed above, the authors based the entire study on the TSM model and asserted several assumptions to guide the study, as given below:

*H1: Algerian students' satisfaction would be associated with their PEU of ICT.*

*H2: Algerian students' satisfaction would be associated with their PU of ICT.*

*H3: Algerian students' CSE would be associated with their PU of ICT.*

*H4: Algerian students' CSE would be associated with their PEU of ICT.*

## 3    Methodology

ICT is a common tool nowadays that is used in many organisations apart from educational institutions. Keeping its rising importance in view, this study was conducted to understand the satisfaction level of Algerian degree students in using ICT in academic research. To begin the study, all the relevant published literature and the developed TSM model were analysed in depth. The authors adapted the research tools based on the Algerian university students' academic competence in using technology in teaching, learning and research. Following a five-point Likert scale (1: strongly agree to 5: strongly disagree), the research instrument was adapted from prior studies (Islam, 2015, 2016). The population sample includes all students who had joined Ain Al-Dhehab University in Medea. The quantitative part of the study included a five-section survey designed to assess students' satisfaction with ICT including 1) a demographic profile of respondents; 2) PEU of ICT facilities; 3) PU of ICT; 4) CSE and 5) ICT satisfaction following the previous studies (Islam, 2015, 2016) .

### 3.1    Data collection

After being approved by the research supervisor, the research instrument was translated into Arabic to enable respondents to fill out the research questionnaire, after which it was distributed to them. We used social media, i.e., WhatsApp, and shared the research instrument link in the group with a request to fill out the questionnaire. In addition, students were assured that their privacy would be maintained and that the data collection was only for research purposes. The study population consisted of students from all disciplines in Ain El Dhehab University in Medea. The sample consisted mainly of male and female students whose ages ranged between 21-years-old and 36-years-old. The sampling procedure was established by surveying students of each discipline and then selecting those who agreed to participate in the study. Students were selected from different faculties depending on their majors so that no single group was overlooked or underrepresented. The whole data collection process took one month, and we received 200 responses out of 500 students selected.

### 3.2    Data analysis

Data collected by students from various departments of the University of Ain El Dehehab were analysed using SEM to check the effects of independent variables for dependency, as shown in the model. All hypotheses that have been developed and associated with TSM were confirmed using SEM software to understand whether the results support the conceptual model. This makes it clear that the observed variables are sufficient to develop a rigorous model.

## 4    Results

### 4.1    Validation of the measurement models

A confirmatory Factor Analysis (CFA) was run for each of the 4 measurement models (see Table 1). The four CFA models fit to the data found in this study: CSE, PU, PEU

and SAT. A few items were removed due to violation of estimation. For instance, CFA1 (CSE): $\chi^2 = 11.094$; df = 5; $\chi^2/df = 2.218$; $p = .050$; RMSEA = .078; TLI = .985 and CFI = .993. CFA2 (PEU): $\chi^2 = 39.708$; df = 20; $\chi^2/df = 1.985$; $p = .005$; RMSEA = .070; TLI = .979 and CFI = .985. CFA3 (PU): $\chi^2 = 29.539$; df = 14; $\chi^2/df = 2.109$; $p = .009$; RMSEA = .074; TLI = .980 and CFI = .987. CFA4 (SAT): $\chi^2 = 13.151$; df = 8; $\chi^2/df = 1.643$; $p = .107$; RMSEA = .057; TLI = .989 and CFI = .994. After validating these four models, this study interrelated all of them to test the convergent and discriminant validity which is called four-factor measurement model ($\chi^2 = 533.320$; df = 269; $\chi^2/df = 1.982$; $p = .000$; RMSEA = .070; TLI = .942 and CFI = .948), but the model was revised for the better performance ($\chi^2 = 323.101$; df = 183; $\chi^2/df = 1.765$; $p = .000$; RMSEA = .062; TLI = .962 and CFI = .967).

**Table 1**　The results of CFA

| | $\chi^2$ | df | $\chi^2/df$ | $p$ | RMSEA | TLI | CFI |
|---|---|---|---|---|---|---|---|
| CSE | 11.094 | 5 | 2.218 | .050 | .078 | .985 | .993 |
| PEU | 39.708 | 20 | 1.985 | .005 | .070 | .979 | .985 |
| PU | 29.539 | 14 | 2.109 | .009 | .074 | .980 | .987 |
| SAT | 13.151 | 8 | 1.643 | .107 | .057 | .989 | .994 |
| Four-factor measurement model | 533.320 | 269 | 1.982 | .000 | .070 | .942 | .948 |
| Revised measurement model | 323.101 | 183 | 1.765 | .000 | .062 | .962 | .967 |

The results of CFA identified 21 valid items and their (CR) and (AVE) as shown in Table 2.

**Table 2**　Valid items

| Items | Loadings | CR | AVE | Alpha |
|---|---|---|---|---|
| SAT4 | .82 | | | |
| SAT5 | .86 | .902 | .698 | .899 |
| SAT6 | .85 | | | |
| SAT7 | .81 | | | |
| PU1 | .86 | | | |
| PU2 | .91 | | | |
| PU5 | .84 | .938 | .716 | .938 |
| PU6 | .89 | | | |
| PU10 | .76 | | | |
| PU11 | .80 | | | |
| PEU1 | .81 | | | |
| PEU2 | .83 | | | |
| PEU3 | .88 | | | |
| PEU4 | .88 | .941 | .694 | .939 |
| PEU5 | .80 | | | |
| PEU6 | .80 | | | |
| PEU9 | .83 | | | |

**Table 2** Valid items (continued)

| Items | Loadings | CR | AVE | Alpha |
|---|---|---|---|---|
| CSE1 | .88 | | | |
| CSE2 | .90 | .929 | .765 | .928 |
| CSE3 | .88 | | | |
| CSE8 | .83 | | | |

## 4.2   Hypotheses testing

Figure 2 indicates the results of hypotheses testing through the TSM as estimated using SEM. All the proposed hypotheses for this study are valid and consistent with the original TSM propounded by Islam (2014). Algerian students' satisfaction is associated with their perceived ease of use of ICT ($\beta = .52$, $p \leq .001$). Similarly, Algerian students' satisfaction is also associated with their PU of ICT ($\beta = .38$, $p \leq .001$). On the other hand, Algerian students' CSE is strongly associated with their PU of ICT ($\beta = .96$, $p \leq .001$). Additionally, Algerian students' CSE is also associated with their PEU of ICT ($\beta = .94$, $p \leq .001$).

