

Students' Perception about the Use of an Educational Web Application During the COVID-19 Pandemic

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Abstract: SARS-CoV-2 virus has caused universities to update their courses in the distance modality. The general aim of this mixed research was to build and analyse the use of a web application for the educational process about the t-test considering data science. In particular, the professor of the Teaching of Mathematics II course needed to update the school activities because of the new educational demands caused by the COVID-19 pandemic. To facilitate the educational process of math, this teacher decided to build a web application that presents the formulas and calculation of the mean, standard deviation and statistical error to understand the use of the t-test. This technological tool allows the personalisation of learning through the simulation of data. The participants were 42 students from a Mexican university. The results of machine learning indicated that the contents of the web application positively influenced the assimilation of knowledge, satisfaction during the learning process, development of mathematical skills and learning in the distance modality. The decision tree technique allows the construction of four (4) predictive models about the use of the web application for the educational process about the t-test. Finally, educators have the opportunity to improve the teaching-learning conditions during the SARS-CoV-2 virus through the design and construction of web applications.

Keywords: ICT, data science, learning, higher education, web application.

Introduction

Universities currently seek to improve their educational quality through the incorporation of Information and Communication Technologies (ICTs) in school activities (Guillén-Gómez, Mayorga-Fernández, & Ramos, 2021; Huang & Zhu, 2021; Ocampo-Alvarado & Ullauri-Ugarte, 2021). In fact, teachers are modifying the planning and organisation of courses through technological tools in order to face the new challenges caused by the SARS-CoV-2 virus (Alawajee, 2021; Amka & Dalle, 2022; Demir & Gologlu-Demir, 2021).

Technological advances such as the Learning Management System (LMS), videoconferencing systems and web applications allow the organisation of new virtual educational spaces where students actively participate inside and outside the classroom (Gormaz-Lobos et al., 2022). Therefore, educators use these digital tools to facilitate the communication, consultation of the school content, review of multimedia resources and interaction with the participants of the educational process (Pham et al., 2022; Prevalla et al., 2022).

Technological tools on the internet such as web applications play a fundamental role during the organisation and realisation of new activities because they promote the active role of the students



before, during and after classes (Cabero-Almenara et al., 2021; Fan et al., 2021; Grunis et al., 2021). Even distance courses are increasing to meet the educational demands of the students in the 21st century (Arsarkij & Laohajatsang, 2021; Chambi-Mescoco, 2021; Maheshwari, 2021).

Educators can improve the learning process from anywhere and encourage the participation of the students at any time by building educational web applications (Halvoník & Psenak, 2021; Huang & Zhu, 2021; Rodriguez-Lora & Herrera-Caballero, 2021). Likewise, web tools allow the autonomy of the students during the educational process (Demir, Kaleli-Yilmaz, & Sert-Celik, 2021; Fan et al., 2021; Tawafak, Alfarsi, & Jabbar, 2021).

Due to the COVID-19 pandemic, universities have modified the activities of their courses with the support of ICTs to improve the teaching-learning conditions in the distance modality. In particular, the educator of the Teaching of Mathematics II course needed to update school activities because of the new educational demands caused by the SARS-CoV-2 virus. To facilitate the educational process for math, this teacher decided to build a web application that presents the formulas and calculation of the mean, standard deviation and statistical error in order to understand the use of the t-test. This technological tool allows the personalisation of learning through the simulation of data.

Research Questions

The general aim of this mixed research was to build and analyse the use of the web application for the educational process about the t-test using the techniques of data science. The research questions are:

- How do the contents of the web application influence the assimilation of knowledge, satisfaction during the learning process, development of mathematical skills and learning in the distance modality, considering the machine learning technique?
- What are the predictive models about the use of the web application considering the decision tree technique?
- What is the perception of the students about the use of the web application during the COVID-19 pandemic?

Hypotheses

The research hypotheses in this study were the following:

- Hypothesis 1 (H1): The contents of the web application positively influence the assimilation of knowledge.
- Hypothesis 2 (H2): The contents of the web application positively influence satisfaction during the learning process.
- Hypothesis 3 (H3): The contents of the web application positively influence the development of mathematical skills.
- Hypothesis 4 (H4): The contents of the web application positively influence the learning in the distance modality.

Literature Review

Online Learning During the Pandemic

During the COVID-19 pandemic, educators faced the challenge of searching for and using new technological tools to carry out the teaching-learning process in the distance modality (Choiriyah et al., 2022; Rasool et al., 2022; Zulherman et al., 2021). For example, the Learning Management Systems (LMS) facilitated the distribution of tasks, review of the multimedia resources, participation in discussion forums and realisation of online exams at any time (Pham et al., 2022; Zulherman et al., 2021). In fact, Google Classroom, Canvas and Moodle have a fundamental role because these technological tools facilitate the interaction between the teacher and students (Pham et al., 2022; Zulherman et al., 2021).

On the other hand, videoconferencing systems facilitated the communication between the participants of the educational process, presentation of the course topics and resolution of doubts from any location (Ismail et al., 2022; Prevalla et al., 2022). In particular, educators used Zoom to explain the school content at any time during the COVID-19 pandemic (Ismail et al., 2022; Prevalla et al., 2022).

