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DESIGN OF CREATIVE VIRTUAL SPACES THROUGH THE USE OF A WEB APPLICATION DURING THE EDUCATIONAL PROCESS ABOUT BANK SAVINGS

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Abstract. The aim of this quantitative research is to design, build and analyze the use of the web application for the teaching-learning process on bank savings. This web application builds creative educational virtual spaces where students learn and analyze the mathematical procedure related to monthly interest rate, initial balance, final balance, interest and savings account. Also, data simulation of the web application for the teaching-learning process on bank savings allows that students have an active role in the learning process through the interaction and control of the contents about bank savings. The ASSURE model facilitates the planning, organization and construction of the web application for the teaching-learning process on bank savings through the stages of analysis, setting, selection, use, requirement and evaluation. The participants are 43 students who took the Financial Mathematics course during the 2018 school year. The results of linear regressions (machine learning) indicate that the construction of creative educational virtual spaces through the web application for the teaching-learning process on bank savings influences positively the assimilation of knowledge about the bank savings, simple interest and financial mathematics. The decision tree technique identifies 3 predictive models about the use of the web application for the teaching-learning process on bank savings in the educational field. The implications of this research allow that teachers analyze the impact of information and communications technology during the realization of school activities. Therefore, educational institutions can promote the construction and use new technological tools. Finally, the web application for the teaching-learning process on bank savings is a web application that allows the construction of creative educational virtual spaces where students personalize the learning and have flexibility of time and space during the educational process on bank savings.

Keywords: ASSURE model, creative educational spaces, information and communications technology, technological education, web application.

Introduction

Today, educational institutions are implementing new policies and regulations about the use of information and communications technology (ICT) inside and outside the classroom

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(Meishar-Tal & Shonfeld, 2019; Singh et al., 2019). In particular, universities are promoting the incorporation of technological applications and digital tools in the school activities to facilitate the learning from anywhere and develop the abilities of students (Meishar-Tal & Shonfeld, 2019).

Technological advances related to Internet are modifying the planning of the educational environment through the use of applications, technological tools, software and multimedia resources (Shakah et al., 2019; Toylan & Cetin, 2019). For example, online education systems, web platforms and computer applications allow analyzing the behavior of students during the learning process, improving the academic performance and realizing new school activities at any time (Sukhbaatar et al., 2019).

The design and use of technological applications inside and outside the classroom facilitate the learning, autonomy and participation of students (Carbonaro, 2019; Das et al., 2019). In particular, teachers use online learning environments in order to carry out student-centered tasks (Larmuseau et al., 2019). Therefore, educational institutions seek to improve the learning process through ICT (Sukhbaatar et al., 2019; Tomić et al., 2019). The benefits of technological tools in the educational field are the reduction of costs, improvement of educational quality and customization of the learning process (Larmuseau et al., 2019; Matviyevskaya et al., 2019).

In Mexico, students demand new pedagogical strategies and technological tools that facilitate the learning process about mathematics and allow the active participation during the realization of school activities. In the Financial Mathematics course, students have difficulty understanding the topics of bank savings because they do not know how to use the formulas to calculate the monthly interest rate, initial and final balance, interest and savings account.

The aim of this quantitative research is to design, build and analyze the use of the web application for the teaching-learning process on bank savings (WATLPBS) in the educational field. In fact, the ASSURE model facilitates the organization and incorporation of this web application in the Financial Mathematics course. The WATLPBS builds creative educational virtual spaces where students learn and analyze the mathematical procedure related to monthly interest rate, initial balance, final balance, interest and savings account. Also, data simulation of the WATLPBS allows that students have an active role in the learning process through the interaction and control of the contents about bank savings. Therefore, the research questions are:

- What is the impact of the WATLPBS during the educational process on bank savings?
- What are the predictive models about the WATLPBS and assimilation of knowledge (bank savings, simple interest and financial mathematics)?

