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Factors that enhance virtual education in a Post-Covid stage

Factores que potencializan la educación virtual en una etapa Post-Covid

Fatores que potenciam a educação virtual numa era pós-Covid

后 Covid 阶段中增强虚拟教育的因素

العوامل التي تعزز التعليم الافتراضي في مرحلة ما بعد كوفيد

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Abstract

The objective of this research was to identify the factors with the highest incidence that potentiated virtual education at the Autonomous University of Tamaulipas during the Covid-19 pandemic. We worked on a quantitative approach with a descriptive transactional design with a correlational scope due to the analytical approach and types of data used. The Satisfaction, Interaction, Self-sufficiency and Self-regulated Learning scale in virtual courses of Kuo et al. (2014), was used. Which analyzes: Student-student interaction, Student-instructor interaction, Student-content interaction, Self-efficacy in the use of the Internet, Self-regulated Learning and Satisfaction Satisfaction about the virtual course. The results showed that most of the students (stratified sample n = 3604, Age M = 20.49, SD ± 0.552, Min = 18, Max = 28) presented high levels of satisfaction in the online courses and more than 80% of the participants expressed their willingness to continue studying under the virtual modality. The factors of self-efficacy in the use of the Internet and the interaction of the student-instructor showed positive and significant correlations ($p < 0.05$) with respect to student satisfaction under the virtual modality, in addition, the older participants presented more satisfaction than the younger subjects younger. On the other hand, the gender of the participants, their employability status and their age range no show significant differences ($p > 0.05$) as to scores obtained.

Keywords: Distance Education; Student; Online Learning; Pandemic.

Resumen

El objetivo de esta investigación fue identificar los factores de mayor incidencia que potencializaron la educación virtual en la Universidad Autónoma de Tamaulipas, durante la pandemia por Covid-19. Se trabajó en un enfoque cuantitativo con diseño transeccional descriptivo con alcance correlacional por el enfoque analítico y tipos de datos usados. Se utilizó la escala de Satisfacción, Interacción, Autosuficiencia y Aprendizaje Autorregulado en cursos virtuales de Kuo et al. (2014), la cual analiza: Interacción estudiante-estudiante, Interacción estudiante-instructor, Interacción estudiante-contenido, Autoeficacia en el uso de internet, Aprendizaje autorregulado y Satisfacción sobre el curso virtual. Los resultados mostraron que la mayor parte de los estudiantes (muestra estratificada n = 3604, Edad M = 20.49, DE ± 0.552, Min = 18, Max = 28) presentaron niveles altos de satisfacción en los cursos en línea y más del 80% de los participantes manifestaron su disposición de continuar estudiando bajo la modalidad virtual. Los factores de autoeficacia en el uso de internet y la interacción del estudiante-instructor mostraron correlaciones positivas y significativas ($p < 0.05$) respecto a la satisfacción estudiantil bajo la modalidad virtual, además, los participantes de mayor edad presentaron una mayor satisfacción que los sujetos menor edad sin importar su estado de empleabilidad en paralelo a su escolaridad. Por otra parte, no se encontraron diferencias significativas ($p > 0.05$) entre el género de los participantes, el estado de su empleabilidad y su rango etario respecto a los puntajes obtenidos.

Palabras clave: Educación a Distancia; Estudiante; Aprendizaje en Línea; Pandemia.

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Resumo

O objetivo desta investigação foi identificar os fatores de maior impacto na educação virtual na Universidade Autónoma de Tamaulipas, durante a pandemia de Covid-19. Trabalhámos numa abordagem quantitativa com design transversal descritivo com âmbito correlacional devido à abordagem analítica e aos tipos de dados utilizados. Utilizou-se a escala de Satisfação, Interação, Autoaprendizagem e Aprendizagem Autorregulada em cursos virtuais de Kuo et al. (2014), que analisa: Interação estudante-estudante, Interação estudante-instrutor, Interação estudante-conteúdo, Autoeficácia no uso de Internet, Aprendizagem autorregulada e Satisfação em relação ao curso virtual. Os resultados mostraram que a maioria dos estudantes (amostra estratificada n = 3604, Idade M = 20,49, DP ± 0,552, Mín. = 18, Máx. = 28) apresentou níveis elevados de satisfação nos cursos online e mais de 80% dos participantes manifestaram a sua disposição para continuar a estudar na modalidade virtual. Os fatores de autoeficácia na utilização da Internet e na interação do estudante-instrutor apresentaram correlações positivas e significativas ($p < 0,05$) relativamente à satisfação dos estudantes na modalidade virtual, tendo os participantes mais velhos demonstrado maior satisfação do que os mais novos, independentemente do seu estatuto de empregabilidade em paralelo com a sua escolaridade. Por outro lado, não foram encontradas diferenças significativas ($p > 0,05$) entre o género, o estatuto de empregabilidade e a faixa etária dos participantes no que diz respeito às pontuações obtidas.

Palavras-chave: Ensino à distância; Estudante; Aprendizagem online; Pandemia; Pandemia; COVID-19.

摘要

本研究的目的是确定在 Covid-19 大流行期间，塔毛利帕斯自治大学虚拟教育潜力的主要影响因素。研究采用定量方法，采用横断面描述性设计，并因使用的数据类型而具有相关性分析范围。使用了 Kuo 等人（2014）的虚拟课程满意度、互动、自我效能感和自我调节学习量表，该量表分析了：学生与学生互动、学生与教师互动、学生与内容互动、互联网使用自我效能感、自我调节学习和对虚拟课程的满意度。

结果显示，大部分学生（分层样本 n = 3604，年龄 M = 20.49，标准差±0.552，最小值= 18，最大值= 28）在在线课程中表现出较高的满意度，超过 80%的参与者表示愿意继续以虚拟方式学习。互联网使用自我效能感和学生与教师互动对虚拟模式下的学生满意度显示出正相关和显著相关性（$p < 0.05$），此外，年龄较大的参与者比年龄较小的参与者表现出更高的满意度，这与其在学业之外的就业状态无关。另一方面，参与者的性别、就业状态和年龄范围在得分上没有显著差异（$p > 0.05$。

关键词：远程教育；学生；在线学习；流行病；COVID-19.

ملخص

كان الهدف من هذا البحث هو تحديد العوامل ذات أعلى نسبة حدوث والتي عززت التعليم الافتراضي في جامعة تاماوليباس المستقلة، خلال جائحة كوفيد-19. لقد عملنا على نهج كمي مع تصميم مقطعي وصفي مع نطاق ارتباطي بسبب النهج التحليلي وأنواع البيانات المستخدمة. تم استخدام مقياس الرضا Kuo et al والتفاعل والاكتفاء الذاتي والتعلم المنظم ذاتياً في الدورات الافتراضية بواسطة (2014)، الذي يحلل: التفاعل بين الطالب والطالب، والتفاعل بين الطالب والمعلم، والتفاعل بين الطالب والمحتوى، والكفاءة الذاتية في استخدام الإنترنت، والتعلم المنظم ذاتياً، والرضا عن المقرر الافتراضي. أظهرت النتائج أن معظم الطلاب (العينة الطبقية ن = 3604، العمر M =20.49 أظهروا مستويات عالية من الرضا في الدورات عبر الإنترنت وأعرب أكثر من 80٪ من المشاركين استعدادهم لمواصلة الدراسة في ظل الطريقة الافتراضية. أظهرت عوامل الكفاءة الذاتية في استخدام الإنترنت والتفاعل بين الطالب والمعلم ارتباطات إيجابية ومعنوية ($p<0.05$ نقطة) فيما يتعلق برضا الطلاب في ظل الطريقة الافتراضية، بالإضافة إلى ذلك، أبدى المشاركون الأكبر سناً رضا أكبر من الأفراد الأصغر سناً، بغض النظر عن وضعهم الوظيفي بالتوازي مع تعليمهم. من ناحية أخرى، لم يتم العثور على فروق ذات دلالة إحصائية ($p<0.05$ نقطة) بين جنس المشاركين وحالة قابليتهم للتوظيف وفئتهم العمرية فيما يتعلق بالدرجات التي تم الحصول عليها.