Likewise, technological tools facilitate the personalisation of learning in the distance modality (Gormaz-Lobos et al., 2022). For example, GeoGebra allows updating the activities of Mathematics courses because this web application facilitates the creation of graphs and the identification of coordinates for linear, quadratic, exponential and logarithmic functions (Salas-Rueda & Salas-Rueda, 2019). The benefits of web applications in the educational field are the consultation with information, interaction with school content and active participation of the students from any location (Choiriyah et al., 2022; Zygouris et al., 2017).

Likewise, Rajabalee et al. (2018) explain the level of students' online participation considering use of discussion forums, online quizzes, blogs, YouTube videos, educational websites and the application of eLearning for knowledge acquisition, critical thinking skills, understanding and practical competencies. In conclusion, the incorporation of technological advances such as LMS, videoconferencing systems and web applications improved the teaching-learning conditions, promoted the active role of the students and facilitated the performance of school activities during the COVID-19 pandemic (Choiriyah et al., 2022; Rasool et al., 2022).

Construction and Use of Technological Tools

The design and construction of technological tools play a fundamental role in facing the challenges caused by the COVID-19 pandemic (Georgieva-Tsaneva & Serbezova, 2021; Liu & Lu, 2021). In fact, the creation and use of technological applications improved the teaching-learning process about the English language (Huang & Zhu, 2021), Computing (Halvoník & Psenak, 2021), Mathematics (Fan et al., 2021) and Medicine (Georgieva-Tsaneva & Serbezova, 2021).

Technological advances open the possibility of creating new virtual spaces for teaching and learning (Arsarkij & Laohajaratsang, 2021; Huang & Zhu, 2021; Liu & Lu, 2021). In Bulgaria, the construction of web games allowed updating school activities in the courses on medicine (Georgieva-Tsaneva & Serbezova, 2021). The use of these technological tools also facilitated the assimilation of knowledge about nursing and developed the skills of the students (Georgieva-Tsaneva & Serbezova, 2021).

In the English course, Huang and Zhu (2021) built a technological tool that allowed the consultation with multimedia resources such as audios, videos and digital presentations from any location. Likewise, Halvoník and Psenak (2021) built a technological application to facilitate the assimilation of knowledge about computing through a virtual assistant.

In the field of mathematics, Fan et al. (2021) built a web system to facilitate the selection of the courses through Bayes' Theorem and the profile of the students. Similarly, Liu and Lu (2021) proposed the construction of web applications to increase the academic performance and motivation of the students, promote the active participation from anywhere and facilitate distance learning.

Finally, educational institutions can update course activities, encourage the active role, facilitate the assimilation of knowledge and develop the students' skills through the construction of technological applications (Fan et al., 2021; Georgieva-Tsaneva & Serbezova, 2021; Halvoník & Psenak, 2021). Even Fan et al. (2021) mention that web tools are the future of education.

Use of Data Science

Currently, data science allows organising and identifying hidden information to establish the relationships between phenomena (Mi et al., 2022; Zheng & Na, 2021). In fact, this is used by researchers in various fields such as medicine, engineering and education to facilitate decision making (Mi et al., 2022). For example, the techniques of data science such as linear regression, decision trees and neural networks allow identifying the patterns to classify and evaluate the information (Zheng & Na, 2021).

In the educational field, the machine learning technique allowed evaluation of the use of technological tools before, during and after face-to-face sessions through linear regression (Salas-Rueda, 2021). Likewise, the decision tree technique facilitated the identification of the predictive conditions between the independent and dependent variables related to the incorporation of ICTs in the teaching-learning process (Salas-Rueda, 2021).

On the other hand, Parahoo et al. (2016) built a predictive model about the satisfaction of the students in online higher education considering the marketing construct of university reputation, physical facilities, faculty empathy and interactions.

According to Zheng and Na (2021), the machine learning technique (linear regression) allowed for identification of the influence of students' emotions on their academic performance during the English language course. In the same way, Mi et al. (2022) used the neural networks, decision trees and regression to find out what are the factors that affect the academic performance of the students in the distance modality.

Finally, the techniques of data science allow finding patterns, identifying hidden information and evaluating the relationship between phenomena in order to facilitate decision making (Mi et al., 2022; Nuankaew et al., 2019).

Methods

The particular aims of this mixed research were: (1) analyse the perception of the students about the use of the web application for the assimilation of knowledge, satisfaction during the learning process, development of mathematical skills and learning in the distance modality through the machine

learning technique, (2) build the predictive models about the web application considering the profile of the students through the decision tree technique, and (3) analyse the perception of the students about the use of the web application during the COVID-19 pandemic.

Sample

The participants were 42 students (20 men and 22 women) in Mathematics and Computer Science. The average age was 22.85 years. These participants studied in the Faculty of Sciences at the National Autonomous University of Mexico during the 2021 school year. The type of sampling was non-probabilistic.