1. Use of information and communications technology in the school activities

Scientific and technological advances are causing that universities reorganize their strategies and pedagogical models to increase the educational quality (Pecanin et al., 2019). For example, mobile devices such as smartphones, tablets and laptops are modifying the interaction of students with the contents of courses, use of digital tools during the learning process and carrying out the activities inside and outside the classroom (Chin et al., 2019; Gezgin et al., 2018).

The benefits of ICT are the sending of the school activities, conducting the online evaluations, participation in the discussion forums, use of the multimedia resources and consultation of contents (Shakah et al., 2019). Even, digital tools and web applications facilitate the organization of activities under the blended learning modality (Larmuseau et al., 2019). Also, digital tools, online platforms and web applications increase the motivation and satisfaction of students (Shakah et al., 2019).

1.1. Use of technology to build creative educational virtual spaces

Technological advances such as digital tools, software and web platforms are essential elements to achieve the innovation in the educational field (Shelevoi et al., 2020; Yang et al., 2020). In fact, teachers use ICT to build creative educational virtual spaces where students have the main role during the learning process (Pleines, 2020; Ramírez-Montoya, 2020; Zhou & Li, 2019).

During the 21st century, technological tools located on Internet are transforming the planning and organization of the courses (Area-Moreira et al., 2020; Shelevoi et al., 2020). For example, teachers use web applications and educational platforms to carry out new activities before, during and after the face-to-face sessions (Kamalova et al., 2021).

Actually, the COVID-19 pandemic is causing that teachers update the school activities through technology (Area-Moreira et al., 2020; López et al., 2020; Todri et al., 2021). In fact, the incorporation of digital tools in the educational field allows the realization of the teaching-learning process under the distance modality (Jones et al., 2020).

Pedagogical models and technological tools allow the organization and implementation of creative activities at home and in the classroom (Lee, 2020; Stratton et al., 2020). For example, flipped classroom and ICT such as videos and web applications allow the construction of educational virtual spaces that increase the motivation and satisfaction of students before and during the face-to-face sessions (Stratton et al., 2020).

Likewise, mobile devices allow the use of technological applications from anywhere and realization of school activities at any time (Chelkowski et al., 2019; Xu & Zhu, 2020; Zhou & Li, 2019). For example, smartphones facilitate the communication during the teaching-learning process and resolution of doubts through *WhatsApp* (Abualrob & Nazzal, 2020).

Even, universities have increased the use of ICT in face-to-face and distance modalities in order to improve the educational quality (Jones et al., 2020; Stratton et al., 2020). In particular, smartphones and tablets are changing the interaction between students and teachers because these mobile devices facilitate the use of web applications for the realization of school activities (Xu & Zhu, 2020; Yang et al., 2020).

1.2. Incorporation of web applications in the school activities

Today, educational institutions and training centers seek to satisfy the needs and requirements of students through the incorporation of technological tools in the school activities (Laato et al., 2019; Matviyevskaya et al., 2019). Consequently, universities are organizing and conducting various courses about the use of ICT and development of digital skills (Harsasi & Sutawijaya, 2018; Matviyevskaya et al., 2019). In particular, web platforms, applications and educational software allow creating new learning environments that favor the active role

of students (Matviyevskaya et al., 2019). Also, virtual learning environments facilitate the transmission, interaction and consultation of information from any place and time (Harsasi & Sutawijaya, 2018).

Therefore, teachers have the opportunity to build new virtual spaces through the creation of technological tools and applications that cover the needs of students (Carbonaro, 2019; Haug & Ebling, 2019). In fact, ICT is transforming the interaction and communication during the educational process (Shakah et al., 2019). In the same way, the design, construction and implementation of technological applications facilitate the teaching-learning process about information technology (Carbonaro, 2019), German language (Haug & Ebling, 2019) and statistics (Salas-Rueda, 2019). For example, Carbonaro (2019) designed a web application in order to improve the learning process on computer science and develop the programming abilities of students.

