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Smartphones and laptops: How do these mobile devices influence the teaching-learning process?

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ABSTRACT

The aim of this quantitative research is to analyze the students' perceptions about the use of smartphones and laptops in the educational process through data science. The sample is composed of 80 students who took the careers of Administration, Commerce, Accounting and Marketing at a Mexican university during the 2017 school year. The results of machine learning (linear regression) indicate that the use of mobile devices in the classroom positively influences the search for information of the courses and realization of school activities through smartphones and laptops. Likewise, data science identifies 4 predictive models about the use of smartphones and laptops in the educational field through the decision tree technique. Finally, the incorporation of mobile devices in the classroom improves the teaching-learning conditions.

Keywords: Mobile devices, higher education, smartphones, laptops, data science, machine learning, educational technology

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1. INTRODUCTION

Advances in the area of wireless technology are transforming the behaviors, roles and attitudes of teachers and students during the 21st century (Chen, 2021; Howlett & Waemusa, 2018; Nazar et al., 2022; Peechapol et al., 2018). For example, smartphones and laptops allow that students use materials, contents and resources of courses such as electronic books, digital presentations, video tutorials and web applications at any time and place (Elammari & Cavus, 2019; Husna & Kuswanto, 2018; The & Usagawa, 2018). According to Peechapol et al. (2018), the incorporation of smartphones in the educational field facilitates the assimilation of knowledge and allows the use of Information and Communication Technologies (ICTs) inside and outside of the classroom. In addition, the consultation of audiovisual contents on laptops and tablets allow customizing the learning process (Abugohar, Yunus, & Rashid, 2018; Fokides & Mastrokoukou, 2018; Sage et al., 2020; Tachinamutu et al., 2022).

The use of mobile devices in the school activities is increasing at the higher educational level (Husna & Kuswanto, 2018; Fokides & Mastrokoukou, 2018; Nazar et al., 2022). Therefore, educational institutions have the possibility of updating educational practices and creating new teaching-learning environments through ICTs (Elammari & Cavus, 2019; Todri et al., 2021). Young people frequently use smartphones, laptops and tablets in the productive context and personal life (Abugohar, Yunus, & Rashid, 2018; The & Usagawa, 2018). Therefore, these mobile devices are ideal technological tools to improve the teaching-learning conditions (Husna & Kuswanto, 2018; The & Usagawa, 2018).

The aim of this quantitative research is to analyze the students' perceptions about the use of smartphones and laptops in the educational process through data science. Therefore, the research questions are:

- What is the frequency about the use of mobile devices in the classroom?
- What is the frequency about the search for information of the courses and realization of school activities through smartphones and laptops?
- How does the use of mobile devices in the classroom influence the search for information of the courses and realization of school activities through smartphones and laptops?
- What are the predictive models about the use of smartphones and laptops in the educational field?

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1.1. Literature review

Mobile learning improves the teaching-learning process through the communication between students and teachers, search for information and dissemination of information (Bando et al., 2017; Li et al., 2018; Husna & Kuswanto, 2018). For example, the incorporation of smartphones, laptops and tablets in the classroom allows the realization of collaborative activities and promotes the active participation of students (Fang, 2019; Mendez et al., 2018). At the basic level, mobile devices facilitated the assimilation of knowledge about microorganisms through the application called "Microb" (Tachinamutu et al., 2022). In fact, teachers are using mobile devices to create and carry out new activities inside and outside of the classroom (Elammari & Cavus, 2019; Pastirmacioglu et al., 2018). Also, students use mobile devices to check the course information and review the school activities on web platforms (Husna & Kuswanto, 2018; Razzaq, Samiha & Anshari, 2018).

Mobile devices are modifying the planning, organization and realization of activities in the educational field (Abugohar, Yunus, & Rashid, 2018; Elammari & Cavus, 2019; Felisoni & Godoi, 2018). In particular, the use of smartphones and laptops allows that students can access, consult and use the information of the courses at any time (Fang, 2019; Peechapol et al., 2018). On the other hand, teachers use smartphones, tablets and laptops to analyze the behavior of students and evaluate the school activities (Li et al., 2018; Mendez et al., 2018). Consequently, these mobile devices are transformed the functions of the participants in the educational process (The & Usagawa, 2018; Yuktirat, Sindhuphak, & Kiddee, 2018).