Tools Used

The educator of the Teaching of Mathematics II course used the PHP programming language to build the web application about the t-test (see Figure 1). This technological tool is available at: <http://sistemasusables.com/2022/aplicacion/inicio.html>

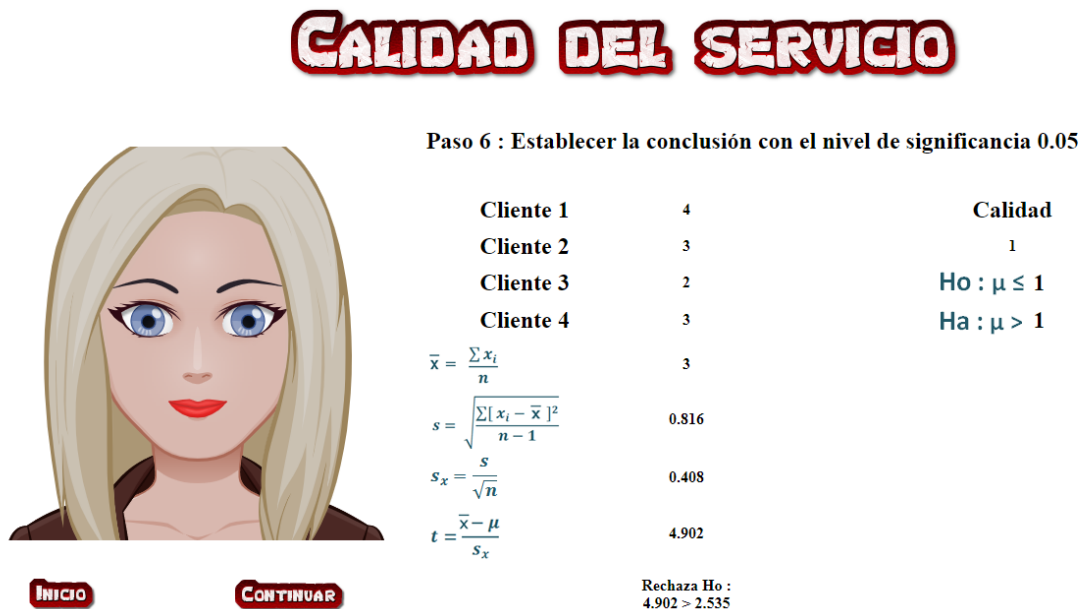


Figure 1: Web application about the t-test

The ADDIE model facilitated the planning and organisation of the educational web application about the t-test (see Table 1).

Table 1: The ADDIE Model

No.	Stage	Aspects	Description
1	Analysis	Problem	Due to the Covid-19 pandemic, universities have modified the activities of the courses with the support of ICTs to improve the teaching-learning conditions in the distance modality
		Educational context	In particular, the educator of the Teaching of Mathematics II course needed to update the school activities because the new educational demands caused by the SARS-CoV-2 virus
		Learning objectives	Understand the calculation and use of the t-test Understand the establishment of hypotheses Understand and use the formulas about the mean, standard deviation and statistical error
2	Design	Strategy	Construction of the educational web application about the t-test
3	Development	Web Application	Step 1: Establish the hypotheses
			Step 2: Show the calculation of the mean
			Step 3: Show the calculation of the standard deviation
			Step 4: Show the calculation of the statistical error
			Step 5: Show the calculation of the t-test
4	Implementation	Distribution	Internet
5	Evaluation	Data collection	Data collection through a questionnaire

Figure 2 shows the model used to analyse the students' perceptions about the web application.

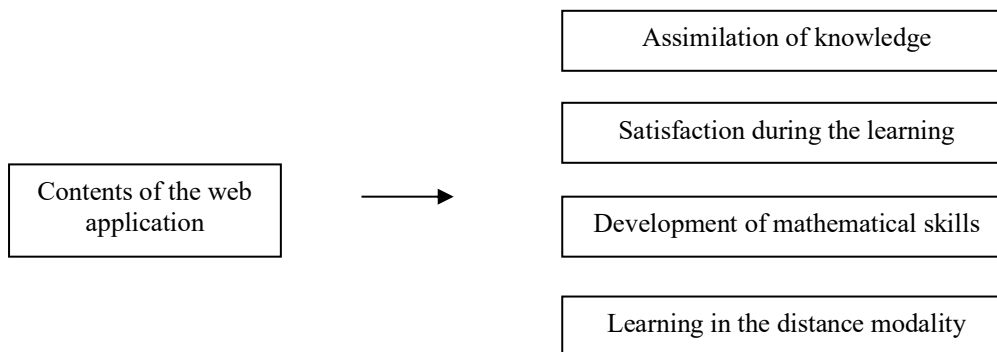


Figure 2: Model used in this research

Various authors (e.g., Arsarkij & Laohajaratsang, 2021; Huang & Zhu, 2021; Liu & Lu, 2021) explain that technological advances such as web applications allow organising new school activities and improving teaching-learning conditions in the distance modality.

The decision tree technique allows identifying the following predictive models about the educational web application:

- Predictive Model 1 (PM1) about the contents of the web application and assimilation of knowledge.
- Predictive Model 2 (PM2) about the contents of the web application and satisfaction during the learning process.

- Predictive Model 3 (PM3) about the contents of the web application and development of mathematical skills.
- Predictive Model 4 (PM4) about the contents of the web application and learning in the distance modality.

Instrument

Table 2 shows the questionnaire used for data collection during the 2021 school year.