Various authors (*e.g.*, Haug & Ebling, 2019; Mohammad & Abu-Amara, 2019) have transformed the educational environment through the creation of educational applications. In particular, Mohammad and Abu-Amara (2019) designed the *MyVoice* mobile application to facilitate communication and improve the abilities of students with autism. On the other hand, it is necessary to build and organize new virtual spaces for the field of mathematics in order to facilitate the use of theoretical concepts in the practical context (Hwang et al., 2019; Salas Rueda et al., 2016). For example, Hwang et al. (2019) created the ubiquitous geometry application to facilitate the learning process about geometry and increase the motivation of the participants. Even Salas Rueda et al. (2016) built a technological application called *SEAM* to improve the educational process about derivatives.

Today, the construction of technological applications allows the consultation of information on Internet and use of school contents at any time and place (Haug & Ebling, 2019; Mohammad & Abu-Amara, 2019). For example, Salas-Rueda (2019) used the technological pedagogical content knowledge model to organize and build the web application on the educational process of statistics through disciplinary, pedagogical and technological knowledge. In fact, this educational application facilitated the learning about Statistics through the use of data simulation (Salas-Rueda, 2019). Likewise, web systems and educational applications facilitate the development of vocabulary skills (Haug & Ebling, 2019). In particular, Haug and Ebling (2019) created a web application to update the German Language course through the use of audiovisual contents and realization of online questionnaires.

Finally, the design and construction of technological tools allow improving the participation of students during the realization of activities at home and in the face-to-face sessions (Carbonaro, 2019; Mohammad & Abu-Amara, 2019). Consequently, educational institutions such as universities can improve the teaching-learning process, organize new school activities and build creative virtual spaces through the creation and use of technological applications (Carbonaro, 2019; Salas-Rueda, 2019).

2. Methodology

The particular aims of this quantitative research are (1) build and use the WATLPBS (2) analyze the impact of the WATLPBS in the educational field and (3) establish the predictive models about the use of the WATLPBS in the school activities through the decision tree technique.

2.1. Design and construction of the web application for the teaching-learning process on bank savings

The WATLPBS builds creative educational virtual spaces where student has an active role during the learning process through the interaction and control of the contents about the calculation of interest for the savings account (see Figure 1). This web application facilitates the learning process about financial mathematics because student selects the data about deposit, retirement and annual interest rate in order to learn and analyze the mathematical procedure related to:

- Monthly interest rate;
- Initial and final balance;
- Interest (interest = initial balance * monthly interest rate);
- Savings account (savings account = interest 1 + interest 2 + interest 3).

The students of Administration and Marketing used the WATLPBS in the Financial Mathematics course (Sistemasusables.com, 2021). This web application requests the annual interest rate, deposits and retirements to present the information about bank savings (see Figure 2).

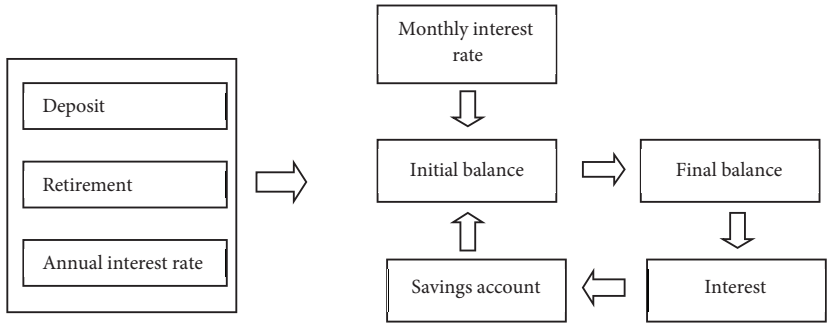

Figure 1. Creative educational virtual spaces of the web application for the teaching-learning process on bank savings (source: created by authors)

Figure 2. Homepage of the web application for the teaching-learning process on bank savings (source: created by authors)

Consequently, the incorporation of the WATLPBS in the Financial Mathematics course allows that students personalize the learning and have flexibility of time and space during the educational process on bank savings.