In the 21st century, the use of mobile devices in the learning process allows that students acquire an active role (Fang, 2019; Felisoni & Godoi, 2018; Razzaq, Samiha & Anshari, 2018). For example, smartphones and laptops allow making video calls, sending information, visiting websites, communicating through messages and accessing social networks (Li et al., 2018; Maloku, Ebner, & Ebner, 2018; The & Usagawa, 2018). Other benefit on the use of mobile devices in the educational field is the flexibility of time and space (Maloku, Ebner, & Ebner, 2018; Peechapol et al., 2018). In particular, smartphones and laptops allow developing the skills of students through the use and consultation of information on Internet (Husna & Kuswanto, 2018; Li et al., 2018; Yuktirat, Sindhuphak, & Kiddee, 2018). Finally, mobile devices increase the motivation and interest of students, create new opportunities for learning and facilitate the realization of school activities (Abugohar, Yunus, & Rashid, 2018; Li et al., 2018; The & Usagawa, 2018).

1.1.1. Smartphones in the educational field

In universities, students use smartphones to consult and disseminate the contents of the courses (Elammari & Cavus, 2019; Razzaq, Samiha & Anshari, 2018). In fact, the use of these mobile devices is increasing in the educational field due to their physical characteristics and ease of transportation (Felisoni & Godoi, 2018; Razzaq, Samiha, & Anshari, 2018). Internet and mobile devices are transforming the functions of students in the educational field (Abugohar, Yunus, & Rashid, 2018; Elammari & Cavus, 2019; Fang, 2019). For example, the use of web applications on smartphones improved the assimilation of knowledge about the English language and facilitated the development of speaking skills (Abugohar, Yunus, & Rashid, 2018). In Russia, mobile devices such as smartphones allow consulting the information on Neuro-linguistic programming from anywhere (Snezhko et al., 2022).

Even applications such as Voice Recognition Software, Speech texter, Speechnotes, Voice Notebook and Speech to Text Converter improve the teaching-learning process about English language because students can consult the information on smartphones at any time and place (Abugohar, Yunus, & Rashid, 2018). Teachers can create new activities that promote the participation and collaborative work of students through the use of social networks on smartphones (Fang, 2019; Felisoni & Godoi, 2018). Also, these mobile devices are used in the educational field to access web applications such as digital games (Felisoni & Godoi, 2018).

In the medical course, students had an active participation in the teaching-learning process through the use of smartphones (Fang, 2019). In particular, these mobile devices facilitated the collection, transmission and consultation of information on the Moodle platform (Fang, 2019). Additionally, smartphones improved the communication between the participants of the educational process and facilitated the feedback of the activities (Fang, 2019). Finally, mobile devices such as smartphones allow the creation of new educational spaces that promote the active role of students and facilitate the consultation of the school contents at any time and place (Abugohar, Yunus, & Rashid, 2018; Elammari & Cavus, 2019; Felisoni & Godoi, 2018).

1.1.2. Laptops in the educational field

Mobile devices such as laptops are modifying the behavior of students during the teaching-learning process (Albo, Hernández-Leo, & Oliver, 2019; Bando et al., 2017; Deveci et al., 2018). In fact, laptops favor the active role of the students in the classroom and facilitate the realization of school activities through web applications and educational software (Deveci et al., 2018; Sage et al., 2020). The benefits on the use of laptops in the educational field are the organization of collaborative activities (Albo, Hernández-Leo, & Oliver, 2019), consultation of information (Bando et al., 2017; Glass & Kang, 2019; Nogry & Varly, 2018) and communication among teachers and students (Deveci et al., 2018; Nogry & Varly, 2018). In addition, students use various multimedia resources on laptops such as videos and digital presentations (Albo, Hernández-Leo, & Oliver, 2019; Sage et al., 2020).

Laptops allow the construction of new educational spaces where students control the learning process (Albo, Hernández-Leo, & Oliver, 2019; Glass & Kang, 2019; Nogry & Varly, 2018). For example, students of the biology course used laptops to consult and carry out the school activities inside and outside the classroom (Aguilar-Roca, Williams, & O'Dowd, 2012). In Indonesia, the students of chemistry used mobile devices such as laptops to assimilate the knowledge about reduction and oxidation reactions and increase their academic performance through the use of web applications (Nazar et al., 2022).