الكلمات الدالة :التعليم عن بعد؛ الطالب؛ التعليم على الانترنت؛ الوباء، كوفيد-19.

Introduction

During 2020, a change occurred worldwide due to the pandemic caused by the Severe Acute Respiratory Syndrome (SARS-Cov2) (OMS, 2020), so that the health protocols of all public and private agencies and organizations became strict to protect personal health through body protection and isolation in a way that rewarded communication technologies (Sánchez & Morales, 2021). This type of protocol allowed face-to-face social life to become a digital social life, where especially universities worked under virtual education schemes (Schianio, Biasutti, & Philippe, 2021).

Although virtual education became mandatory for all educational levels during the Covid-19 pandemic, universities were the educational sector that best adapted or can adapt to this change because of the age of their students, mostly adults (over 18 years old) (Gagliardi, 2020; Feng & Gavin, 2021). Virtual education works best at these levels because it requires a greater degree of autonomy and self-discipline on the part of the students to carry out the courses, an aspect that becomes difficult for young students (children, adolescents) (Manes & Niro, 2014; Ho Tim, Bruce, & Korszun, 2021).

In the midst of a health crisis, Schianio, et al. (2021) point out that one of the key virtues of distance education is the curricular flexibility offered to university students who usually work in parallel to their (academic) studies to support their family or themselves in their maintenance and tuition. Reimers (2021) indicates that the inflationary schemes of the market and the health contingency have caused more higher education students to seek part-time jobs to support family expenses while pursuing their professional careers.

One of the key aspects to understand the impact of virtual education on students during the Covid-19 pandemic is precisely to know their perception and satisfaction on the different essential axes of interaction and pedagogical achievement of students during their virtual education (Salinas, Morales, & Martínez, 2008). Identifying the factors of university student satisfaction during virtual classes will allow evaluating distance higher education to know the trend about a possible new academic normality that permeates a better adaptation to the needs and interests of adult students (González, Pino, & Penado, 2017).

In order to identify the factors surrounding student satisfaction in virtual teaching, attention must be paid to the student as the active axis of the educational act in relation to what he interacts with, that is, with the content he learns, with his teachers, with the technological means and with the dynamics of his classmates (Bolliger & Martindale, 2004; Chang & Smith, 2008). Satisfaction is then a feeling of fullness of a desire or need satisfied, which implies an essential predictor to know the tendency and confidence of the students to repeat the satisfactory experience (Chejlyk, 2006).

Analyzing satisfaction is a primary indicator to know the success of an educational program that considers the student as the central axis (Bolliger & Martindale, 2004; Battalio, 2007). Student experiences are often related to the educational quality of a course and are good predictors for institutional evaluation (Alqurashi, 2018). High and positive student satisfaction will be linked to academic well-being and to the likelihood of persistence and adequate course completion (Rodríguez & Caicedo, 2012). Knowing the potential benefits of student satisfaction in virtual training settings will generate a better picture of understanding about areas of opportunity to provide better targeted support strategies for students in virtual modalities (Morales, 2016; Salinas et al. 2018).

Based on the above, this research seeks to identify the factors of greater incidence that potentiated virtual education at the Autonomous University of Tamaulipas (UAT), during the Covid-19 pandemic. In this analysis exercise, the Satisfaction, Interaction, Self-efficacy and Self-regulated Learning in virtual courses scale of Kuo et al. (2014) was used, which analyzes: Student-student interaction, Student-instructor interaction, Student-content interaction, Self-efficacy in the use of the Internet, Self-regulated learning and Satisfaction about the virtual course. Throughout this study, in addition to knowing different views related to the benefits of virtual interaction and provide context of the progress of virtual education in the UAT, during the last

decade; in the section of questions and objectives, the sense of this work is unfolded, and the problem statement. In the methodology section, in addition to presenting the hypotheses of the research, relevant aspects related to the participants, instruments and procedures of the work were also integrated. On the other hand, the results offer significant data from the participants' affiliation profile, achievement levels by factor, to correlations of the factors of Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in virtual courses. Finally, in the discussion and conclusions sections, different points of view of expert authors in the field were addressed, as well as the scope of the work, identifying the fulfillment of the objective and providing an answer to the research question and hypothesis.

The Value of Interaction in Virtual Education

The constructivist vision of virtual academic training is based on the interaction of the subject (as the central active axis) with its environment (Rodríguez, 2007; Araya, Alfaro, & Andonegui, 2007). Interaction is a mechanism of action and reciprocal relationship between two or more parties that generally have to do with the same purpose. The harmony of interaction is achieved when self-efficiency, axiological framework and shared achievement occurs between the parties in an efficient manner, that is, between the interaction of the student with other students, with the instructor, with the content and with the optimal management of virtual learning and communication platforms (Bolliger & Martindale, 2004).

Interaction is the afferent means by which the brain understands the universe around it, i.e., it learns by interacting with the world with previous knowledge bases that give meaning to the incoming sensory information (Ausubel, 2002; Almeida, 2011). Learning, as indicated, lies in social interaction (educational actors, such as teachers and students) and in interaction with the environment (content and assertive media), and when these indicators are met, favorable contexts are generated for the construction of experience (learning) (Ausubel, 2002; García, 2011).

In this sense, while interactions are important, the result is the internalization of learning in the learner (Barnard, Paton, & Lan, 2008). The virtual social framework (in the course) of interaction will provide relevant feedback and a framework of content and areas of opportunity to develop the activity on knowledge (Di Bernardo & Pereira, 2005). Virtual schooling should prioritize guided learning so that the student achieves a harmonic self-efficiency, both personal and collective. These indicators will result in the success of the students' decision confidence to make the decision to continue their studies under distance modalities (Alqurashi, 2018).

Learner-centered virtual courses and programs should prioritize self-regulation of learning as the learner assumes greater responsibility for autonomy in regulating his or her thinking (McManus, 2000). Self-regulation is essential for academic achievement and student satisfaction because it pivots on the internalization of learning that is the goal of formative courses. All these factors are vital not only for predicting student satisfaction in university virtual education but also for improving the quality of courses and the development of learning skills (Hargis, 2000; Peterson, 2011).

On the other hand, self-efficacy about technological tools in virtual courses has been a reported factor for virtual college satisfaction. Studies such as Shyju, Vinodan, Sadekar, Sethu and Lama (2021), have indicated that self-efficacy for handling basic software and hardware in virtual courses is very important for virtual student satisfaction. Kuo, Walker, Belland and Schroder (2013) on the other hand, reported that self-efficacy in handling technological tools in virtual courses and interpersonal interactions between student-teacher, are better predictors for student satisfaction than relationships between students themselves. In this work (Kuo, et al. 2013), 291 participants (unequal gender) were surveyed using a questionnaire on self-efficacy of basic technology use for virtual courses, self-regulated learning and on student-content, student-student and student-teacher interaction (Likert-type items). By performing ANOVA and Pearson inferential analyses (Kuo, et al. 2013), teacher-student and student-student-content interactions showed large positive correlations for satisfaction than student-student interactions.

Self-efficacy about technology and self-regulation of learning were other important factors for student satisfaction, although self-efficacy showed the higher positive correlations than self-regulation.

Later, Kuo, Walker, Schroder and Belland (2014) developed a questionnaire that considered the main types of virtual interaction in virtual courses with university students (student-professor, student-student, student-content, self-efficacy of technological use, self-regulation and the proclivity to continue in the distance mode (Likert-type items). On these factors and under a Pearson correlation analysis, Kuo et al. (2014) indicated that student-instructor interaction and student-content interaction showed the strongest relationships with satisfaction compared to student-student interactions, although student-content interaction stood out as the strongest predictor for satisfaction. No differences were considered between participants' gender or previous experience in the virtual educational modality.