2.2. Participants

The participants are 43 students (20 men and 23 women) that took the Financial Mathematics course during the 2018 school year. Also, they studied the careers of Administration (n = 17, 39.53%) and Marketing (n = 26, 60.47%) in a La Salle University, United States. The average age is 19.46 years, which is distributed in the categories of 19 years (n = 30, 69.77%), 20 years (n = 8, 18.60%), 21 years (n = 4, 9.30%) and 23 years (n = 1, 2.33%).

2.3. Procedure

The ASSURE model allows the planning, organization and creation of the WATLPBS through the stages of analysis, setting, selection, use, requirement and evaluation (see Table 1).

Table 1. ASSURE model (source: created by authors)

No.	Stage	Aspect	Description
1	Analysis of educational context	Problem	Students have difficulty understanding the topics of bank savings because they do not know how to use the formulas to calculate the monthly interest rate, initial and final balance, interest and savings account
		Course	Financial Mathematics
		Didactic unit	Simple interest
2	Setting the objectives	General objective	Understand the use of interest during the administration of savings account
		Particulars objective	Understand the aspects of the deposit, retirement and balance for the savings account
			Understand the use of simple interest in the savings account
			Use the theoretical concepts of interest in bank savings
3	Selection of strategies, media, technology and materials	Technology	The web application for the teaching-learning process on bank savings presents the mathematical procedure about the calculation of interest for savings account
		Strategy	Data simulation through the web application for the teaching-learning process on bank savings
		Materials	The creation of the web application for the teaching-learning process on bank savings through *PHP* programming language
		Medium	Internet

End of Table 1

No.	Stage	Aspect	Description
4	Use of strategies, media, technology and materials	Use of the web application for the teaching-learning process on bank savings	The web application for the teaching-learning process on bank savings requests the information about the annual interest rate, deposits and retirements in order to present the data simulation of savings account
			The web application for the teaching-learning process on bank savings presents the calculation about monthly interest rate
			The web application for the teaching-learning process on bank savings presents the deposits and retirements
			The web application for the teaching-learning process on bank savings presents the calculation about initial and final balance
			The web application for the teaching-learning process on bank savings presents the calculation about interest
			The web application for the teaching-learning process on bank savings presents the calculation about savings account
5	Requirement	Active strategies	The incorporation of the web application for the teaching-learning process on bank savings in the Financial Mathematics course allows that students personalize the learning and have flexibility of time and space during the educational process on bank savings
6	Evaluation	Measurement instrument	Questionnaire

Applications located on Internet play a fundamental role in the educational field because these technological tools allow transforming the teaching-learning process during the 21st century (Ramírez-Montoya, 2020; Shelevoi et al., 2020). Therefore, the hypothesis about the construction of creative educational virtual spaces and learning process about bank savings is:

– Hypothesis 1 (H1): The construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about bank savings.

Educational institutions use technological advances to build new spaces that facilitate learning and develop students' abilities (Jones et al., 2020; Ramírez-Montoya, 2020; Stratton et al., 2020). Therefore, the hypothesis about the construction of creative educational virtual spaces and learning process about simple interest is:

– Hypothesis 2 (H2): The construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about simple interest.

The incorporation of ICT in the educational field allows that universities improve the teaching-learning process through the organization of activities focused on students (Abualrob & Nazzal, 2020; Lee, 2020; López et al., 2020). Therefore, the hypothesis about the

construction of creative educational virtual spaces and learning process about financial mathematics is:

– Hypothesis 3 (H3): The construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about financial mathematics.