At the University of Canada, the use of laptops in the classroom improved the academic performance and facilitated the learning process on social sciences, science, arts and health (Gaudreau, Miranda, & Gareau, 2014). Likewise, these students are satisfied and motivated to use this mobile device to carry out the school activities such as sending emails, consulting audiovisual content, using social networks and reviewing information on web platforms (Gaudreau, Miranda, & Gareau, 2014).

The incorporation of mobile devices in the educational field allows transforming the functions of students during the learning process (Bando et al., 2017; Glass & Kang, 2019; Nogry & Varly, 2018). For example, the students of Spanish and Math courses acquire an active role in the classroom because laptops allow the consultation of digital books (Bando et al., 2017). Finally, the use of laptops in the educational field favors the active role and collaborative participation of students in the classroom through web applications, educational platforms and multimedia resources (Albo, Hernández-Leo, & Oliver, 2019; Glass & Kang, 2019; Nogry & Varly, 2018).

1.1.3. Use of smartphones and laptops in the teaching-learning process

The incorporation of the devices in the school activities improved the teaching-learning conditions on Physics (Husna & Kuswanto, 2018; Zhai, Zhang, & Li, 2016), English language (Lin, 2014), Mathematics (Asmianto et al., 2022; Maloku, Ebner, & Ebner, 2018; Mendez et al., 2018), Arts (Yuktirat, Sindhuphak, & Kiddee, 2018) and Medicine (Li et al., 2018). In the mathematics course, the use of mobile applications on smartphones and laptops increased the student motivation, improved the academic performance and facilitated the learning about trigonometry (Asmianto et al., 2022).In the field of Physics, Husna and Kuswanto (2018) developed a mobile educational application to facilitate the analysis and resolution of vector problems. In the same way, Maloku, Ebner and Ebner (2018) designed a digital game to improve the educational process of mathematics through the use of smartphones and laptops.

During the math course, smartphones facilitated the assimilation of knowledge and developed the skills through the Socrative application (Mendez et al., 2018). Even the use of web applications (e.g., SketchBook, Art Set, UBrush Pro, Sketch Pad and ArtRage) on smartphones, iPads and tablets improved the teaching-learning process about arts (Yuktirat, Sindhuphak and Kiddee, 2018). Salas-Rueda and Salas-Silis (2018) used various mobile devices such as laptops and smartphones in the classroom to facilitate the use of the Logic.ly online simulator and social network Facebook.

Likewise, Li et al. (2018) used smartphones, laptops and tablets in Medical courses to increase the motivation during the learning process, allow the social interaction between students and improve the academic performance. Smartphones and laptops facilitate the realization of activities in the classroom because these mobile devices allow the use of educational resources (Busulwa & Bbuye, 2018; Husna & Kuswanto, 2018; Mendez et al., 2018). Finally, mobile learning allows the construction of new educational spaces through the consultation of information on Internet and use of web applications (Busulwa & Bbuye, 2018; Li et al., 2018; Yuktirat, Sindhuphak & Kiddee, 2018).

2. METHODOLOGY

The particular aims of this quantitative research are to (1) analyze the frequency about the use of mobile devices in the classroom (2) analyze the frequency about the search for information of the courses and realization of school activities through smartphones (3) analyze the frequency about the search for information of the courses and realization of school activities through laptops (4) analyze the impact of the use of mobile devices in the classroom during the search for information of the courses and realization of school activities through smartphones and laptops and (5) identify the predictive models about the use of smartphones and laptops in the educational field.

2.1. Participants

The participants are 80 students (51 men and 29 women) who took the careers of Administration (n = 21, 26.25%), Accounting (n = 14, 17.50%), Commerce (n = 29, 36.25%) and Marketing (n = 16, 20.00%) in a Mexican university during the 2017 school year. The average age of the participants is 18.80 years. This study uses a non-probabilistic sample.

2.2. Procedure

Figure 1 shows the technological model used in this research to analyze the use of smartphones and laptops in the educational field.