These results (Kuo, et al. 2014) coincided with those reported by Alqurashi (2018), who indicated that student-content interaction was the factor most related to virtual educational satisfaction in higher education students. Alqurashi's (2018) study worked with 167 university participants through a series of questionnaires (29 Likert-type items) on student and content interaction, student and instructor, student with respect to other students, and on self-regulation of learning, although the dimension of proclivity to continue with virtual courses was not considered. The gender samples were not equivalent, and it was learner interaction with the content that was the most important factor for satisfaction, in addition to self-regulation of learning that showed the highest arithmetic mean scores across all participants.

In contrast to these reports, Chang and Smith (2008) indicated that student interpersonal interaction with the teacher and with peers were the most important predictors of satisfaction. In this study (Chang & Smith, 2008), more than 900 students were surveyed by means of a questionnaire of perception of interaction on virtual education (Likert-type items) that sought to measure student interaction with the content, with classmates, with the professor and with the characteristics of the technology used in the course (without considering the tendency to continue with the virtual modality). In this sense, through correlation analysis, Chang and Smith (2008) reported positive and significant correlations in the combined personal interactions (student-professor; student-student) with respect to student satisfaction, compared to other types of interaction (student-content).

Another correlational report (Chejlyk, 2006) noted that course format and student-content interactions were not as relevant to virtual college satisfaction as were interpersonal interactions between key educational stakeholders (students, faculty). In this work (Chejlyk, 2006) a virtual interaction satisfaction questionnaire was used that aimed to measure student-student, student-instructor, and student-content interactions with respect to overall satisfaction, without considering the factor of proclivity to continue with distance courses. In the same vein, Lin, Zheng and Zhang (2015) identified that interpersonal interactions were important for satisfaction but only for the student-teacher factor, i.e., the student-student and student-content factors were not relevant to participants' perception of satisfaction.

Most of the studies (Bolliger & Martindale, 2004; Chejlyk, 2006; Chang & Smith, 2008; Lin, Zhang, & Zheng, 2015; Alqurashi, 2018; Shyju, et al. 2021; Rajeh, Abduljabbar, Alqahtani, & Waly, 2021; Elshami, et al. 2021) are cross-sectional in nature and used validated instruments on student satisfaction in virtual contexts, however, not all of them included the factor of tendency to repeat the experience to know if students were satisfied to continue in pursuing virtual educational programs. Although the questionnaire used by Rajeh et al. (2021) had a dimension of intention to use (proclivity) in the future, the instrument itself does not focus on the study of the interaction of the vital parts in the virtual educational process. Satisfaction is a good predictor of possible tendencies to continue in the virtual modality; however, including a specific factor that addresses this dimension is important to confirm that students are indeed likely to prefer to continue in virtual training modalities in a post-Covid-19 educational stage.

Background of Distance Education

The Autonomous University of Tamaulipas (UAT), during the period 2014-2017, had unprecedented advances in virtual education, such is the case that the Distance Education model was designed with a constructivist vision, considering meaningful learning. In this way, all actors revolve around the online student, and seek the conditions so that they can reconstruct and self-manage new knowledge and experiences through self-learning and collaborative learning (Amaya & Navarro, 2017). This model also incorporates connectivism principles that develop skills in the online student to connect to knowledge networks that facilitate continuous updating and lifelong learning. These characteristics allow students to learn to search for information, select it, classify it, build new knowledge and share it through technologies for learning and knowledge. Also, during this period, the first 100% online undergraduate educational programs were designed and implemented: Bachelor's Degree in Education and Technologies for Learning, Renewable Energy Engineering, and bachelor's degree in Graphic Design and Digital Animation. In parallel, work began on the first online postgraduate degree at UAT, called master's degree in Educational Innovation and Technologies for Learning. Based on the above, when the COVID-19 contingency arose, knowledge and experiences were shared with teachers of face-to-face programs, from the instructional method for distance education to strategies for retaining students with the support of the Online Campus, facilitating their transition to virtual education, and providing responses to the needs of educational services demanded by students of the traditional modality, who could not attend their face-to-face classes.

Questions and objectives

Each educational context presents different factors that influence academic decision-making, not only by students, but also by Higher Education Institutions (HEI) themselves. The management of electronic platforms in HEI was diverse and in many cases chaotic during the COVID-19 pandemic, even more so when there was no previous experience in distance education. However, it should not be lost sight of that electronic platforms are only a means of communication and collaboration between teachers and students. That is, to achieve the learning goals and objectives, it is essential to manage teaching/learning models, methods and strategies ad hoc to the educational modality. In other words, a face-to-face instructional method cannot be used to teach remotely and vice versa. To demonstrate the above, research must be carried out that uses reliable instruments and that, in addition to studying the correlations between key binomials: teacher-student, student-student, student-content and student-internet, among others; The instrument must also be oriented to the case study, mainly to cover the entire spectrum of the educational modality in question. In this sense, this study, in addition to demonstrating the value of designing and implementing instructional methods based on the educational modality and that technological tools per se will not guarantee the success of learning, mainly seeks to identify the factors with the greatest impact that enhanced virtual education at the Autonomous University of Tamaulipas, during the Covid-19 pandemic. Based on the precedents seen, the following research question arises: What are the factors with the greatest impact that enhance virtual education in a Post-Covid stage? Based on the question, the factors with the greatest impact that allowed virtual education to be enhanced at the Autonomous University of Tamaulipas, during the Covid-19 contingency, will be identified and which, in turn, achieved high levels of satisfaction in students to continue studying through this educational modality. In an exercise of reflection, these same factors set the stage for universities to revalue virtual education in a Post-Covid stage. For this purpose, the scale of Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in Virtual Courses by Kuo et al. (2014) was used.

Method

We worked under a quantitative approach with a descriptive transectional design and correlational scope due to the analytical approach and types of data used (Hernández, Fernández, & Baptista, 2014). An ex post facto design of transectional cut was used, since no variables were manipulated and the data used were collected at a single time point (Vega, 2015). This research was conducted during the Covid-19

pandemic in the third school term of 2021 based on the parameters of the Distance Education model of the Autonomous University of Tamaulipas, Mexico. The feasibility of the study was made possible by means of surveys conducted through the Google Forms© platform, distributed to the participants through institutional mail (Balderas, Roque, López, Salazar & Juárez, 2021). The following hypotheses were established:

H1: "Student interaction with teacher show significant correlations ($p < 0.05$) with student satisfaction in virtual courses".

H2: "Self-efficacy in internet use show significant correlations ($p < 0.05$) with student satisfaction in virtual courses".

H3: "Most of the students show high levels of satisfaction in the virtual courses they took at the Autonomous University of Tamaulipas in 2021, during the Covid-19 pandemic".

H4: "The gender of the participants does NOT differ significantly ($p < 0.05$) between their results".

H5: "Marital status and employability status do NOT lead to significant differences ($p > 0.05$) between the scores obtained by the participant".

H6: "Older participants show significant ($p < 0.05$) higher satisfaction scores than younger participants".

Participants

The study was carried out with students enrolled in the Faculties of Commerce and Administration Tampico (FCAV1), Faculty of Commerce and Administration Victoria (FCAV2), Faculty of Commerce, Administration and Social Sciences Laredo (FCAV3), Faculty of Law and Social Sciences Tampico (FADyCS1), Faculty of Law and Social Sciences Victoria (FADyCS2), Faculty of Veterinary Medicine and Animal Husbandry "Dr. Norberto Treviño Zapata" (FMVZ), Academic Unit of Social Work and Sciences for Human Development (UAMTSC), Multidisciplinary Academic Unit of Sciences, Education and Humanities (UAMCEH), Multidisciplinary Academic Unit Matamoros (UAMM), Multidisciplinary Academic Unit Reynosa Aztlán (UAMR1), Multidisciplinary Academic Unit Reynosa Rodhe (UAMR2) and Faculty of Engineering "Arturo Narro Siller" (FI), belonging to the Autonomous University of Tamaulipas during the fall of 2021.

