Influencing factors in perceived learning mediated by satisfaction in university students in times of Covid- 19

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Abstract*– There are different factors that directly influence student satisfaction and their perceived learning, in times of pandemic, educational models in their implementation and practice have been reoriented to an eminently online education. In the present investigation, arising from a collaboration between higher education teachers, it was detected that such factors as the use of ICT, productivity and creativity in learning, openness to novelty and especially technological stress, would reasonably influence in the endogenous variables of the proposed model. Under a non-experimental research design, an electronic questionnaire (n=25; α=.952; ω=.953) is applied to a sample of 300 university students (Arequipa, Peru). The results, in agreement with previous studies, show that factors such as the use of ICT, student satisfaction, exert a positive influence on perceived learning, unlike productivity, creativity in learning and technological stress would not exert favorably on perceived learning. Regarding student satisfaction, factors such as openness to the novelty of ICT, creativity, and the use of ICT, would exert a positive influence on satisfaction, unlike productivity in learning. In conclusion, the idea of inquiry and search about the key influencing factors in dependent variables for educational development in times of Covid-19, such as perceived learning and student satisfaction in university education, is highlighted.

Keywords*-- Perceived learning, student satisfaction, technological stress, learning productivity, learning creativity, Openness to the novelty of ICT, Covid-19, PLS-SEM.

I. INTRODUCTION

The presence of Covid-19 in the educational context has resulted in a modification of the current educational models, of radical and opposite changes, such as moving from face-to-face educational activities to non-face-to-face and virtual modalities, perhaps this could be one of the most significant changes in education in recent years. Today more than ever, as an attitude of openness to the novelty of ICT, is the establishment of the relationship between Information Technology (IT) and creativity in learning, there are studies that highlight the degree of innovation of the students showed as inventive mind, cognition building and increased utilities and technological discovery processes[1]. On the other hand, virtual education is analyzed and promotes group learning, learning outside the classroom, direct and respectful conversations, creation and invention, as forms of knowledge for life[2]. Along this line of thinking, other factors are added such as the use of ICT, productivity and creativity in learning, openness to novelty as a key aspect of educational development, and on the other hand,overcoming technological stress, caused by internal and external variables, the same ones that influenced the student's satisfaction and the student's perceived learning.

The inclusion of ICT is no longer just a support tool for the teaching-learning process, but it is a didactic-pedagogical system, it must consider the contextual implications in which students and teachers operate[3]. Information and communication technologies (ICT) have become an inevitable part of social work[4], the correlation between access to ICT and academic performance varies according to the type of student and the area of knowledge ICTs Ariza[5] have contributed significantly to different neuralgic aspects, in the educational context and that the applications in the pedagogical processes are increasing[6] Thus, technological literacy was quite acceptable to students and teachers. Martinez-Serrano[7], meanwhile, teachers are increasingly aware of the importance of adapting teaching and learning to the environment and the reality of the students [8]. According to the study by González, the results obtained in this study suggest that the use of information and communication technologies in the teaching of medical sciences, such as virtual tools of Google Groups, increases academic performance in these students[9].

Likewise, there are studies about the implication of IT associations in the increase of innovative and creative skills of university students, such as applying new technology and teaching future workers in their work performance[10]. Abedine aims to differentiate the innovation skills of virtual and classroom university students. The former have outstanding innovation, they are provided with better technological learning than those in the classroom[11]. Similarly, the study about the use of memes can help students learn various literacies and development of mental processes, promote social justice, innovation, emotional intelligence, among others[12]. Jeong provides, through an analysis, the relationship between the use of mobile devices by university students and thinking skills of high cognitive demand through their implication and learning spirit[13]. Another study aims to specify the influence of collaborative creativity learning models to condition the learning effect of student research innovation[14].

The openness to novelty as a primary reason for the incorporation of ICTs into daily educational processes is the establishment of the relationship between IT and productivity in learning, in this case the role of WhatsApp in significant learning and encourages work, interaction, group collaboration,

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in order to achieve university triumphs and perceived learning[15], on the other hand, Al-Labadi analyzed that the advancement of technology, the university students noticed help and improvement in the exercise and thematic understanding, adding a computer program in their learning[16].