Table 2: Questionnaire

No.	Variable	Dimension	Question	Answer	n	%
1	Profile of the students	Sex	1. What is your sex?	Man	20	47.62%
				Woman	22	52.38%
	Age	2. What is your age?	21 years	7	16.67%	
			22 years	14	33.33%	
			23 years	7	16.67%	
			24 years	6	14.29%	
			25 years	8	19.05%	
	Contents	3. The contents of the web application facilitate the creation of new educational virtual spaces	Very much (1)	17	40.48%	
			Much (2)	17	40.48%	
			Little (3)	6	14.29%	
Very little (4)			2	4.76%		
Assimilation of knowledge	4. The web application facilitates the assimilation of knowledge	Very much (1)	16	38.10%		
		Much (2)	18	42.86%		
		Little (3)	4	9.52%		
		Very little (4)	4	9.52%		
2	Web application about the T-Test	Satisfaction during the learning process	5. The web application increases the satisfaction during the learning process	Very much (1)	16	38.10%
			Much (2)	18	42.86%	
			Little (3)	4	9.52%	
			Very little (4)	4	9.52%	
	Development of mathematical skills	6. The web application facilitates the development of mathematical skills	Very much (1)	17	40.48%	
			Much (2)	16	38.10%	
			Little (3)	7	16.67%	
			Very little (4)	2	4.76%	
Distance modality	7. The web application facilitates the learning in the distance modality	Very much (1)	20	47.62%		
		Much (2)	13	30.95%		
		Little (3)	6	14.29%		
		Very little (4)	3	7.14%		
3	Students' perception	Use	8. What are the benefits about the use of the web application in the educational field?	Open	-	-

Table 3 shows the validation of the questionnaire by means of Load factor, Cronbach's Alpha and Composite Reliability.

Table 3: Validation of the Questionnaire

Variable	Dimension	Load Factor	Cronbach's Alpha	Average Variance Extracted	Composite Reliability
Web application about the t-test	Contents	0.885	0.965	0.705	0.978
	Assimilation of knowledge	0.950			
	Satisfaction during the learning process	0.956			
	Development of mathematical skills	0.963			
	Distance modality	0.928			

The RapidMiner tool allows evaluating the research hypotheses by means of the machine learning technique (linear regression) and building the predictive models by means of the decision tree technique. In the machine learning technique, 60%, 70% and 80% of the sample (training section) allow the calculation of linear regressions and 40%, 30% and 20% of the sample (evaluation section) allow identification of the accuracy of these linear regressions through the squared error (see Figure 3). Also, the independent variable is the contents of the web application about the t-test. On the other hand, the dependent variables are the assimilation of knowledge, satisfaction during the learning process, development of mathematical skills and learning in the distance modality.

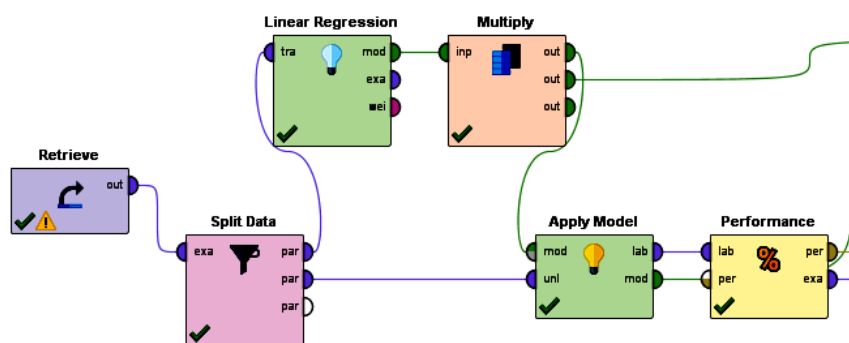


Figure 3: Use of RapidMiner for the machine learning technique

The student's profile (sex and age) allowed the construction of the predictive models in the use of the educational web application about the t-test. The target variables were the assimilation of knowledge, satisfaction during the learning process, and the development of mathematical skills and learning in the distance modality through the decision tree technique (see Figure 4).

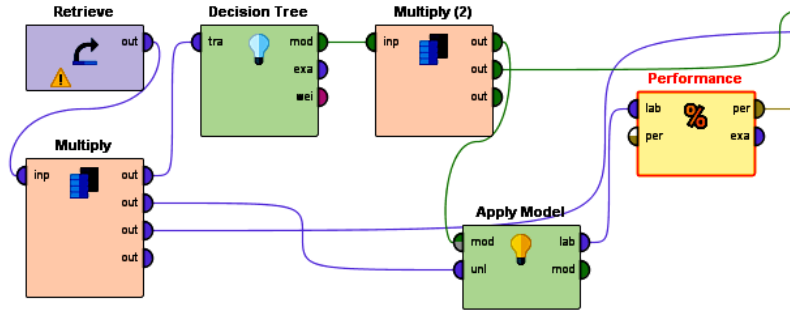


Figure 4: Use of RapidMiner for the decision tree technique

On the other hand, the word cloud application allows identifying the words with the highest frequency.