At that time, the registered enrollment for each of the faculties (FCAV1 [N = 1654], FCAV2 [N = 1789], FCAV3 [N = 1256], FADyCS1 [1665], FADyCS2 [N=1764], FMVZ [N = 808], UAMTSH [N = 1631], UAMCEH [N = 831], UAMM [N = 1466], UAMR1 [N = 1694], UAMR2 [N = 1626] and FI [N = 1101]) was 17,285 students respectively. In this sense, the probabilistic sample (n) of finite population (N) was stratified under the formula:

$$n = \frac{Z_a^2 Npq}{E^2(N-1) + Z_a^2 pq}$$

Where "n" is the sample size, "N" the population, "p" the probability in favor (50%), "q" the probability against (50%), "Z" the 95% confidence level, and "E" the acceptable error (0.05%) (Levine, Krehbiel, & Berenson, 2006). In this respect the sample was:

n = 311.922 ([1.96]^2[1654][0.5][0.5])/([0.09]^2[1654-1]+[1.96]^2[0.5][0.5]), of FCAV2 of n = 316.395 ([1.96]^2[1789][0.5][0.5])/([0.09]^2[1789-1]+[1.96]^2[0.5][0.5]), of FCAV3 of n = 294.368 ([1.96]^2[1256][0.5][0.5])/([0.09]^2[1256-1]+[1.96]^2[0.5][0.5]), of FADyCS1 of n = 312.296 ([1.96]^2[1665][0.5][0.5])/([0.09]^2[1665-1]+[1.96]^2[0.5][0.5]), of FADyCS2 n = 315.606 ([1.96]^2[1763][0.5][0.5])/([0.09]^2[1764-1]+[1.96]^2[0.5][0.5]), of FMVZ of n = 260 ([1.96]^2[808][0.5][0.5])/([0.09]^2[808-1]+[1.96]^2[0.5][0.5]), of UAMTSH of n = 311.082 ([1.96]^2[1631][0.5][0.5])/([0.09]^2[1631-1]+[1.96]^2[0.5][0.5]), of UAMCEH of n = 262.928 ([1.96]^2[831][0.5][0.5])/([0.09]^2[831-1]+[1.96]^2[0.5][0.5]), of UAMM of n =304.559 ([1.96]^2[1466][0.5][0.5])/([0.09]^2[146

6-1]+[1.96]^2[0.5][0.5]), of UAMR1 of n = 313.295 ([1.96]^2[1694][0.5][0.5])/([0.09]^2[1694-1]+[1.96]^2[0.5][0.5]), of UAMR2 of n = 310.898 ([1.96]^2[1626][0.5][0.5])/([0.09]^2[1626-1]+[1.96]^2[0.5][0.5]), y FI n = 284.982 ([1.96]_^2[1101][0.5][0.5])/([0.09]^2[1101-1]+[1.96]_^2[0.5][0.5]).

In this sense, the samples were rounded to define the groups (FCAV1 [n = 312], FCAV2 [n = 316], FCAV3 [n = 295], FADyCS1 [n = 313], FADyCS2 [n = 316], FMVZ [n = 261], UAMTSH [n = 312], UAMCEH [n = 263], UAMM [n = 305], UAMR1 [n = 314], UAMR2 [n = 311], FI [n = 285] giving a total of 3604 participants (Age: M = 20.49, SD ± 0.552, Min = 18, Max = 28), made up of 49.4% men (n = 1782) and 50.6% women (n = 1822) classified into age ranges from 18 to 20 years (M = 19.46, SD ± 0.449, Min = 18, Max = 20), 21 to 25 years (M = 22.61, SD ± 0.481, Min = 21, Max = 25), over 25 years (M = 26.59, SD ± 0.494, Min = 26, Max = 28). The complementary data of the affiliation profile are shown in Table 1.

The research considerations on dealing with human beings established by the Code of Ethics of the Autonomous University of Tamaulipas (UAT, 2018) were followed, in addition to the criteria for privacy of information in studies on pedagogy proposed by Hall (2006). All participants were informed about the purpose of the work, guaranteeing the confidentiality of the data for strictly academic purposes. All subjects expressed their willingness to report for the objectives of this research, being able at any time not to answer or abandon the survey, which was anonymous in nature and did not collect in any way personal data such as proper names, surnames, telephone numbers, emails, addresses, among others.

Instruments

The scale of Satisfaction, Interaction, Self-sufficiency and Self-regulated Learning in Virtual Courses was used, validated by Kuo et al. (2014), and developed from the Internet Self-efficacy scale of Eastin and LaRose (2000) and the Self-Regulation of Learning Questionnaire (MSLQ) of Pintrich, Smith, García and McKeach (1993), in addition to the scale of Satisfaction and Interaction in virtual environments of Kuo, Eastmond, Schroder and Bennet (2009). The scale of Satisfaction, Interaction, Self-sufficiency and Self-regulated Learning in virtual courses of Kuo et al. (2014) is made up of 43 polytomous Likert-type reagents with five response alternatives and distributed in six factors: Student-student interaction (SSI; reliability of Cronbach's alpha coefficient α = 0.93), Student-instructor interaction (SII, Cronbach's alpha coefficient α = 0.88), Student-content interaction (SCI, Cronbach's alpha coefficient α = 0.92), Self-efficacy in the use of the Internet (AI, Cronbach's alpha coefficient α = 0.93), Self-regulated learning (AA, Cronbach's alpha coefficient α = 0.79) and Satisfaction with the virtual course (SC, Cronbach's alpha coefficient α = 0.93). The items are measured on a 5-point scale ranging from 1 (“Never”), 2 (“Rarely”), 3 (“Occasionally”), 4 (“Often”) to 5 (“Always”), except for frequency questions 1 and 8 of factor AA, which were rated at 1 (“Always”), 2 (“Rarely”), 3 (“Occasionally”), 4 (“Often”) and 5 (“Always”).

The factors of the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in Virtual Courses scale (Kuo et al. 2014) allow to measure the frequency of perceived acceptance and satisfaction regarding interpersonal interaction between key actors in virtual courses (student-student, and students-teacher), in addition to the student's interaction with the course materials. On the other hand, it makes it possible to understand the confidence between the student and his skill regarding his self-sufficiency in the use and understanding of the Internet (the basis of virtual schooling) and his habits of control over the understanding of what he learns (self-regulation).

The items (n = 8) related to the SSI factor (α = 0.93) are made up of 1) “In general, I had numerous interactions related to the course content with other students.” 2) “I received many comments from my classmates.” 3) “I communicated with my classmates about the course content through different electronic means, such as email, discussion forums, instant messaging tools, among others.” 4) “I answered questions from my classmates through different

electronic means, such as email, discussion forum, instant messaging tools, among others." 5) "I shared my thoughts or ideas about the lectures and their application with other students during this class." 6) "I comment on the thoughts and ideas of other students." 7) "Group activities during class gave me the opportunity to interact with my classmates"; and 8) "Class projects led to interactions with my classmates" (Kuo et al. 2014).

On the other hand, the items (n = 6) linked to the SII actor (α = 0.88) are: 1) "I had numerous interactions with the instructor during the class". 2) "I asked my questions to the instructor through different electronic means, such as email, discussion forum, instant messaging tools, among others". 3) "The instructor regularly posted some questions for students to discuss in the discussion forum", 4) "The instructor answered my questions in a timely manner", 5) "I responded to the instructor's messages" and 6) "I received sufficient feedback from my instructor when I needed it". In this sense, the SCI factor reagents (n = 4, α = 0.92) were: 1) "The virtual course materials helped me better understand the content of the class", 2) "The virtual course materials stimulated my interest in this course", 3) "The virtual course materials helped relate my personal experience to new concepts or knowledge"; and 4) "It was easy for me to access the virtual course materials" (Kuo et al. 2014).