The relationship of IT and learning satisfaction; Rushidi, studied the relationships between the dimensions of impartiality, representation, satisfaction with service rehabilitation, user behaviors and information between the consumer and the supplier to improve and maintain competitiveness[17]. Ploj examined the factors that influence the voluntary choice of online teaching in times of pandemic, teachers have become familiar with their teaching procedures in virtual mode[18]. The Flipped Classroom applied in different contexts as a teaching method, it was very well received by students and the teacher takes into account planning, themes, strategies, resources, early delivery and formative evaluation[19], for their part Ramraj and Marimuthu, examined the students' position on the importance of technological skills in the academic program to guarantee subsistence in the labor field, in the industry and improve their critical thinking[20].

Perceived learning and its relationship with IT, Baquir researched the current registration with a means of storage in the cloud in higher education to increase its performance in a competent and valuable way to share university activities[21], on the other hand, Agile, proposes an approach for business societies, since it supports staff to fill out, easily adapt to variety, provide university students with skills in their performance[22]. Regarding productivity in perceived learning, with the Flipped Classroom (FC) model, productivity in perceived learning contributed to the development of a series of skills such as autonomy, responsibility, organizational skills and teamwork[23], such that online student engagement is one of the strongest determinants of perceived student learning productivity, because in online classes there is no physical socialization[24].

With cooperative learning, the direct and positive influence on the subjective learning result perceived by the student and the indirect influence on the objective result or productivity in the learning achieved by the student is evidenced[25]. Thus, the use of applied software (Microsoft Teams), presented a good percentage of student satisfaction due to the productivity of learning since the students could handle it easily and intuitively in the development of their activities[26].

Student satisfaction and the impact on perceived learning have established a determining aspect in CSCL (Computer Supported Collaborative Learning). For this study, multivariate analysis was used through structural equation modeling, with the partial least squares (PLS) technique[27], Maqableh and Alia, point out that productivity in learning shows that more than a third of students are dissatisfied with the online learning experience[28]. Productivity in online learning was affected by unstable internet connection, lack of motivation and lack of instructions, so the satisfaction of medical school students was moderate[29].

As an opening to novelty in this educational context, the application of the Flipped Classroom (FC) model has great potential from different levels, such as productivity in student learning, achieving very good satisfaction[23]. In the same way, the interaction, the motivation to participate, the structure of the course, the facilitation and the knowledge of the teacher are decisive for the productivity in learning and the satisfaction of the students[24]. To measure satisfaction with university life, other constructs must be considered, such as academic performance and motivation to study[30].

In the study of technostress with differential equation modeling. It was shown that the Technological insecurity decreases job satisfaction, while inhibitors increase it, and that job satisfaction positively affects the job commitment of ICT users. For Feng, the study of the widespread use of ICT that can create "techno-stress", the researchers opined that technostress negatively influences the performance of managers. For this reason, the relationship between satisfaction and job performance can be highlighted[31]. On the other hand, Salazar warns that the bibliometric analysis of records indexed in the Scopus database. The main contribution is the scientific map of technostress and a detailed understanding of the scientific production. It is important to highlight that satisfaction with dependence on technology[32].

Villavicencio propose through a study of technostress in Mexico and affirmed that there is the presence of technostress. Likewise, it was found that people with a higher level of schooling, managers, and independent entrepreneurs presented greater technoanxiety, technofatigue and technoaddiction. The results constitute satisfaction [33]. On the other hand, Araoz, in a study of technostress in students from the Peruvian Amazon during the COVID-19 pandemic, found that there were low levels of techno-anxiety and moderate levels of techno-addiction and techno-fatigue, and they conclude that some preventive and corrective measures should be taken in well-being and student learning[34].

In the study carried out on the level of technostress in a University of Mexico, due to COVID-19 and teaching-learning in virtual mode, a high level of stress was found in teachers and to a lesser extent in students. Technostress is a psychosocial risk factor. On the other hand, the study carried out in Mexican university students, of the level of technostress and addiction due to the use of Information and Communication Technologies (ICT) in teaching-learning processes, it was determined that it is essential to recognize that ICT will produce positive and negative effects in teachers and students[35]. Regarding work technostress and the mandatory virtuality of prevention of Covid-19 in university teachers in Medellín. The causes were identified that included the constant or inappropriate use of ICT. For these reasons, new teaching-learning strategies should be used to reduce technostress[36].

From the point of view of teaching-learning, in the study of a Peruvian university, it was analyzed as part of the impact

of new technologies, and it was concluded that there is a relationship between teaching technostress and the perception of the quality of educational service[37]. Thus, resources, autonomy and work-life balance are characteristics of telework that increase technostress in terms of fatigue, anxiety and inefficiency. These effects involve learning.