The predictive models on the WATLPBS and assimilation of knowledge about bank savings, simple interest and financial mathematics are:

– Predictive model 1 (PM1) on the WATLPBS and assimilation of knowledge about bank savings;
– Predictive model 2 (PM2) on the WATLPBS and assimilation of knowledge about simple interest;
– Predictive model 3 (PM3) on the WATLPBS and assimilation of knowledge about financial mathematics.

2.4. Data analysis

The *RapidMiner* tool allows calculating the linear regressions (machine learning) to evaluate the research hypotheses about the use of the WATLPBS in the educational process on bank savings. Machine learning allows that the sample is divided into two sections (training and evaluation). The training section is used to calculate the linear regressions and the evaluation section is used to find the accuracy of these linear regressions.

Also the *RapidMiner* tool allows the identification of 3 predictive models about the construction of creative educational virtual spaces through the WATLPBS and assimilation of knowledge. The information about the profile of students and WATLPBS is used to create these predictive models through the decision tree technique.

2.5. Data collection

The questionnaire was applied at the end of the simple interest unit during the 2018 school year.

Table 2. Questionnaire about the web application for the teaching-learning process on bank savings and educational process (source: created by authors)

No.	Variable	Dimension	Question	Answer	n	%
1	Use of the web application for the teaching-learning process on bank savings	Learning process	1. The web application for the teaching-learning process on bank savings facilitates the construction of creative educational virtual spaces			
				Too much (1)	14	32.56%
				Much (2)	26	60.47%
				Little (3)	3	6.98%
				Too little (4)	0	0.00%

End of Table 2

No.	Variable	Dimension	Question	Answer	n	%
		Bank Savings	2. The web application for the teaching-learning process on bank savings improves the assimilation of knowledge about bank savings			
				Too much (1)	15	34.88%
				Much (2)	21	48.84%
				Little (3)	7	16.28%
				Too little (4)	0	0.00%
		Simple interest	3. The web application for the teaching-learning process on bank savings improves the assimilation of knowledge about simple interest			
				Too much (1)	16	37.21%
				Much (2)	20	46.51%
				Little (3)	7	16.28%
				Too little (4)	0	0.00%
		Financial mathematics	4. The web application for the teaching-learning process on bank savings improves the assimilation of knowledge about financial mathematics			
				Too much (1)	10	23.26%
				Much (2)	29	67.44%
				Little (3)	4	9.30%
				Too little (4)	0	0.00%

The load factor (>0.50), Cronbach's alpha (>0.70) and composite reliability (>0.70) values allow validating the measurement instrument (Jaffar & Musa, 2019). Table 3 shows that the questionnaire about the WATLPBS meets these criteria.

Table 3. Validation of the questionnaire (source: created by authors)

Variable	Dimension	Load Factor	Cronbach's alpha	Average variance extracted	Composite reliability
Web application for the teaching-learning process on bank savings	Learning process	0.871	0.881	0.739	0.918
	Bank savings	0.870			
	Simple interest	0.911			
	Financial mathematics	0.783			

3. Results

Table 2 shows that the WATLPBS facilitates too much (n = 14, 32.56%), much (n = 26, 60.47%) and little (n = 3, 6.98%) the construction of creative educational virtual spaces. In addition, the results of machine learning indicate that the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about bank savings, simple interest and financial mathematics (see Table 4).

Table 4. Results of machine learning (source: created by authors)

Hypothesis	Training	Linear regression	Conclusion	t-value	p-value	Square error
H1: Web application for the teaching-learning process on bank savings → assimilation of knowledge about bank savings	70%	y = 0.979x + 0.135	Accepted: 0.979	6.480	0.000	0.558
	80%	y = 0.886x + 0.285	Accepted: 0.886	6.205	0.000	0.457
	90%	y = 0.803x + 0.398	Accepted: 0.803	6.597	0.000	0.517
H2: Web application for the teaching-learning process on bank savings → assimilation of knowledge about simple interest	70%	y = 0.952x + 0.148	Accepted: 0.952	7.004	0.000	0.389
	80%	y = 0.886x + 0.285	Accepted: 0.886	6.427	0.000	0.369
	90%	y = 0.880x + 0.261	Accepted: 0.880	6.205	0.000	0.102
H3: Web application for the teaching-learning process on bank savings → assimilation of knowledge about financial mathematics	70%	y = 0.554x + 0.972	Accepted: 0.554	3.799	0.000	0.454
	80%	y = 0.515x + 1.047	Accepted: 0.515	3.822	0.000	0.525
	90%	y = 0.488x +1.059	Accepted: 0.488	4.005	0.000	0.647