On the other hand, the reagents that made up the AI factor (n = 8, α = 0.93) were: 1) "I understand the terms/words related to Internet hardware", 2) "I understand the terms/words related to Internet software", 3) "I can describe the functions of Internet hardware", 4) "I can troubleshoot Internet hardware", 5) "I can explain why a task will not run on the Internet", 6) "I can use the Internet to collect data", 7) "I can learn advanced skills within a specific Internet program", and 8) "I can go to a virtual discussion group when help is needed" (Kuo et al. 2014).

Finally, the AA and SC factors consisted of the following items: (AA [n = 12, α = 0.79]) were: 1) "During class time I often miss important points because I am thinking about other things", 2) "When I read for this course, I ask questions to help focus my reading", 3) "When I get confused by something I am reading for this class, I go back and try to understand it", 4) "If the course materials are difficult to understand, I change the way I read the material", 5) "Before I study a new course material thoroughly, I often review it to see how it is organized", 6) "I ask myself questions to make sure I understand the material I have been studying in this class", 7) "I try to change the way I study to fit the course requirements and the instructor's teaching style", 8) "I often find that I have been reading for class but I don't know what it is about", 9) "When I study, I try to think about the subject matter and decide what I am supposed to learn from it rather than just reading about it," 10) "When I study for this course, I try to determine what concepts I don't understand well," 11) "When I study for this class, I set goals to direct my activities at each phase of studying; and 12) "If I get confused taking notes in class, I make sure to fix it afterward." SC (n = 5, α = 0.93): 1) "Overall, I am satisfied with the online classes," 2) "This online course contributed to my educational development," 3) "This online course contributed to my professional development," 4) "I am satisfied with the level of interaction that happened in this online course," and 5) "In the future, I would be willing to take a completely online course again" (Kuo, et al. 2014).

Procedure

This research was conducted in three stages (Pérez, 2011). A prior review of the background of the object of the problem and the key elements related to student satisfaction in virtual environments (stage 1). The Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in Virtual Courses scale by Kuo et al. (2014) was implemented to 3,604 student participants, with prior authorization from the institutional authorities (stage 2). Due to the in-person health restrictions due to Covid-19, control of the instrument was limited, and the surveys were applied via institutional email through the Google Forms© tool.

The results were quantified (stage 3) in basic statistics (Table 1) using Microsoft Excel© software that calculated the affiliation profile of the participants (n=3604, SD ± 0.502) such as gender, age range, marital status, employability, working time and previous experience with virtual courses. Next, the global scores (Table 2)

of all the items of the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in Virtual Courses scale (Kuo, et al. 2014) were calculated with their respective statistics such as the values of arithmetic means, standard deviations, minimums, maximums, and typical errors.

Equitable achievement levels were established for each factor of the instrument (Table 3), which were developed based on the range of the total score of each reagent, which had a maximum value of five points according to the intervals of response options (as observed). The achievement levels were adapted in different categories: 1) Student-student interaction ("very low SSI" [R = 1-8], "low SSI" [R = 9-16], "regular SSI [R = 17-24], "high SSI" [R = 25-32], and "very high SSI" [R = 33-40]); 2) Student-instructor interaction (very low SII [R = 1-6], "low SII" [R = 7-12], "regular SII [R = 13-18], "high SII" [R = 19-24], and "very high SII" [R = 25-30]); 3) Student-content interaction (SCI very low" [R=1-4], "SCI low" [R=5-8], "SCI average [R=9-12], "SCI high" [R=13-16], and "SCI very high" [R=17-20]); 4) Self-efficacy in internet use ("AI very low" [R=1-8], "AI low" [R=9-16], "AI average [R=17-24], "AI high" [R=25-32], and "AI very high" [R=33-40]); 5) Self-regulated learning ("AA very low" [R=1-12], "AA low" [R=13-24], "AA average [R=25-36], "AA high" [R=37-48], and "AA very high" [R=49-60]); 6) Satisfaction with the virtual course ("very low SC" [R=1-5], "low SC" [R=6-10], "regular SC [R=11-15], "high SC" [R=16-20], and "very high SC" [R=21-25]).

The statistical software IBM SPSS© version 22 was used to perform the inferential analysis in order to identify the assumption of normality using the Kolmogorov-Smirnov test with bilateral asymptotic probability from the Lilliefors tables, in each of the categories of the instrument, in addition to the Levene test for equality of variances. The significance value was set to 0.05% (Hernández et al. 2014). If the normality criterion was met, Student *t* analyses were computed for independent samples in order to compare group scores by gender, marital status, employability status and previous experience with virtual courses. In addition to this test, one-way ANOVA analyses and the univariate linear model with Scheffé post hoc tests were performed to find significant differences between the groups compared. In case of non-compliance with normality, the Mann-Whitney U test will be used.

On the other hand, the linear relationship between quantitative variables of the covariance analysis was calculated using the Pearson product-moment correlation coefficient (*r*) with post hoc tests using the partial eta coefficient squared in order to identify the effect size. For this analysis, the statistical program G*Power version 3.1.9.7 was used, which also calculated the size of the statistical power of the results (Cárdenas & Arancibia, 2014). Following Cohen (1986) and Hopkins (2006), a value less than 0.20 was estimated to reflect a trivial effect size, between 0.20 and 0.62 small, between 0.63 and 1.14 medium, between 1.15 and 1.99 large, and greater than or equal to 2 very large. On the other hand, as indicated by Cohen (1988) and Hernández et al. (2014), the absolute values of | *r* | <0.10 reflects a weak association strength, between 0.10 and 0.25 small, between 0.26 and 0.49 medium, between 0.50 and 0.74 considerable, between 0.75 and 0.89 very strong, and ≥0.900 unitary. After the analysis of the findings, these were compared with the previous evidence of primary literature and the conclusions were presented in manifestation of the fulfillment of the objectives and hypotheses raised.

It is important to mention that this work did not aim to correlate student satisfaction with other physical and social factors of the participants, such as their general health status, family harmony, self-esteem levels, sleep quality, and general academic performance scores (grades). All these indicators can be considered in subsequent studies in order to also compare them with student satisfaction levels in virtual environments between different public and private educational levels.

Results

Table 1 identifies the affiliation profile of the participants (N = 3604, SD ± 0.502), where 1782 men (49.4%) and 1822 women (50.6%) participated, all students enrolled at the Autonomous University of Tamaulipas, during

the third school term of 2021. All participants were of legal age. It can be found that the gender percentage was equivalent, and that more than 70% were students between the ages of 18 and 20. A majority percentage (75.9%) of the population was single, and more than 38% were employed at the time of data collection. Of this percentage of the population, more than 80% worked part-time in parallel with their studies, and only a little more than 10% worked full-time. All participants agreed to have previous experience in virtual courses.

Table 1. Affiliation profile of participants (N = 3604, SD ± 0.502).

Gender	Min	Max	M	SD	n	%
Male					1782	49.4
Female					1822	50.6
General age range	18	28	20.49	± 0.552	3604	100.0
18 to 20 years	18	20	19.46	± 0.449	2570	71.3
21 to 25 years	21	25	22.61	± 0.481	882	24.5
More than 25 years	26	28	26.59	± 0.494	151	4.2
Marital status						
Single					2736	75.9
Married or in a common-law relationship					844	23.4
Divorced, separated or widowed					24	0.7
Employability						
Yes, the person works in parallel to his/her studies					1385	38.4
The person does not work					2219	61.6
Working hours*						
Full time					152	10.97
Part time					1233	89.03
Previous experience with virtual courses					3604	100.0

* It is considered from the percentage of participants who worked in parallel to their studies. Min=minimum, Max=maximum, M=arithmetic mean, SD= standard deviation, n= sample size, %= percentage. Source: Own elaboration based on the results collected.