Findings

The contents of the web application facilitate very much ($n = 17, 40.48\%$), much ($n = 17, 40.48\%$), little ($n = 6, 14.29\%$) and very little ($n = 2, 4.76\%$) the creation of new educational virtual spaces (see Table 2). Likewise, the results of machine learning indicate that the contents of the web application positively influence the assimilation of knowledge, satisfaction during the learning process, and development of mathematical skills and learning in the distance modality (see Table 4).

Table 4: Results of Machine Learning

Hypothesis	Training	Linear Regression	Conclusion	Value of t	Value of p	Squared Error
H1: Web application → assimilation of knowledge	60%	$y = 0.923x + 0.307$	Accepted: 0.923	6.809	0.000	0.210
	70%	$y = 0.943x + 0.243$	Accepted: 0.943	8.077	0.000	0.255
	80%	$y = 0.949x + 0.147$	Accepted: 0.949	8.363	0.000	0.362
H2: Web application → satisfaction during the learning process	60%	$y = 0.943x + 0.243$	Accepted: 0.943	8.077	0.000	0.399
	70%	$y = 0.886x + 0.325$	Accepted: 0.886	8.074	0.000	0.384
	80%	$y = 0.856x + 0.365$	Accepted: 0.856	7.778	0.000	0.295
H3: Web application → development of mathematical skills	60%	$y = 0.873x + 0.362$	Accepted: 0.873	9.452	0.000	0.274
	70%	$y = 0.898x + 0.292$	Accepted: 0.898	11.192	0.000	0.335
	80%	$y = 0.886x + 0.325$	Accepted: 0.886	11.878	0.000	0.462
H4: Web application → learning in the distance modality	60%	$y = 0.778x + 0.505$	Accepted: 0.778	4.882	0.000	0.328
	70%	$y = 0.814x + 0.414$	Accepted: 0.814	5.923	0.000	0.394
	80%	$y = 0.804x + 0.414$	Accepted: 0.804	6.371	0.000	0.399

Table 5 shows the Pearson's correlations about the use of the educational web application.

Table 5: Pearson Correlations

	Contents	Assimilation of Knowledge	Satisfaction	Development of Mathematical Skills	Distance Modality
Contents	1	-	-	-	-
Assimilation of knowledge	0.808	1	-	-	-
Satisfaction	0.777	0.944	1	-	-
Development of mathematical skills	0.853	0.854	0.884	1	-
Distance modality	0.717	0.839	0.867	0.916	1

Assimilation of Knowledge

The web application facilitates very much (n = 16, 38.10%), much (n = 18, 42.86%), little (n = 4, 9.52%) and very little (n = 4, 9.52%) the assimilation of knowledge (see Table 4). The results of machine learning with 60% (0.923, t-value = 6.809, p-value = 0.000), 70% (0.943, t-value = 8.077, p-value = 0.000) and 80% (0.949, t value = 8.363, p value = 0.000) of training indicate that H1 is accepted (see Table 4.) Consequently, the contents of the web application positively influence the assimilation of knowledge.

Figure 5 shows eight conditions of the PM1 with an accuracy of 88.10%. For example, if the student considers that the contents of the web application very much facilitate the creation of new educational virtual spaces and has an age > 22.5 years then the web application very much facilitates the assimilation of knowledge.

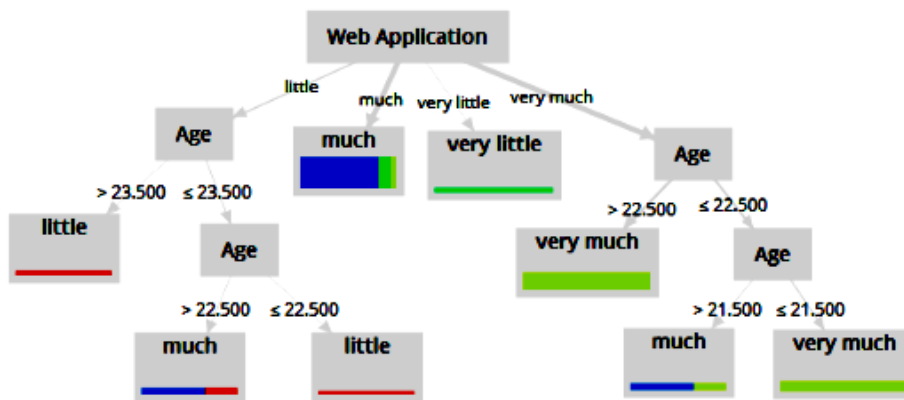


Figure 5: PM1 about the use of the web application

The age of the students determines six conditions of the PM1. For example, if the student considers that the contents of the web application very much facilitate the creation of new educational virtual spaces and has an age ≤ 21.5 years then the web application very much facilitates the assimilation of knowledge.

Satisfaction During the Learning Process

The web application increases very much (n = 16, 38.10%), much (n = 18, 42.86%), little (n = 4, 9.52%) and very little (n = 4, 9.52%) the satisfaction during the learning process (see Table 2). The results of machine learning with 60% (0.943, t-value = 8.077, p-value = 0.000), 70% (0.886, t-value = 8.074, p-value = 0.000) and 80% (0.856, t-value = 7.778, p value = 0.000) of training indicate that H2 is accepted (see Table 4). Consequently, the contents of the web application positively influence satisfaction during the learning process.