Table 5 shows the Pearson's correlations about the use of the WATLPBS and assimilation of knowledge.

Table 5. Pearson's correlations (source: created by authors)

	Learning process	Bank savings	Simple interest	Financial mathematics
Learning process	1	–	–	–
Bank savings	0.701	1	–	–
Simple interest	0.734	0.736	1	
Financial mathematics	0.546	0541	0.644	1

3.1. Assimilation of knowledge about bank savings

The WATLPBS improves too much (n = 15, 34.88%), much (n = 21, 48.84%) and little (n = 7, 16.28%) the assimilation of knowledge about bank savings (see Table 2). Furthermore, the results of machine learning with 70% (0.979, t-value = 6.480, $p < 0.000$), 80% (0.886, t-value = 6.205, $p < 0.000$) and 90% (0.803, t-value = 6.597, $p < 0.000$) indicate that H1 is accepted (see Table 4). Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about bank savings. The value on the Pearson's correlation between learning process and bank savings is 0.701 (see Table 5).

Figure 3 shows 6 conditions of the PM1 (76.74% of accuracy). For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about bank savings.

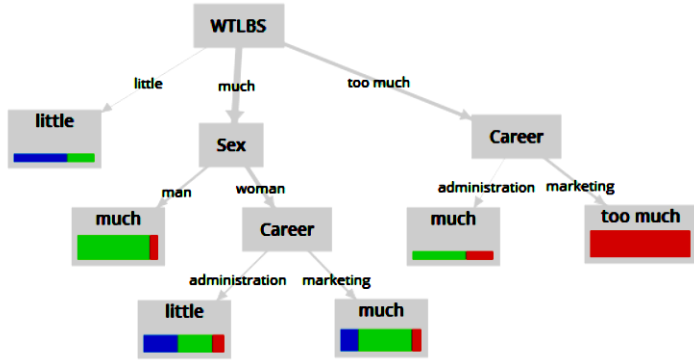

Figure 3. The predictive model 1 on the use of the web application
for the teaching-learning process on bank savings (source: created by authors)

3.2. Assimilation of knowledge about simple interest

The WATLPBS improves too much (n = 16, 37.21%), much (n = 20, 46.51%) and little (n = 7, 16.28%) the assimilation of knowledge about simple interest (see Table 2). Likewise, the results of machine learning with 70% (0.952, t-value = 7.004, $p < 0.000$), 80% (0.886, t-value = 6.427, $p < 0.000$) and 90% (0.880, t-value = 6.205, $p < 0.000$) indicate that H2 is accepted (see Table 4). Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about simple interest. The value on the Pearson's correlation between learning process and simple interest is 0.734 (see Table 5).

Figure 4 shows 6 conditions of the PM2 (81.40% of accuracy). For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about simple interest.