Below, Table 2 shows the basic statistics of the overall findings of the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning scale in Virtual Courses (Kuo et al., 2014). As can be seen, more than 50% of the participants indicated response frequencies of "Often" and "Always" for all items of the factors SSI (student-student interaction), SII (student-instructor interaction), SCI (student-content interaction), AI (self-efficacy in the use of the Internet) and SC (satisfaction with the online course) with the exception of the AA factor (self-regulated learning). Of these dimensions, the SC factor stands out, which showed the most outstanding scores in the "Always" option; in addition to the SII factor, which together with SC showed arithmetic means above 4.0 in all its reagents. No item showed an absence of frequency in any of the intervals of the options and no missing values were reported among the participants' responses.

Table 2. Basic statistics of the results of each item.

I.N	Key	N	Min	Max	M	SD	Err.T	Response options									
								NV		RR		OC		OF		AL	
								Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
1	SSI1	3604	1	5	4.45	1.005	0.017	48	1.3	179	5.0	156	4.3	815	22.6	2406	66.8
2	SSI2	3604	1	5	4.36	0.854	0.014	25	0.7	143	4.0	319	8.9	1141	31.7	1976	54.8
3	SSI3	3604	1	5	3.73	1.233	0.021	206	5.7	343	9.5	1084	30.1	544	15.1	1427	39.6
4	SSI4	3604	1	5	4.43	0.640	0.011	7	0.2	10	0.3	224	6.2	1555	43.1	1808	50.2
5	SSI5	3604	1	5	4.03	0.989	0.016	25	0.7	177	4.9	1024	28.4	807	22.4	1571	43.6
6	SSI6	3604	1	5	4.11	1.113	0.019	203	5.6	150	4.2	389	10.8	1176	32.6	1686	46.8
7	SSI7	3604	1	5	4.20	0.916	0.015	4	0.1	96	2.7	907	25.2	753	20.9	1844	51.2
8	SSI8	3604	1	5	4.26	0.869	0.014	9	0.2	143	4.0	535	14.8	1144	31.7	1773	49.2
9	SII1	3604	1	5	4.36	0.860	0.015	7	0.2	30	0.8	784	21.8	614	17.0	2169	60.2
10	SII2	3604	1	5	4.74	0.556	0.009	16	0.4	24	0.7	43	1.2	714	19.8	2807	77.9
11	SII3	3604	1	5	4.47	0.737	0.012	16	0.4	81	2.2	191	5.3	1238	34.4	2078	57.7
12	SII4	3604	1	5	4.36	0.805	0.013	23	0.6	77	2.1	380	10.5	1210	33.6	1914	53.1
13	SII5	3604	1	5	4.13	0.763	0.012	5	0.1	38	1.1	702	19.5	1597	44.3	1262	35.0
14	SII6	3604	1	5	4.51	0.885	0.015	58	1.6	132	3.7	217	6.0	693	19.2	2504	69.5
15	SCI1	3604	1	5	3.96	0.806	0.103	28	0.8	15	0.4	1027	28.5	1527	42.4	1007	27.9
16	SCI2	3604	1	5	3.69	1.215	0.020	284	7.9	189	5.2	1121	31.1	778	21.6	1232	34.2
17	SCI3	3604	1	5	3.57	1.211	0.021	16	0.4	902	25.0	935	25.9	501	13.9	1250	34.7
18	SCI4	3604	1	5	4.55	0.709	0.012	2	0.1	9	0.2	420	11.7	760	21.2	2413	66.9
19	AI1	3604	1	5	4.67	0.614	0.010	8	0.2	13	0.4	193	5.4	733	20.3	2657	73.7
20	AI2	3604	1	5	4.80	0.466	0.008	9	0.2	10	0.3	21	0.6	627	17.4	2937	81.5
21	AI3	3604	1	5	4.16	0.917	0.015	15	0.4	107	3.0	864	24.0	921	25.6	1697	47.1
22	AI4	3604	1	5	3.94	0.915	0.015	6	0.2	27	0.7	1510	41.9	701	19.4	1359	37.8
23	AI5	3604	1	5	3.87	0.914	0.015	14	0.4	70	1.9	1468	40.7	856	23.8	1196	33.2
24	AI6	3604	1	5	4.42	0.710	0.012	4	0.1	26	0.7	364	11.1	127	35.3	1937	53.7
25	AI7	3604	1	5	4.16	0.878	0.015	6	0.2	38	1.1	994	27.6	893	24.8	1673	46.4
26	AI8	3604	1	5	4.39	0.758	0.013	5	0.1	27	0.7	496	13.8	1113	30.9	1963	54.5
27	AA1	3604	1	5	3.87	0.873	0.015	994	27.6	1325	36.8	1135	31.5	135	3.7	15	0.4
28	AA2	3604	1	5	3.84	1.043	0.017	6	0.2	366	10.2	1169	32.4	732	20.3	1331	36.9
29	AA3	3604	1	5	4.09	0.971	0.016	19	0.5	237	6.6	726	20.1	1045	29.0	1577	43.8
30	AA4	3604	1	5	3.64	1.061	0.018	17	0.5	435	12.1	1508	41.8	520	14.4	1124	31.2
31	AA5	3604	1	5	3.58	1.137	0.019	65	1.8	704	19.5	915	25.4	929	25.8	991	27.5
32	AA6	3604	1	5	3.68	1.019	0.017	23	0.6	337	10.5	1363	37.8	808	22.4	1033	28.7
33	AA7	3604	1	5	3.88	0.980	0.016	14	0.4	272	7.5	1076	29.9	1016	28.2	1226	34.0
34	AA8	3604	1	5	3.58	1.044	0.017	910	25.2	829	23.0	1363	37.8	446	12.4	56	1.6
35	AA9	3604	1	5	3.87	0.960	0.016	27	0.7	133	3.7	1357	37.7	843	23.4	1244	34.5
36	AA10	3604	1	5	3.79	0.998	0.017	26	0.7	292	8.1	1224	34.0	943	26.2	1119	31.0
37	AA11	3604	1	5	3.61	0.956	0.016	34	0.9	209	5.8	1785	49.5	669	18.6	907	25.2
38	AA12	3604	1	5	3.72	1.063	0.018	76	2.1	389	10.8	1068	29.6	1018	28.2	1053	29.2
39	SC1	3604	1	5	4.71	0.603	0.010	2	0.1	4	0.1	264	7.3	481	13.3	2853	79.2
40	SC2	3604	1	5	4.23	0.971	0.015	18	0.5	288	8.0	408	11.3	1027	28.5	1863	51.7
41	SC3	3604	1	5	4.25	0.747	0.012	5	0.1	8	0.2	611	17.0	1424	39.5	1556	43.2
42	SC4	3604	1	5	4.36	0.938	0.016	21	0.6	205	5.7	428	11.9	740	20.5	2210	61.3
43	SC5	3604	1	5	4.68	0.756	0.013	16	0.4	104	2.9	231	6.4	301	8.3	2952	81.9

I.N= item number, Key=factor nomenclature, SSI=student-student interaction, SII=student-instructor interaction, SCI=student-content interaction, AI=self-efficacy in the use of the internet, AA=self-regulated learning, SC=satisfaction with the virtual course, N=population, Min=minimum, Max=maximum, M=arithmetic mean, SD= standard deviation, Err.T= typical error, NV=never, RR=rarely, OC=occasionally, OF=often, AL=Always, Fr= frequency, %=percentage. Source: Own elaboration based on data collected from the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning in Virtual Courses Scale (Kuo, et al. 2014).