The perception of learning by the student is the result of subjective learning[38], such that creative thinking skills play an important role in modern society[39]. The virtual environment is an exceptionally useful tool to provide a radial and comprehensive view of the teaching-learning process [40]. Thus, the acquisition of knowledge is mediated by creativity[41].

Satisfaction helps students to develop skills and improve their academic performance, hence the importance of evaluating it using a reliable instrument[42]. Thus, Structural Equation Modeling (SEM) for hypothesis testing proposes a model where student satisfaction is the result of perceived quality and perceived value; and where fidelity is a consequence of satisfaction[43]. Based on the above considerations, the following hypotheses are formulated:

H1. The openness to the novelty of IT positively influences creativity in Learning.
H2. Openness to the novelty of IT positively influences productivity in learning.
H3. Openness to the novelty of IT positively influences student satisfaction.
H4. Creativity in learning positively influences perceived learning.
H5. Creativity in learning positively influences productivity in learning.
H6. Creativity in learning positively influences student satisfaction.
H7. Productivity in learning positively influences perceived learning.
H8. Productivity in learning positively influences student satisfaction.
H9. Student satisfaction positively influences perceived learning.
H10. Technological stress positively influences perceived learning.
H11. Technological stress positively influences student satisfaction.
H12. The use of Information Technology - IT has a positive influence on perceived learning.
H13. The use of Information Technology - IT has a positive influence on student satisfaction.

II. Methodology

The sample for the study was made up of 300 students from the area of social sciences, from the Catholic University of Santa Maria de Arequipa, whose ages are between 18 and 26 years old. Being 51.7% men and 48.3% women. Being the most representative groups, the students who are enrolled in the I semester with 36.4% and the III semester of studies with 43.0%. The application of the instrument was carried out in the month of November 2021, in the midst of a state of social isolation as a result of Covid-19, through the digital platform www.encuesta.com.

The applied instrument is an adaptation of the one used in Switching to online learning during COVID-19: Theorizing the role of IT mindfulness and techno eustress for facilitating productivity and creativity in student learning, by Anuragini Shirisha, Shalini Chandra and Shirish C.Srivastava[44]. For the adaptation of the instrument from English to Spanish, it was carried out by an expert in foreign languages and linguistics, in addition, preliminary statistical tests were carried out, such as an exploratory and confirmatory factor analysis, respectively, to guarantee the robustness of the instrument.

For the analysis of the information, both descriptive statistics and the application of Structural Equation Modeling were used, using partial least squares, based on variances (PLS-SEM). Based on the characteristics of the variables studied – scale variables from a Likert-type scale, the reliability and consistency tests of the model were carried out. The development of the research followed at all times a systematic and rigorous process of data classification and analysis with the statistical software IBM SPSS Statistics (v. 27), Smart PLS (v. 3.3.6) and JASP (v.0.16).

III. Results

The reliability tests gave result a Cronbach's alpha α=.952, a McDonald's coefficient ω=.953, which means an excellent measurement. The Kaiser-Meyer-Olkin (KMO) measurement test gave a result of 0.950, with a significance level of 0.000. Then, the communalities were evaluated, which are the sum of the squared factorial weights for each of the rows, the result is that the communalities range between 0.659 and 0.868, which means that in the worst case the items would explain the model by 65 .9% and in the best of cases they would reach 86.8%. As for the total variance explained, the results obtained from the 7 components would explain the model by 76.88%.

For the confirmatory analysis, the PLS-SEM (Partial Least Square Structural Equation Modeling)[45] was used, which is made up of two elements, the first proposes a measurement model that tries to analyze the factor loads of the variables to be analyzed. through its items, in such a way that a relationship can be established with 2 or more variables, with this methodology the reliability and validity of the dimensions of the theoretically supported model are evaluated.

In the confirmatory analysis, the matrix of external loads explains the measurement model and is made up of the indicators and their trajectories that connect them with their factors. The values of the external loads could have a variation between 0 and 1, so the closer it is to unity, the stronger they will be to explain the validity of the model.

Table II presents the matrix of external loads with their respective values, so that the items ratify their consistency and

their presence in the model, in addition to being considered very acceptable.