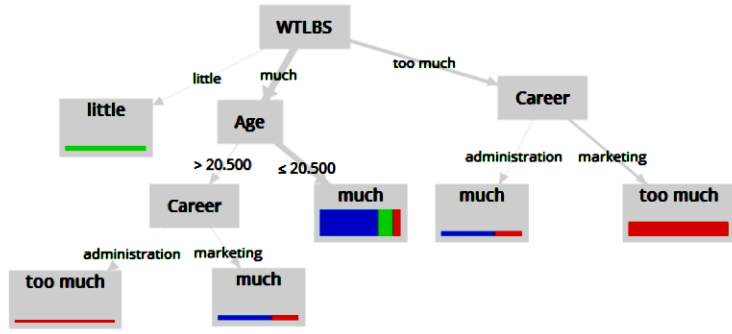

Figure 4. The predictive model 2 on the use of the web application
for the teaching-learning process on bank savings (source: created by authors)

3.3. Assimilation of knowledge about financial mathematics

The WATLPBS improves too much (n = 10, 23.26%), much (n = 29, 67.44%) and little (n = 4, 9.30%) the assimilation of knowledge about financial mathematics (see Table 2). Likewise, the results of machine learning with 70% (0.554, t-value = 3.799, p < 0.000), 80% (0.515, t-value = 3.822, p < 0.000) and 90% (0.488, t-value = 4.005, p < 0.000) indicate that H3 is accepted (see Table 4). Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about financial mathematics. The value on the Pearson's correlation between learning process and financial mathematics is 0.546 (see Table 5).

Figure 5 shows 6 conditions of the PM3 (79.07% of accuracy). For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces, is a man and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about financial mathematics.

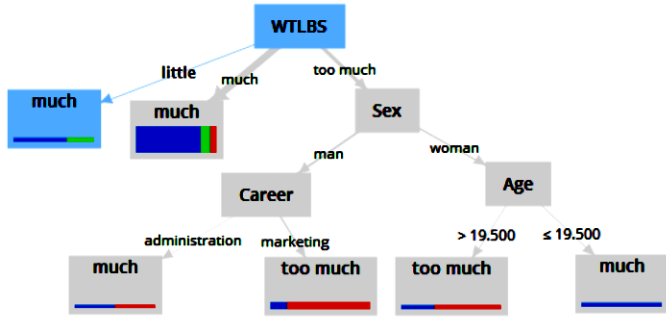

Figure 5. The predictive model 3 on the use of the web application for the teaching-learning process on bank savings (source: created by authors)

Discussion

Technology allows updating the courses and modifying the behavior of students and teachers (Ali et al., 2019; Cakir et al., 2018; Salas Rueda, 2018). In fact, educational institutions use applications and web platforms to improve the teaching-learning process and facilitate the active role of students (Jones et al., 2020; Pleines, 2020; Todri et al., 2021). For example, the WATLPBS shows the contents about the calculation of bank savings considering simple interest, balances, deposits and retirements and allows the active role of the student during the learning process.

Assimilation of knowledge about bank savings

Various authors (*e.g.*, Lee, 2020; Ramírez-Montoya, 2020; Todri et al., 2021) mention that technological advances play a fundamental role during the transformation of the teaching-learning process. As a result of the analysis performed, 48.84% of the students (n = 21) believe that the WATLPBS improves much the assimilation of knowledge about bank savings. Also, the WATLPBS improves too much (n = 15, 34.88%) the assimilation of knowledge

about bank savings. Therefore, the majority of students (83.72%) have a favorable opinion about the use of this web application.

The results of machine learning about H1 exceed the value of 0.800. Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about bank savings. Also, the value on the Pearson's correlation between learning process and bank savings is higher than 0.700.

Data science identifies 6 predictive conditions of the PM1 with the accuracy of 76.74%. In this predictive model, the career and sex of the students determine how the WATLPBS influences the assimilation of knowledge about bank savings. The decision tree technique identifies 1 condition where the WATLPBS improves too much the assimilation of knowledge about bank savings. For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about bank savings.

Assimilation of knowledge about simple interest

Nowadays, students demand the use of new strategies that facilitate the learning (Pleines, 2020). Therefore, the incorporation of ICT acquires great relevance to transform the teaching process (Kamalova et al., 2021; Pleines, 2020). In particular, 46.51% of the students (n = 20) believe that the WATLPBS improves much the assimilation of knowledge about simple interest. Likewise, quantitative data reveals that the WATLPBS improves too much (n = 16, 37.21%) the assimilation of knowledge about simple interest. Therefore, the majority of students (83.72%) have a favorable opinion about the use of this web application.