In Table 3, the achievement levels reached by the participants in each of the factors were calculated. As can be seen, the achievement levels of the "very high" category reported the highest scores in each factor, highlighting the dimensions SSI, SII, AI, AA and SC that did not indicate frequencies at the "very low" and "low" levels, with the exception of the SCI factor that presented a "high" achievement level. But in general, none of the dimensions showed frequencies at the "very low" level. The AI self-efficacy factor was distinguished by the absence of frequency at the "very low", "low" and "regular" levels and the SC satisfaction factor showed scores above 95% at the "very high" and "high" levels, so evidence can be provided to support H3: "Most of the students show high levels of satisfaction in the virtual courses they took at the Autonomous University of Tamaulipas in 2021, during the Covid-19 pandemic"

Table 3. Achievement levels by factor.

Level of achievement	Fr	%	% Valid	% Accumulated
Student-student interaction factor (SSI)				
Student-student interaction very low	0	0	0	0
Student-student interaction low	0	0	0	0
Student-student interaction average	4	0.1	0.1	0.1
Student-student interaction high	1193	33.1	33.1	33.2
Student-student interaction very high	2407	66.8	66.8	100.0
Totals	3604	100.0	100.0	
Student-instructor interaction factor (SII)				
Student-instructor interaction very low	0	0	0	0
Student-instructor interaction low	0	0	0	0
Student-instructor interaction average	2	0.1	0.1	0.1
Student-instructor interaction high	488	13.5	13.5	13.6
Student-instructor interaction very high	3114	86.4	86.4	100.0
Totals	3604	100.0	100.0	
Student-content interaction factor (SCI)				
Student-content interaction very low	0	0	0	0
Student-content interaction low	2	0.1	0.1	0.1
Student-content interaction average	209	5.8	5.8	5.8
Student-content interaction high	2039	56.5	56.5	62.3
Student-content interaction very high	1354	37.6	37.6	100.0
Totals	3604	100.0	100.0	
Self-efficacy in the use of the Internet factor (AI)				
Self-efficacy in the use of the Internet very low	0	0	0	0
Self-efficacy in the use of the Internet low	0	0	0	0
Self-efficacy in the use of the Internet average	0	0	0	0
Self-efficacy in the use of the Internet high	725	20.1	20.1	20.1
Self-efficacy in the use of the Internet very high	2879	79.9	79.9	100.0
Totals	3604	100.0	100.0	
Self-regulated learning factor (AA)				
Self-regulated learning very low	0	0	0	0
Self-regulated learning low	0	0	0	0
Self-regulated learning average	19	0.5	0.5	0.5
Self-regulated learning high	2963	82.2	82.2	82.7
Self-regulated learning very high	622	17.3	17.3	100.0
Totals	3604	100.0	100.0	
Satisfaction with the virtual course factor (SC)				
Satisfaction with the virtual course very low	0	0	0	0
Satisfaction with the virtual course low	0	0	0	0
Satisfaction with the virtual course average	6	0.2	0.2	0.2
Satisfaction with the virtual course high	627	17.4	17.4	17.6
Satisfaction with the virtual course very high	2971	82.4	82.4	100.0
Totals	3604	100.0	100.0	

Fr=frequency, %=percentage, % Valid=valid percentage, % Accumulated=accumulated percentage. Source: Own elaboration based on data collected.

To perform the inferential analysis, the Kolmogorov-Smirnov test of bilateral asymptotic significance with Lilliefors correction showed a normal distribution fit in all the factors of the Scale (SSI: │Dmax│= 0.139, p>0.05; SII: │Dmax│= 0.154, p>0.05; SCI: Dmax│= 0.110, p>0.05; AI: │Dmax│= 0.098, p>0.05; AA: │Dmax│= 0.059, p>0.05; SC: │Dmax│= 0.105, p>0.05), in addition to the Levene test (p = 0.228, p>0.05) for equality of variances. Which admitted the normality factor to compute the ANOVA analyses between the results obtained.

In this sense, the Student *t* test and one-way ANOVA analysis showed that there were no significant differences between men (n = 1782, M = 33.55, SD ± 2.629) and women (n = 1822, M = 33.49, SD ± 2.762) regarding the SSI factor of Student-Student Interaction (*t* = -0.426, P > 0.682, p > 0.05, 95% CI [-0.218, 0.141]; ANOVA F = 0.181, P = 0.670, p > 0.05) in all participants, as well as for the other dimensions of Student-Instructor Interaction (men M = 26.60, SD ± 1.894; women M = 26.55, SD ± 1.881; *t* = 0.768, P > 0.644, p > 0.05, 95% CI [-0.075, 0.172]; ANOVA F = 0.589, P = 0.443, p > 0.05), Student-Content Interaction (males M = 15.81, SD ± 2.036; females M = 15.64, SD ± 2.046; *t* = 0.960, P > 0.337, p > 0.05, 95% CI [-0.068, 0.199]; ANOVA F = 0.922, P = 0.337, p > 0.05), Self-efficacy in the use of the Internet (males M = 34.38, SD ± 2.282; women M = 34.43, SD ± 2.546; *t* = -0.616, P > 0.473, p > 0.05, 95% CI [-0.203, 0.094]; ANOVA F = 0.514, P = 0.462, p > 0.05), Self-Regulated Learning (men M = 45.17, SD ± 3.613; women M = 45.12, SD ± 3.442; *t* = 0.419, P > 0.676, p > 0.05, 95% CI [-0.181, 0.280]; ANOVA F = 0.175 P = 0.676, p > 0.05), Satisfaction with the virtual course (Men M = 22.27, SD ± 1.840; Women M = 22.20, SD ± 1.845; *t* = 0.676, P > 0.499, p > 0.05, 95% CI [-0.079, 0.162]; ANOVA F = 0.457, P = 0.499, p > 0.05), which provided evidence to reject H4: "The gender of the participants does NOT differ significantly (p < 0.05) between their results".

The ANOVA test of the univariate linear model showed no significant differences (p > 0.05) between the 3 age groups (Table 1) in five factors (SSI, SII, SCI, AI and AA) of the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning Scale in Virtual Courses (Kuo et al. 2014): (SSI [F = 0.115, P = 0.995, p > 0.05]; SII [F = 0.378, P = 0.685, p > 0.05]; SCI [F = 0.756, P = 0.460, p > 0.05]; AI [F = 0.646, P = 0.524, p > 0.05]; and AA [F = 2.760, P = 0.062, p > 0.05], except for the SC factor, which did present significant differences ([F = 3.052, P = 0.047, p > 0.05, small effect size η^2=0.41, 1-β=.60]), which allowed the Scheffé post hoc analysis for this factor, which revealed that older participants (over 25 years old) (M = 23.68, SD ± 1.760) had significantly greater satisfaction with virtual courses (P = 0.048, p < 0.05) than younger students (18 to 20 years old M = 22.19, SD ± 1.651; 21 to 25 years old M = 22.23, SD ± 1.823), although with a small effect size difference (η^2=0.42, 1-β=.80). This provided evidence to support H6: "Older participants show significant (p < 0.05) higher satisfaction scores than younger participants".

On the other hand, marital status (Table 1) was generally not a differentiating aspect between the participants' scores. The ANOVA test of the univariate linear model showed no significant differences between the 3 groups for each of the factors (SSI [F = 0.042, P = 0.961, p > 0.05]; SII [F = 1.104, P = 0.332, p > 0.05]; SCI [F = 0.378, P = 0.685, p > 0.05]; AI (F = 0.141, P = 0.868, p > 0.05]; AA [F = 1.823, P = 0.162, p > 0.05], and SC [F = 2.175, P = 0.114, p > 0.05]), so it did not admit the post hoc analysis. Likewise, the employability status also showed no significant differences (p > 0.05) between the groups. of participants who worked in parallel to their studies in part-time, full-time modalities, or who did not work (SSI [F = 0.493 , P = 0.611, p > 0.05]; SII [F = 1.143 , P = 0.319, p > 0.05]; SCI [F = 0.522 , P = 0.594, p > 0.05]; AI [F = 0.805 , P = 0.447, p > 0.05]; AA [F = 1.924 , P = 0.146, p > 0.05], and SC [F = 2.846 , P = 0.053, p > 0.05]) which provides evidence to not support H5: "Marital status and employability status do NOT lead to significant differences (p > 0.05) between the scores obtained by the participant".