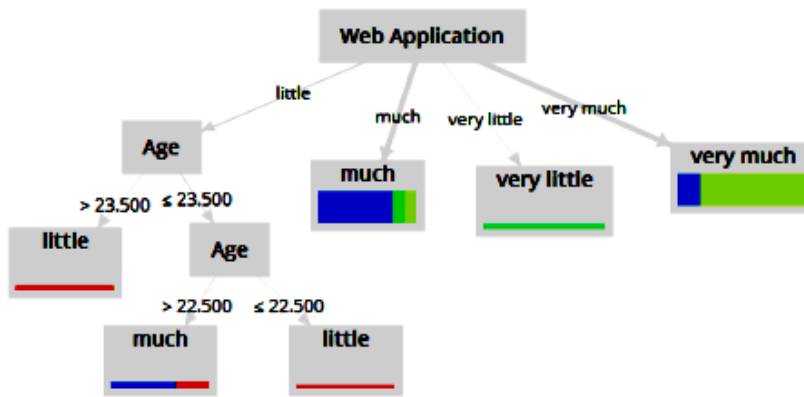


Figure 6: PM2 about the use of the web application

Figure 6 shows six conditions of the PM2 with an accuracy of 80.95%. For example, if the student considers that the contents of the web application very much facilitate the creation of new educational virtual spaces then the web application very much increases the satisfaction during the learning process.

The age of the students determines three conditions of the PM2. For example, if the student considers that the contents of the web application facilitate little the creation of new educational virtual spaces and has an age > 23.5 years then the web application increases satisfaction little during the learning process.

Development of Mathematical Skills

The web application facilitates very much (n = 17, 40.48%), much (n = 16, 38.10%), little (n = 7, 16.67%) and very little (n = 2, 4.76%) the development of mathematical skills (see Table 2). The results of machine learning with 60% (0.873, t-value = 9.452, p-value = 0.000), 70% (0.898, t-value = 11.192, p-value = 0.000) and 80% (0.886, t-value = 11.878, p-value = 0.000) of training indicates that H3 is accepted (see Table 4). Therefore, the contents of the web application positively influence the development of mathematical skills.

Figure 7 shows seven conditions of the PM3 with an accuracy of 85.71%. For example, if the student considers that the contents of the web application very much facilitate the creation of new educational virtual spaces then the web application very much increases the satisfaction during the learning process.

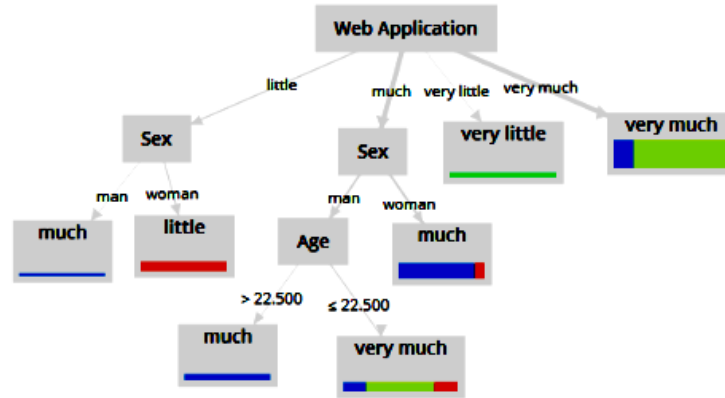


Figure 7: PM3 about the use of the web application

The sex of the students determines five conditions of the PM3. For example, if the student considers that the contents of the web application facilitate little the creation of new educational virtual spaces and is a woman then the web application increases little the satisfaction during the learning process.

Likewise, the age of the students determines two conditions of the PM3. For example, if the student considers that the contents of the web application facilitate much the creation of new educational virtual spaces, has an age > 22.5 years and is a man then the web application increases much the satisfaction during the learning process.

Learning in the Distance Modality

The web application facilitates very much ($n = 20, 47.62\%$), much ($n = 13, 30.95\%$), little ($n = 6, 14.29\%$) and very little ($n = 3, 7.14\%$) the learning in the distance modality (see Table 2). The results of machine learning with 60% (0.778, t -value = 4.882, p -value = 0.000), 70% (0.814, t -value = 5.923, p -value = 0.000) and 80% (0.804, t -value = 6.371, p -value = 0.000) of training indicate that H4 is accepted (see Table 4). Therefore, the contents of the web application positively influence the learning in the distance modality.

Figure 8 shows seven conditions of the PM4 with an accuracy of 80.95%. For example, if a student considers that the contents of the web application very much facilitate the creation of new educational virtual spaces then the web application very much facilitates the learning in the distance modality.