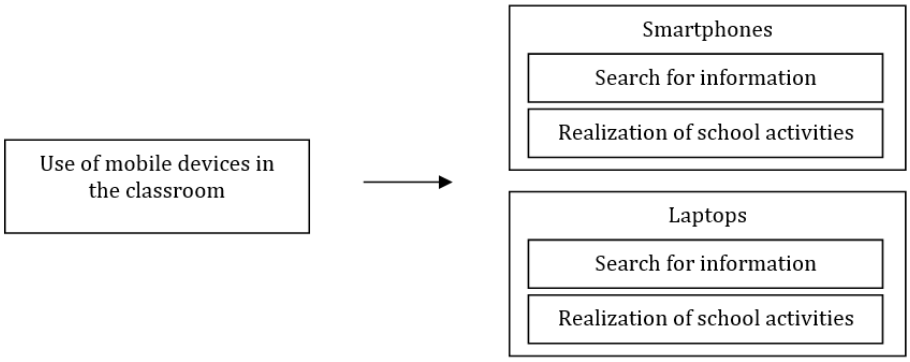

Figure 1. Technological model about mobile devices.

Mobile devices allow that students actively participate in the learning process by searching for information, reviewing the school contents and using web applications (Li et al., 2018; Maloku, Ebner, & Ebner, 2018; Snezhko et al., 2022). Thus, the research hypotheses on the use of smartphones and laptops in the educational process are:

- Hypothesis 1 (H1): The use of mobile devices in the classroom positively influences the search for information of the courses through smartphones
- Hypothesis 2 (H2): The use of mobile devices in the classroom positively influences the realization of school activities through smartphones
- Hypothesis 3 (H3): The use of mobile devices in the classroom positively influences the search for information of the courses through laptops
- Hypothesis 4 (H4): The use of mobile devices in the classroom positively influences the realization of school activities through laptops

Data science allows the construction of the following predictive models through the decision tree technique:

- Predictive model 1 (PM1) on the use of mobile devices in the classroom and search for information of the courses through smartphones
- Predictive model 2 (PM2) on the use of mobile devices in the classroom and realization of school activities through smartphones
- Predictive model 3 (PM3) on the use of mobile devices in the classroom and search for information of the courses through laptops
- Predictive model 4 (PM4) on the use of mobile devices in the classroom and realization of school activities through laptops

2.3. Data analysis

This quantitative research used the Rapidminer tool to analyze the use of mobile devices (smartphones and laptops) in the educational process through data science. According to Salas-Rueda et al. (2022), the machine learning technique allows knowing the relationship between the independent and dependent variables through linear regression and the decision tree technique allows identifying the conditions that intervene in phenomena such as the use of technological tools in the educational field. Machine learning allows calculating the linear regressions on the use of mobile devices through the training section (55%, 65% and 75% of the sample) and establishing the accuracy of these linear regressions through the evaluation section (45%, 35% and 25% of the sample). Figure 2 shows the use of the Rapidminer tool for the machine learning technique.

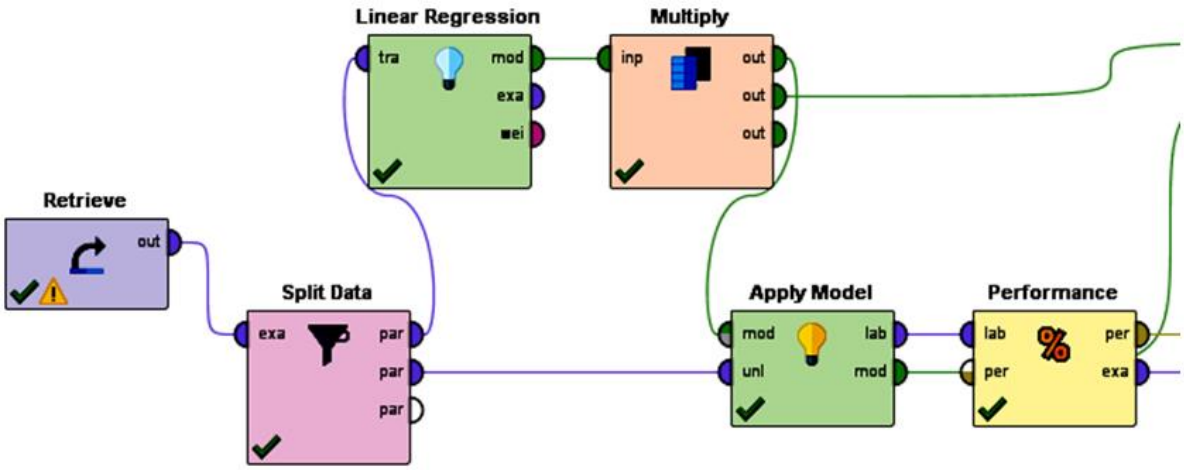

Figure 2. Use of the Rapidminer tool for the machine learning technique.