Table 4 below presents the correlations between the dimensions of the Satisfaction,

Interaction, Self-Sufficiency and Self-Regulated Learning scale in Virtual Courses (Kuo et al. 2014), in order to determine the degree of relationship between its factors. As can be seen, all the factors show positive correlations with each other, although most are not significant ($p > 0.05$). However, the virtual course satisfaction factor (SC) showed a significant correlation ($p < 0.05$, with a small effect size $\eta^2 = .41$) with the student-instructor interaction factor (SII). Based on the above, H1 is supported: "Student interaction with teacher show significant correlations ($p < 0.05$) with student satisfaction in virtual courses". This means that interpersonal contact between the professor and the student is a relevant aspect for their satisfaction in virtual courses. On the contrary, the link between student-student interpersonal interaction (SSI) and the satisfaction factor (SC) although they presented positive relationships, were not significant ($p > 0.05$), as well as its correlation with student-content interaction (SCI).

Table 4. Correlations between the factors of the Satisfaction, Interaction, Self-Sufficiency and Self-Regulated Learning scale in Virtual Courses (Kuo et al. 2014) (N = 3604, SD ± 0.502).

Factor	Statistical	SSI	SII	SCI	AI	AA	SC
SSI		-					
SII	*r*	.064	-				
	Sig.	.211					
	η2	.25					
	1-β	.98					
SCI	*r*	.058	.084	-			
	Sig.	.140	.223				
	η2	.24	.28				
	1-β	.98	.98				
AI	*r*	.080	.038	.113	-		
	Sig.	.181	.249	.059			
	η2	.28	.19	.34			
	1-β	.98	.96	.99			
AA	*r*	.056	.109	.068	.042	-	
	Sig.	.344	.072	.161	.229		
	η2	.22	.34	.26	.20		
	1-β	.98	.99	.98	.96		
SC	r	.115	.218*	.104	.361*	.098	-
	Sig.	.058	.042	.074	.028	.063	
	η2	.34	.41	.32	.60	.31	
	1-β	.99	1	.99	1	.98	

*p<.05. r=Pearson correlation coefficient, η2=effect size by eta squared coefficient (Cohen, 1992).
1-β=power test, SSI=student-student interaction, SII=student-instructor interaction, SCI=student-content interaction, AI=self-efficacy in the use of the internet, AA=self-regulated learning, SC=satisfaction with the virtual course. Source: Own elaboration based on the results obtained.

Finally, the SC factor presented a considerable and significant positive correlation ($p < 0.05$, medium effect size $\eta2=.60$) with self-efficacy in the use of the internet (AI). This means that student autonomy and self-sufficiency on the Internet was the most important aspect among participants for their satisfaction in the virtual course. These data provided evidence to support H2: "Self-efficacy in internet use show significant correlations ($p < 0.05$) with student satisfaction in virtual courses".

Discusión

The correlational findings of this study are consistent with data reported by Bolliger and Martindale (2004), Chejlyk (2006), Chang and Smith (2008), Lin et al (2015), and Elshami et al. (2021) who identified that student-instructor interaction was an important aspect for university student satisfaction in the virtual

modality. On the other hand, according to the findings of Kuo et al. (2013) and Shyju et al. (2021), self-efficacy in the use of the Internet was the most outstanding factor for the student satisfaction of the participants. In this sense, Eastin and LaRose (2000) and Liang and Tsai (2008) indicate that self-sufficiency in the use of the Internet and software for virtual courses is a preferred factor for satisfaction, because it is the medium where the student must work with the greatest degree of ease and freedom. If the effectiveness of digital media management becomes scarce, the probability of satisfaction tends to decrease.

Unlike the study by Kuo et al (2014) who reported that student-teacher and student-content interaction were the best factors related to satisfaction, in this study, only the student-instructor bond stood out in a preponderant way. A similarity of this research with the findings of Kuo et al (2014) is that student-student interpersonal interaction did not show significant relationships for student satisfaction in the virtual modality. Data like those reported by Chejlyk (2006) and Lin et al (2015).

On the other hand, unlike the study by Alqurashi (2018), the gender samples were equivalent, however the results regarding the scores obtained did not show significant differences ($p > 0.05$) between men and women in any of the factors analyzed. These data agree with Elshami et al. (2021) who indicated that the gender of the participants did not present differences between them regarding their scores. The findings in this regard provided evidence that supported H4: “The gender of the participants does NOT differ significantly ($p < 0.05$) between their results”.

On the other hand, H5 was supported: “Marital status and employability status do NOT lead to significant differences ($p > 0.05$) between the scores obtained by the participant”, mainly because no significant differences were found between the participants' marital status and their employability status with respect to the scores obtained. This means that gender, marital status and employability were not indicators that significantly influenced the participants' responses.

Among other findings, it was found that more than 80% of the participants were willing to retake a course under the virtual modality; in addition, older students (over 25 years old) showed higher and significant scores ($p < 0.05$) of satisfaction than younger students. This supported H6: "Older participants show significant ($p < 0.05$) higher satisfaction scores than younger participants". In this sense, Reimers (2021) indicates that higher age ranges may show greater motivation for their studies because they are commonly employed in parallel with their schooling, however, in this study no significant differences were found ($p > 0.05$) between students who were working and those who were not employed.

Conclusion

It was possible to identify that most of the students showed high levels of satisfaction in the virtual courses, supporting H3: “Most of the students show high levels of satisfaction in the virtual courses they took at the Autonomous University of Tamaulipas in 2021, during the Covid-19 pandemic”. It is worth mentioning that the virtual courses were designed based on the parameters of the Distance Education model of the Autonomous University of Tamaulipas during the year 2021.

Answering the research question: What are the most influential factors that enhance virtual education in a Post-Covid stage?, the essence of the data showed that H1: " Student interaction with teacher show significant correlations ($p < 0.05$) with student satisfaction in virtual courses" and H2: "Self-efficacy in internet use show significant correlations ($p < 0.05$) with student satisfaction in virtual courses"; were the factors that most influenced student satisfaction under the virtual modality. On the other hand, the links between student-student interaction (SSI), student-content interaction (SCI) and self-regulated learning (AA) in relation to the satisfaction factor (SC), although they presented positive relationships, were not significant ($p > 0.05$), presenting

incidences (medium-high). It is worth mentioning that interactive teaching materials should be incorporated, designed with emerging technologies (gamification, augmented reality, including artificial intelligence) that not only stimulate students' intrinsic motivation, but also allow them to build their own learning, enhancing virtual education in a Post-Covid stage.

It is important to mention that more than 80% of the students who participated in this research expressed their willingness to continue studying online, with older participants showing greater satisfaction, regardless of their marital status and employability status. Complementing the above, no significant differences were found between the participants' gender, their employability status and their age range with respect to the scores obtained.

Finally, as with all research, there were limitations. In this sense, it is important to mention that of the 17,285 students enrolled in the faculties that participated in this research, only 3,604 students used the Campus Online system and were subject to attention and follow-up based on the UAT Distance Education model, having the opportunity to know the perception and satisfaction of the virtual courses they took during the Covid-19 pandemic. It would have been interesting to know the perception and satisfaction of the other students who used other electronic platforms available at the university.

Overall, the results of this research also provided evidence that students have changed, that is, after developing digital skills to learn during the pandemic, today students value the flexibility of virtual education more. Based on the above, universities in a Post-Covid stage must move towards multimodal models with the aim of diversifying their teaching/learning options, fundamentally to be able to meet the new educational demands at a higher level.

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Author Contribution (DCC)**:** Data analysis, validation test design and data correlation techniques, to identify significant differences.

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