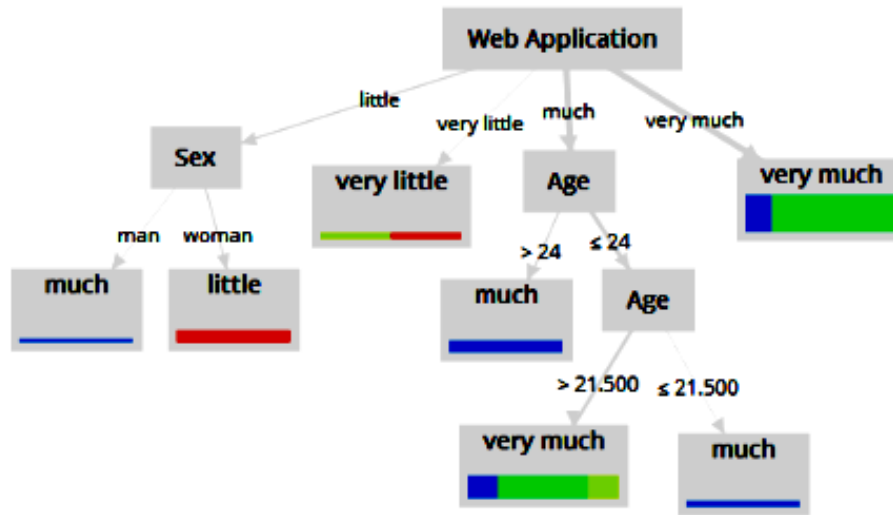


Figure 8: PM4 about the use of the web application

The sex of the students establishes two conditions of the PM4. For example, if the student considers that the contents of the web application facilitate little the creation of new educational virtual spaces and is a woman then the web application facilitates little the learning in the distance modality.

The age of the students establishes three conditions of the PM4. For example, if the student considers that the contents of the web application facilitate much the creation of new educational virtual spaces and has an age > 24 years then the web application facilitates much the learning in the distance modality.

Students' Perception

According to the students, one of the benefits about the use of the educational web application is the flexibility of time and space to carry out the school activities during the teaching-learning process.

- “It allows me to work when I need” (Student 1, 25 years old, man).
- “Learn at your own pace” (Student 17, 25 years old, woman).

Likewise, the educational web application about the t-test allowed the personalisation of learning from anywhere.

- “Different ways of acquiring the knowledge” (Student 3, 21 years old, man).
- “The freedom to manage the time individually and to have more tools at hand when we are studying” (Student 6, 24 years old, man).

The educational web application about the t-test facilitated the learning process because the simulator presents the detailed procedure and formulas for the mean, standard deviation and statistical error.

- “See the steps of a procedure very clearly and interactively” (Student 7, 22 years old, man).
- “It helps me to better understand the mathematical concepts” (Student 9, 21 years old, man).

The incorporation of the web application about the t-test in the school activities increased the motivation of the students during the educational process. Also, this technological tool is interactive.

- “Interactive” (Student 5, 23 years old, woman).
- “It facilitates the learning process and motivates me to learn” (Student 12, 22 years old, woman).

In addition, Figure 9 shows the word cloud about the use of the educational web application. The most common words are: knowledge, better, time, learning, procedure, tools and learn.

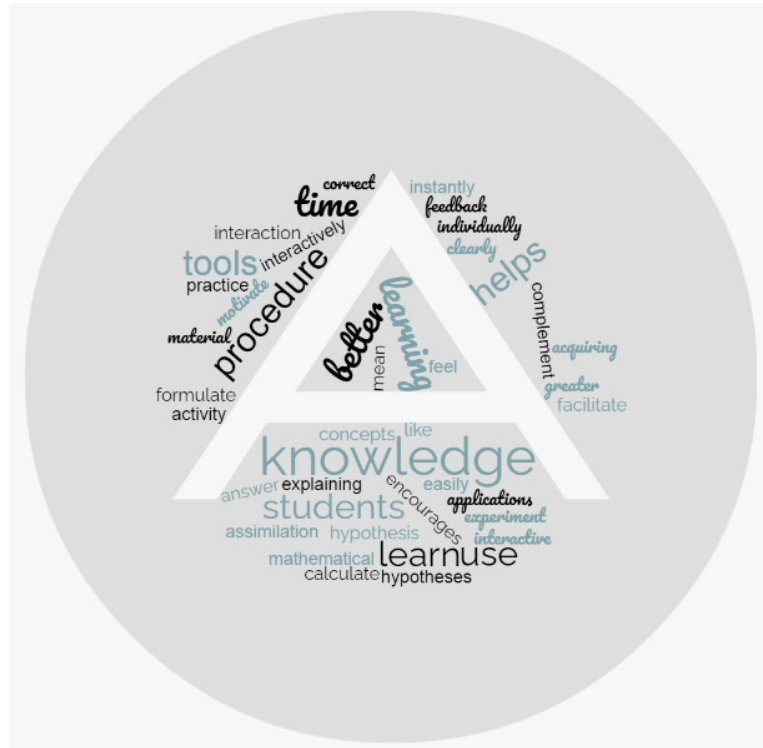


Figure 9: Word cloud about the use of the educational web application

Discussion

Today, universities improve the realisation of the teaching-learning process through the incorporation of technology (Arsarkij & Laohajarsang, 2021; Liu & Lu, 2021). In particular, 40.48% of students consider that the contents of the web application very much facilitate the creation of new educational virtual spaces. In fact, this technological tool facilitates the active role from anywhere through the simulator. Likewise, the contents of the web application facilitate much (n = 17, 40.48%) the creation of new educational virtual spaces. Therefore, most of the students had a favorable opinion about this aspect.