The results of machine learning about H2 exceed the value of 0.879. Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about simple interest. Also, the value on the Pearson's correlation between learning process and simple interest is higher than 0.730.

Data science identifies 6 predictive conditions of the PM2 with the accuracy of 81.40%. In this predictive model, the career and age of the students determine how the WATLPBS influences the assimilation of knowledge about simple interest. The decision tree technique identifies 2 conditions where the WATLPBS improves too much the assimilation of knowledge about simple interest. For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about simple interest.

Assimilation of knowledge about financial mathematics

Currently, teachers use technological tools to organize and carry out creative activities on Internet (Area-Moreira et al., 2020; López et al., 2020; Ramírez-Montoya, 2020). Most of the students (n = 29, 67.44%) believe that the WATLPBS improves much the assimilation of knowledge about financial mathematics. Also, the WATLPBS improves too much (n = 10, 23.26%) the assimilation of knowledge about financial mathematics. Therefore, the majority of students (90.70%) have a favorable opinion about the use of this web application.

The results of machine learning about H3 exceed the value of 0.480. Therefore, the construction of creative educational virtual spaces through the WATLPBS positively influences the assimilation of knowledge about financial mathematics. Also, the value on the Pearson's correlation between learning process and financial mathematics is higher than 0.540.

Data science identifies 6 predictive conditions of the PM3 with the accuracy of 79.07%. In this predictive model, the career, sex and age of the students determine how the WATLPBS influences the assimilation of knowledge about financial mathematics. The decision tree technique identifies 2 conditions where the WATLPBS improves too much the assimilation of knowledge about financial mathematics. For example, if the student considers that the WATLPBS facilitates too much the construction of creative educational virtual spaces, is a man and takes the career of Marketing then the WATLPBS improves too much the assimilation of knowledge about financial mathematics.

Finally, the most significant results of machine learning are located in the use of the WATLPBS to assimilate knowledge about simple interest. On the other hand, the least significant results of machine learning are located in the use of the WATLPBS to assimilate knowledge about financial mathematics. Therefore, technological advances such web application facilitate the planning and organization of creative activities (Auerbach et al., 2019; Pardo et al., 2019).

Conclusions

The use of ICT in the educational field allows the construction of new virtual spaces where students have the main role during the learning process. For example, the WATLPBS allowed that the students of Marketing and Administration learn and analyze the mathematical procedure related to monthly interest rate, initial balance, final balance, interest and savings account. Also, data simulation of this web application allows that students have an active role in the learning process through the interaction and control of the contents about bank savings.

The design and construction of web applications allow updating the activities of the courses and achieving the innovation in the educational field. During the Financial Mathematics course, the construction of creative educational virtual spaces through the WATLPBS positively influenced the assimilation of knowledge about bank savings, simple interest and financial mathematics.

Teachers have the opportunity to modify the roles and behavior of students by organizing and conducting new school activities. In particular, the use of WATLPBS in the financial mathematics course allowed the active participation of students at any time and facilitated the personalized learning about the savings account.

The limitations of this research are the contents of the WATLPBS about the topics of simple interest and the size of the sample. Therefore, future research can build web applications that use the topics about compound interest and analyze the impact of technology in universities and high schools.

The implications of this research allow that teachers analyze the impact of ICT such as web applications, digital games and third-dimensional tools during the realization of school activities. Therefore, educational institutions can promote the construction and use new technological tools.

Finally, the incorporation of technology in the educational context allows the construction of creative virtual spaces that facilitate the personalization of learning. In particular, the WATLPBS improved the learning process on financial mathematics because this web application allowed that students learn and analyze the mathematical procedure about bank savings at any time and place.

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