**Figure 2**   TSM (see online version for colours)
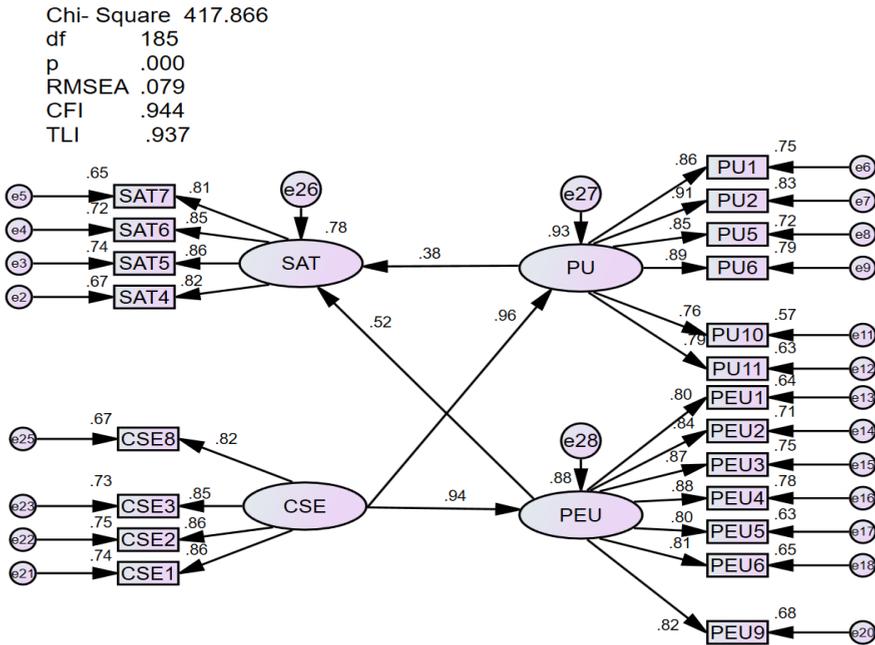
## 5   Discussion

In the age of satellite communications, the incorporation of technology into academic activities has transformed academic learning, lecturing and research. In addition to corporate executives' satisfaction with service quality, ICT is also increasingly popular among students and teachers in the education sector (Swai et al., 2022). A wide range of literature was reviewed for the study to examine the use of technology in academic settings, including the ODAS model for the use of online resources using ICT in the context of developing countries (Rafi and Najmaldeen, 2023). Given the increasing importance and active inclusion of technology in academic research, this study was conducted to examine the TSM and its application among Algerian students. The study was based on the four research hypotheses associated with the model to validate the relationship between exogenous variables such as CSE and endogenous variables such as satisfaction and the mediating variables such as PEU and PU. The results of the TSM advance the understanding of university students' perceptions of ICT use, as recent studies have shown that CSE is indirectly related to feelings of satisfaction with academic achievement (Bin et al., 2020; Chen et al., 2020). The study revealed that CSE directly influences the PEU and PU of ICT. In other words, those university students' perceptions of how easy ICTs are to use and how useful they are depending on their belief in their ability to make these technologies work for them.  Increasing enables incremental competency gains among university students through the use of technology, ultimately leading to quality improvements and reforms in the use of ICT by faculty and students. This study, which proves that user perception is related to satisfaction with using ICT tools, has confirmed that new technologies are accepted, adopted and satisfied when the user's experience is considered in terms of PEU and PU (Chen et al., 2020). Using the TSM, it was not difficult to find that the ease of computer use or the additional benefits of the technology determine students' satisfaction; however, there is one exception where usefulness is more effective than ease of use when it comes to influencing user experience, as shown in this study (Islam, 2014). This result is consistent with recent studies of wireless internet, online research databases and digital technologies in higher education even though there were no direct relationships found between CSE and satisfaction; nevertheless, it could have a positive effect on university students' perception of their ease in using ICTs (Islam, 2014; Jiang et al., 2021).

## 6   Conclusion

ICTs are playing an increasingly important role in higher education to modernise the student body by introducing the latest technologies in various ways, such as ICT training, mobile applications and internet-based distance learning to support education. This study showed that Algerian students generally have a positive attitude towards the use of ICT in higher education, with over 78% of students indicating satisfaction with the use of ICT in the university. Algerian universities are experiencing difficulties due to limited funding, lack of trained staff and lack of administrative support from the government in the field of ICT. Insufficient funding, lack of appropriate equipment, and other constraints have emerged as pressing barriers to the use of ICT by students at different universities (Alsobaihai and Agrawal, 2017). Despite limited resources and lack of administrative co-operation, research has suggested that students potentially benefit from

the integration of ICT in academic institutions, as the study concludes that student satisfaction depends on their CSE, PEU and PU. For students to improve and develop technology-based skills, regular training and capacity-building programs are needed at all levels of educational institutions in Algeria.

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