TABLE I
EXTERNAL LOADS - SMART PLS

	Opening to the Novelty of IT	Creativity in Learning	technological stress	Productivity in Learning	Student satisfaction	Use of IT
ANTI.1	0.876					
ANTI.2	0.915					
ANTI.3	0.920					
ANTI.4	0.909					
ANTI.5	0.904					
CA.3		0.854				
CA.4		0.926				
CA.5		0.895				
PA.1				0.919		
PA.2				0.909		
PA.3				0.845		
PA.4				0.904		
PA.5				0.899		
PL1						
SAT1					0.962	
SAT2					0.964	
ST.1			0.824			
ST.2			0.908			
ST.3			0.898			
ST.4			0.850			
ICU.1						0.800
UTI.2						0.815
UTI.3						0.810
UTI.4						0.839
UTI.5						0.831

Considering the correlation coefficients in all its dimensions, the reliability and validity of the construct is expressed in Cronbach's alpha, the values obtained vary between 0.871 and 0.945, being acceptable. The values of the Average Variance Extracted (AVE), are 0.671 and 0.928, these results exceed the minimum recommended value of 0.500[46], therefore, it is concluded that the convergent validity is acceptable in its model components. Regarding the composite reliability, its application is necessary[47], therefore, as an acceptance criterion, its values should be greater than 0.6, thus, it would demonstrate high reliability levels of internal consistency in each of the variables, according to table 2, their values vary between 0.911 and 0, 963. The coefficient (rho_A), is used to verify the reliability of the values obtained in the construction and design of the PLS[48], the results in the (rho_A) as an acceptance criterion, should be greater than 0.7 to demonstrate a composite reliability, the results vary between 0.876 and 0.946. As seen in Table II.

TABLE II
ASSESSMENT OF THE MEASUREMENT MODEL FOR REFLECTIVE CONSTRUCTS

	Cronbach's Alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Opening To the Novelty Of IT	0.945	0.946	0.958	0.819
Creativity In Learning	0.871	0.876	0.921	0.796
Technological Stress	0.894	0.902	0.926	0.758
Productivity In Learning	0.938	0.941	0.953	0.802
Student Satisfaction	0.922	0.923	0.963	0.928
Use Of IT	0.879	0.897	0.911	0.671
Perceived Learning	1	1	1	1

For the verification of the discriminant validity of the model, the proposal by Fornell and Larcker[49] was used, which suggests that the square root of AVE in each variable, its resulting values should be greater than the results of the correlation among the variables studied, the result indicates that the discriminant validity is well established, See Table III.

TABLE III
FORNELL-LARCKER CRITERION

	Opening to the Novelty of IT	Perceived learning	Creativity in Learning	Technological stress	Productivity in Learning	Student satisfaction	Use of IT
Opening to the Novelty of IT	**0.905**						
Perceived learning	0.401	**1**					
Creativity in Learning	0.650	0.522	**0.892**				
Technological stress	0.704	0.533	0.728	**0.871**			
Productivity in Learning	0.611	0.545	0.762	0.794	**0.896**		
Student satisfaction	0.385	0.824	0.522	0.551	0.533	**0.963**	
Use of IT	0.719	0.548	0.658	0.672	0.659	0.502	**0.819**

Another criterion to establish discriminant validity is the one suggested by Henseler, CM Ringle, and M. Sarstedt[50] and uses the Heterotrait-Monotrait (HTMT) relationship. In this way, the HTMT coefficient was used according to the results obtained, these are justified because their values are below the conservative threshold of 0.85 proposed by G. Franke and M. Sarstedt[51]. See Table IV.

TABLE IV
HETEROTRAIT CRITERION - MONOTRAIT –HTMT

	Opening tothe Novelty of IT	Perceived learning	Creativity in Learning	Techno logical stress	Productivity in Learning	Student satisfaction	Use of IT
Opening to the Novelty of IT							
Perceived learning	0.412						
Creativity in Learning	0.714	0.559					
Technological stress	0.768	0.558	0.823				
Productivity in Learning	0.646	0.562	0.842	0.862			
Student satisfaction	0.410	0.857	0.583	0.602	0.571		
Use of IT	0.780	0.569	0.749	0.746	0.713	0.538	

Regarding the analysis of reliability and validity of the model, this is explained from the R^2 (Pearson's coefficient). Its usefulness lies in the fact that the latent variables of the model establish different causal relationships: the results obtained from the PLS algorithm express an R^2 of 0.369 for the endogenous variable Student Satisfaction, which is equivalent to saying that 36.9% is explained by the variance of the model. Regarding the Perceived Learning variable that is part of the model as an endogenous or dependent variable, considering the R^2, it is 0.706, that is, 70.6%, it is explained by the model through its variances as observed in Figure 2.