The Rapidminer tool allows identifying 4 predictive models on the use of mobile devices in the educational process. The information about the student's profile (Age, Sex, Career and Use of mobile devices in the classroom) is used to build these predictive models through the decision tree technique (See Figure 3).

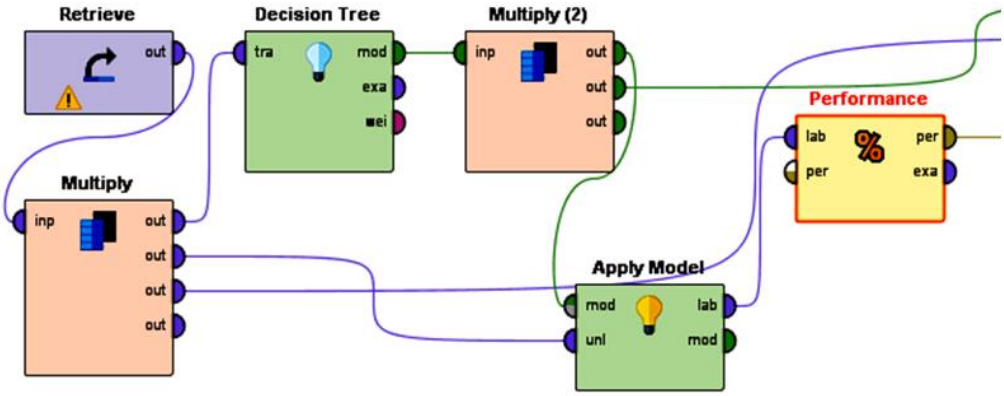

Figure 3. Use of the Rapidminer tool for the decision tree technique

2.4. Data collection

Table 1 shows the questionnaire used to collect the information about the use of mobile devices in the educational process. Data collection was carried out in April 2017 at a university located in Mexico City.

Table 1.
Questionnaire on the Use of Mobile Devices in the Educational Process

Variable	Dimension	Question	Answer	n	%
Profile of students	Sex	1. What is your sex?	Man	51	63.75%
			Woman	29	36.25%
	Career	2. What is your career?	Administration	21	26.25%
			Accounting	14	17.50%
			Commerce	29	36.25%
			Marketing	16	20.00%
	Age	3. What is your age?	17 years	3	3.75%
			18 years	40	50.00%
			19 years	22	27.50%
			20 years	8	10.00%
			21 years	2	2.50%
			> 21 years	5	6.25%
	Use of mobile devices	4. The use of mobile devices in the classroom is	Very frequent (1)	25	31.25%
			Frequent (2)	37	46.25%
			Occasional (3)	9	11.25%
			Rare (4)	6	7.50%
			Very rare (5)	3	3.75%
Smartphones	Search for information	5. The search for information of the courses through smartphones is	Very frequent (1)	14	17.50%
			Frequent (2)	34	42.50%
			Occasional (3)	21	26.25%
			Rare (4)	6	7.50%
			Very rare (5)	5	6.25%
	Realization of school activities	6. The realization of school activities through smartphones is	Very frequent (1)	18	22.50%
			Frequent (2)	32	40.00%
			Occasional (3)	23	28.75%
			Rare (4)	3	3.75%
			Very rare (5)	4	5.00%
Laptops	Search for information	7. The search for information of the courses through laptops is	Very frequent (1)	5	6.25%
			Frequent (2)	23	28.75%
			Occasional (3)	24	30.00%
			Rare (4)	14	17.50%
			Very rare (5)	14	17.50%
	Realization of school activities	8. The realization of school activities through laptops is	Very frequent (1)	8	10.00%
			Frequent (2)	18	22.50%
			Occasional (3)	24	30.00%
			Rare (4)	12	15.00%
			Very rare (5)	18	22.50%

The values of Cronbach's Alpha, Average Variance Extracted, Composite Reliability and Load factor allow validating the measuring instrument (see Table 2).