Similar to Dubé et al. (2020), the use of technological tools favors the teaching-learning process about mathematics. In particular, 42.86% of the students think that the web application facilitates much the assimilation of knowledge. In fact, this technological tool allowed the personalisation of learning from

anywhere. Likewise, the web application facilitates very much ($n = 16, 38.10\%$) the assimilation of knowledge. Therefore, most of the participants had a favorable opinion about this aspect.

In the field of mathematics, the incorporation of ICTs improves the learning process inside and outside the classroom (Acikgul & Aslaner, 2020; Akugizibwe & Ahn, 2020; Dubé et al., 2020). The results of machine learning on H1 are higher than 0.920, therefore, the contents of the web application positively influence the assimilation of knowledge.

Data science identifies eight conditions of the PM1 with an accuracy greater than 88.00%. In this predictive model, the age of the students determines how the contents of the web application influence the assimilation of knowledge. Also, the decision tree technique establishes two conditions where the web application very much facilitates the assimilation of knowledge.

In the educational field, ICTs allow the organisation of creative activities that meet the educational needs of the students during the COVID-19 pandemic (Alawajee, 2021; Amka & Dalle, 2022; Halvoník & Psenak, 2021). In particular, 42.86% of students consider that the web application increases much the satisfaction during the learning process. According to the students, one of the benefits about this technological tool is the flexibility of time and space to carry out the school activities during the teaching-learning process. Likewise, the web application increases very much ($n = 16, 38.10\%$) the satisfaction during the learning process. Consequently, the majority of the participants had a favorable opinion about this aspect.

Various authors (e.g., Georgieva-Tsaneva & Serbezova, 2021; Huang & Zhu, 2021; Maheshwari, 2021) mention that technological tools play a fundamental role in innovating school activities and creating new educational virtual spaces. The results of machine learning on H2 are higher than 0.850, therefore, the contents of the web application positively influence the satisfaction during the learning process.

Data science identifies six conditions of the PM2 with an accuracy greater than 80.95%. In this predictive model, the age of the students determines how the contents of the web application influence satisfaction. The decision tree technique establishes two conditions where the web application increases much the satisfaction during the learning process.

In the educational context, educators organise and carry out school activities considering ICTs in order to develop the skills and facilitate the assimilation of knowledge at any time (Acikgul & Aslaner, 2020; Akugizibwe & Ahn, 2020; Georgieva-Tsaneva & Serbezova, 2021). In particular, 40.48% of the students consider that the web application very much facilitates the development of mathematical skills. Also, this technological tool facilitated the learning process because the simulator presents the detailed procedure and formulas for the mean, standard deviation and statistical error. Likewise, the web application facilitates much ($n = 16, 38.10\%$) the development of mathematical skills. Consequently, the majority of the participants had a favorable opinion about this aspect.

Similar to Tawafak, Alfarsi and Jabbar (2021), the use of technological tools in the educational field allows students to develop their skills from anywhere. The results of machine learning on the H3 are higher than 0.870, therefore, the contents of the web application positively influence the development of mathematical skills.

Data science identifies seven conditions of the PM3 with an accuracy greater than 85.70%. In this predictive model, the age and sex of the students determine how the contents of the web application

influence the development of mathematical skills. The decision tree technique establishes two conditions where the web application very much facilitates the development of mathematical skills.

During the COVID-19 pandemic, the use of ICTs is essential because these technological tools allow the realisation of the school activities from anywhere (Alawajee, 2021; Amka & Dalle, 2022; Halvoník & Psenak, 2021). According to 47.62% of the students, the web application facilitates very much the learning in the distance modality. The incorporation of this technological tool in the school activities increased the motivation of the students during the educational process. Also, the web application facilitates much ($n = 13$, 30.95%) the learning in the distance modality. Therefore, the majority of the participants had a favorable opinion.

Educators modify their educational practices with the support of ICTs to meet the educational needs of the students (Grunis et al., 2021; Guillén-Gámez, Mayorga-Fernández, & Ramos, 2021; Liu & Lu, 2021). The results of machine learning on the H4 are higher than 0.778, therefore, the contents of the web application positively influence the learning in the distance modality.

Data science identifies seven conditions of the PM4 with an accuracy greater than 80.90%. In this predictive model, the age and sex of the students determine how the contents of the web application influence the learning in the distance modality. The decision tree technique establishes two conditions where the web application facilitates very much the learning in the distance modality.

Implications

The implications of this study are the construction and use of web applications to facilitate the teaching-learning process from anywhere and the creation of new school activities through the incorporation of technological tools. Also, this research recommends the design and construction of educational web applications because students can learn the topics of the courses from anywhere and at any time.

Conclusion

Today, technological tools play a fundamental role in facing the challenges caused by the COVID-19 pandemic. The results of machine learning indicate that the contents of the web application positively influence the assimilation of knowledge, satisfaction during the learning process, development of mathematical skills and learning in the distance modality.

The limitations of this research are the size of the sample and participants. Therefore, future research can analyse the web application about the t-test in high schools and universities considering the aspects of the active role of the students before, during and after the virtual classes.

Finally, the COVID-19 pandemic is encouraging educators to use technological tools to improve the teaching-learning conditions and facilitate the organisation of new school activities in the distance modality.

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