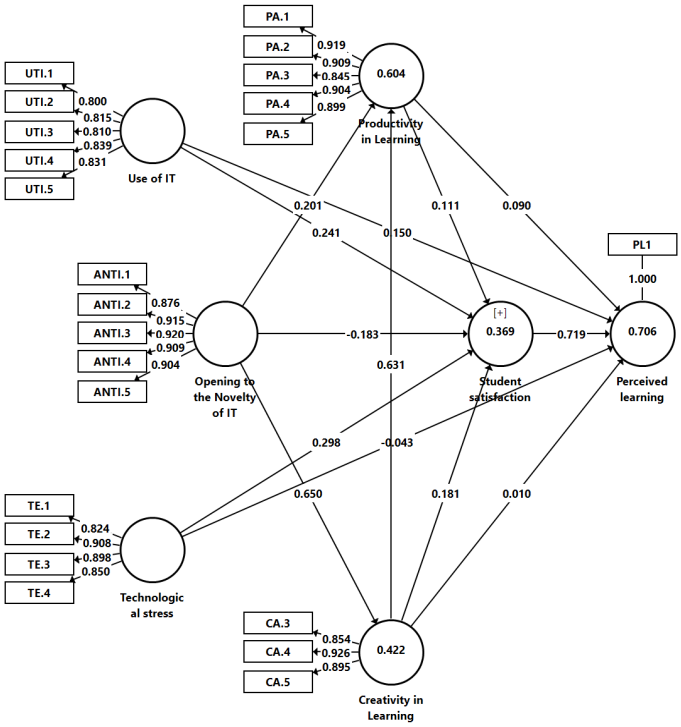

Figure 1 Model R^2 - SmartPLS.

Table V presents the results of the Bootstrapping test, which is a process to extract a large number of resamples (5,000) with replacement of the original sample and then estimate the model parameters for each bootstrap resampling. The standard error of an estimate is inferred from the standard deviation of the bootstrap estimates[52]. Considering the level of significance for the P Value ($p < 0.05$), the hypotheses: H4, H7 and H9 and H10 are rejected, and the other hypotheses are accepted.

TABLE V
BOOTSTRAPPING TEST RESULTS

Hypothesis	Original sample (OR)	Sample mean (M)	Standard deviation (STDEV)	t-Statistics (|O/STDEV|)	P Values
H1 .Opening to the Novelty of IT -> Creativity in Learning	0.650	0.650	0.043	15,284	0.000
H2. Openness to the Novelty of IT -> Productivity in Learning	0.201	0.199	0.072	2,802	0.003
H3. Openness to the Novelty of IT -> Student Satisfaction	-0.183	-0.181	0.077	2,389	0.008
H4. Creativity in Learning -> Perceived Learning	0.010	0.009	0.062	0.165	**0.435**
H5. Creativity in Learning -> Productivity in Learning	0.631	0.633	0.064	9,853	0.000
H6. Creativity in Learning -> Student Satisfaction	0.181	0.18	0.078	2,317	0.010
H7. Technological stress -> Perceived learning	-0.043	-0.038	0.086	0.504	**0.307**
H8. Technological stress -> Student satisfaction	0.298	0.297	0.11	2,726	0.003
H9. Learning Productivity -> Perceived Learning	0.090	0.084	0.07	1,287	**0.099**
H10. Learning Productivity -> Student Satisfaction	0.111	0.11	0.103	1,079	**0.140**
H11. Student satisfaction -> Perceived learning	0.719	0.72	0.055	13,027	0.000
H12. Use of IT -> Perceived learning	0.150	0.150	0.061	2,448	0.007
H13. Use of IT -> Student satisfaction	0.241	0.244	0.075	3,197	0.001

IV. CONCLUSIONS

Considering the results obtained according to the tests of the proposed structural model, the results indicate that factors such as the use of ICT, student satisfaction exert a positive influence on perceived learning, unlike productivity, creativity in the learning and technological stress would not exert favorably on perceived learning. Through the variance explained by the coefficient of determination R^2, whose result is 0.706, such causal relationships would be explained by 70.6%. Regarding student satisfaction, acting as influencing factors, such as openness to the novelty of ICT, creativity, and the use of ICT, would exert a positive influence on satisfaction as opposed to productivity in learning, considering coefficient of determination R^2, these relationships would be explained by 0.369, which is equivalent to explaining the model by 36.9%.

The idea of inquiry and search about the key influencing factors in dependent variables for educational development in times of Covid-19, such as perceived learning and student satisfaction in university education, is highlighted.

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