Table 2.
Validation of the Questionnaire

Dimension	Load Factor	Cronbach's Alpha	Average Variance Extracted	Composite Reliability
Use of mobile devices	0.509			
Smartphones: Search for information	0.800			
Smartphones: Realization of school activities	0.718	0.771	0.528	0.845
Laptops: Search for information	0.791			
Laptops: Realization of school activities	0.777			

3. FINDINGS

Table 1 shows that the use of mobile devices in the classroom is very frequent (n = 25, 31.25%), frequent (n = 37, 46.25%), occasional (n = 9, 11.25%), rare (n = 6, 7.50%) and very rare (n = 3, 3.75%). Likewise, the results of machine learning indicate that the use of mobile devices in the classroom positively influences the search for information of the courses and realization of school activities through smartphones and laptops (See Table 3).

Table 3.
Results of the Machine Learning Technique

Hypothesis	Training	Linear regression	Conclusion	Error squared
H1: Use of mobile devices in the classroom	55%	y = 0.258x + 1.841	Accepted: 0.258	0.239
→ search for information of the courses	65%	y = 0.267x + 1.829	Accepted: 0.267	0.221
through smartphones	75%	y = 0.251x + 1.884	Accepted: 0.251	0.244
H2: Use of mobile devices in the classroom	55%	y = 0.444x + 1.351	Accepted: 0.444	0.141
→ realization of school activities through	65%	y = 0.446x + 1.337	Accepted: 0.446	0.143
smartphones	75%	y = 0.423x + 1.365	Accepted: 0.423	0.138
H3: Use of mobile devices in the classroom	55%	y = 0.303x + 2.546	Accepted: 0.303	0.286
→ search for information of the courses	65%	y = 0.304x + 2.546	Accepted: 0.304	0.217
through laptops	75%	y = 0.216x + 2.740	Accepted: 0.216	0.196
H4: Use of mobile devices in the classroom	55%	y = 0.347x + 2.297	Accepted: 0.347	0.167
→ realization of school activities through	65%	y = 0.357x + 2.247	Accepted: 0.357	0.142
laptops	75%	y = 0.268x + 2.466	Accepted: 0.268	0.167

3.1. Smartphones

Table 1 indicates that the search for information of the courses through smartphones is very frequent (n = 14, 17.50%), frequent (n = 34, 42.50%), occasional (n = 21, 26.25%), rare (n = 6, 7.50%) and very rare (n = 5, 6.25%). The results of machine learning with 55% (0.258), 65% (0.267) and 75% (0.251) of training indicate that H1 is accepted (See Table 3). Therefore, the use of mobile devices in the classroom positively influences the search for information of the courses through smartphones. Table 4 shows the PM1 on the use of mobile devices in the classroom and search for information through smartphones. For example, if the student considers that the use of mobile devices in the classroom is frequent and has an age > 21.5 years then the search for information of the courses through smartphones is frequent.

Table 4.
Conditions of the PM1

No.	Use of mobile devices in the classroom	Sex	Age	Career	Search for information of the courses through smartphones
1	Occasional	-	> 21.5 years	-	Rare
2	Frequent	-	> 21.5 years	-	Frequent
3	-	-	≤ 21.5 & > 20.5 years	Accounting	Very frequent
4	-	-	≤ 21.5 & > 20.5 years	Marketing	Frequent
5	Frequent	-	≤ 20.5 & > 17.5 years	-	Frequent
6	Rare	-	≤ 20.5 & > 17.5 years	-	Rare
7	Very rare	-	≤ 20.5 & > 17.5 years	-	Rare
8	Occasional	-	≤ 20.5 & > 17.5 years	-	Occasional
9	Very frequent	-	≤ 20.5 & > 17.5 years	-	Frequent
10	Frequent	-	≤ 17.5 years	-	Occasional
11	Occasional	-	≤ 17.5 years	-	Frequent

Table 4 shows that the age of the students determines 11 conditions of the PM1. For example, if the student considers that the use of mobile devices in the classroom is occasional and has an age > 21.5 years then the search for information of the courses through smartphones is rare. Also, the career of the students determines 2 conditions of this predictive model.

On the other hand, Table 1 indicates that the realization of school activities through smartphones is very frequent (n = 18, 22.50%), frequent (n = 32, 40.00%), occasional (n = 23, 28.75%), rare (n = 3, 3.75%) and very rare (n = 4, 5.00%). The results of machine learning with 55% (0.444), 65% (0.446) and 75% (0.423) of training indicate that H2 is accepted (See Table 3). Therefore, the use of mobile devices in the classroom positively influences the realization of school activities through smartphones. Table 5 shows the PM2 on the use of mobile devices in the classroom and realization of school activities through smartphones. For example, if the student considers that the use of mobile devices in the classroom is very frequent and has an age ≤ 19.5 years then the realization of school activities through smartphones is frequent.

Table 5.
Conditions of the PM2

No.	Use of mobile devices in the classroom	Sex	Age	Career	Realization of school activities through smartphones
1	-	-	> 21.5 years	-	Frequent
2	-	-	≤ 21.5 & > 20.5 years	-	Very frequent
3	Rare	Man	≤ 20.5 years	-	Occasional
4	Rare	Woman	≤ 20.5 years	-	Very rare
5	Frequent	-	≤ 20.5 & > 19.5 years	-	Frequent
6	Frequent	-	≤ 19.5 years	-	Occasional
7	Very rare	-	≤ 20.5 years	Administration	Rare
8	Very rare	-	≤ 20.5 years	Commerce	Occasional
9	Very frequent	-	≤ 20.5 & > 19.5 years	-	Occasional
10	Very frequent	-	≤ 19.5 years	-	Frequent
11	Occasional	-	≤ 20.5 & > 17.5 years	-	Occasional
12	Occasional	-	≤ 17.5 years	-	Frequent

Table 5 shows that the age of the students determines 12 conditions of the PM2. For example, if the student considers that the use of mobile devices in the classroom is frequent and has an age ≤ 19.5 years then the realization of school activities through smartphones is occasional.

The sex of the students determines 2 conditions of the PM2. For example, if the student considers that the use of mobile devices in the classroom is rare, is a man and has an age ≤ 20.5 years then the realization of school activities through smartphones is occasional. Also, the career of the students determines 2 conditions of this predictive model.

3.2. Laptops

Table 1 indicates that the search for information of the courses through laptops is very frequent (n = 5, 6.25%), frequent (n = 23, 28.75%), occasional (n = 24, 30.00%), rare (n = 14, 17.50%) and very rare (n = 14, 17.50%). The results of machine learning with 55% (0.303), 65% (0.304) and 75% (0.216) of training indicate that H3 is accepted (See Table 3). Therefore, the use of mobile devices in the classroom positively influences the search for information of the courses through laptops.

Table 6 shows the PM3 about the use of mobile devices in the classroom and search for information through laptops. For example, if the student considers that the use of mobile devices in the classroom is very frequent, takes the career of Marketing and has an age > 17.5 years then the search for information of the courses through laptops is frequent.

Table 6.
Conditions of the PM3

No.	Use of mobile devices in the classroom	Sex	Age	Career	Search for information of the courses through laptops
1	Rare	Man	> 17.5 years	-	Rare
2	Rare	Woman	> 17.5 years	-	Very rare
3	Frequent	-	> 17.5 years	Administration	Frequent
4	Frequent	-	> 17.5 years	Commerce	Frequent
5	Frequent	-	> 17.5 years	Accounting	Occasional
6	Frequent	-	> 17.5 years	Marketing	Rare
7	Very rare	-	> 17.5 years	-	Occasional
8	Very frequent	-	> 17.5 years	Administration	Occasional
9	Very frequent	-	> 17.5 years	Commerce	Occasional
10	Very frequent	-	> 17.5 years	Accounting	Occasional
11	Very frequent	-	> 17.5 years	Marketing	Frequent

12	Occasional	-	> 18.5 years	-	Rare
13	Occasional	-	≤ 18.5 & > 17.5 years	-	Occasional
14	-	-	≤ 17.5 years	-	Occasional

Table 6 shows that the age of the students determines 14 conditions of the PM3. For example, if the student considers that the use of mobile devices in the classroom is frequent, takes the career of Administration and has an age > 17.5 years then the search for information of the courses through laptops is frequent. Also, the career of the students determines 8 conditions of this predictive model.

On the other hand, Table 1 indicates that the realization of school activities through laptops is very frequent (n = 8, 10.00%), frequent (n = 18, 22.50%), occasional (n = 24, 30.00%), rare (n = 12, 15.00%) and very rare (n = 18, 22.50%). The results of machine learning with 55% (0.347), 65% (0.357) and 75% (0.268) of training indicate that H4 is accepted (See Table 3). Therefore, the use of mobile devices in the classroom positively influences the realization of school activities through laptops. Table 7 shows the PM4 on the use of mobile devices in the classroom and realization of school activities through laptops. For example, if the student considers that the use of mobile devices in the classroom is very frequent and has an age between ≤ 20.5 years and > 17.5 years then the realization of school activities through laptops is frequent.

Table 7.
Conditions of the PM4

No.	Use of mobile devices in the classroom	Sex	Age	Career	Realization of school activities through laptops
1	-	-	> 21.5 years	Administration	Frequent
2	-	-	> 21.5 years	Commerce	Occasional
3	-	-	≤ 21.5 & > 20.5 years	-	Very rare
4	Rare	-	≤ 20.5 & > 17.5 years	-	Very rare
5	Frequent	-	≤ 20.5 & > 17.5 years	-	Occasional
6	Very rare	-	≤ 20.5 & > 17.5 years	-	Very rare
7	Occasional	-	≤ 20.5 & > 17.5 years	-	Occasional
8	Very frequent	-	≤ 20.5 & > 17.5 years	-	Frequent
9	-	-	≤ 17.5 years	-	Occasional

Table 7 shows that the age of the students determines 9 conditions of the PM4. For example, if the student considers that the use of mobile devices in the classroom is frequent and has an age between ≤ 20.5 years and > 17.5 years then the realization of school activities through laptops is occasional. Also, the career of the students determines 2 conditions of this predictive model.

Finally, Table 8 shows the Pearson correlations about Use of mobile devices, Smartphones (Search for information and Realization of school activities) and Laptops (Search for information and Realization of school activities.

Table 8.
Pearson Correlations

	Use of mobile devices	Smartphones: Search for information	Smartphones: Realization of school activities	Laptops: Search for information	Laptops: Realization of school activities
Use of mobile devices	1	-	-	-	-
Smartphones: Search for information	0.320	1	-	-	-
Smartphones: Realization of school activities	0.414	0.608	1	-	-
Laptops: Search for information	0.179	0.461	0.327	1	-
Laptops: Realization of school activities	0.181	0.452	0.288	0.778	1

4. DISCUSSION AND RECOMMENDATIONS

Various authors (e.g., Abugohar, Yunus, & Rashid, 2018; Peechapol et al., 2018; Tachinamutu et al., 2022) mention that mobile devices can be used as support tools for the teaching-learning process. For example, smartphones, tablets and laptops allow the consultation of audiovisual contents, interaction between the participants and communication (Busulwa & Bbuye, 2018;

Pastirmacioglu et al., 2018). As a result of the analysis performed, 46.25% of the students (n = 37) consider that the use of mobile devices in the classroom is frequent.

4.1. Smartphones

Similitar to Howlett and Waemusa (2018), the incorporation of smartphones in the educational field promotes the active participation of students during the teaching-learning process. Quantitative data reveals that 42.50% of the students (n = 34) consider that the search for information of the courses through smartphones is frequent. According to Ortiz and Green (2019), smartphones are support tools for the educational process because these mobile devices facilitate the performance of school activities from anywhere. Also, 17.50% of the students (n = 14) consider that the search for information of the courses through smartphones is very frequent. Therefore, most of the participants have a favorable opinion about this mobile device.

As Shraim and Crompton (2015) indicated, smartphones allow the construction of new educational spaces and the realization of creative school activities at any time. The results of machine learning on H1 are greater than 0.250, therefore, the use of mobile devices in the classroom positively influences the search for information of the courses through smartphones.

On the other hand, the PM1 identifies 11 conditions about the use of smartphones. In this predictive model, the age and career of the students determine how the use of mobile devices in the classroom influences the search for information. In particular, the age influences 11 conditions and career influences 2 conditions.

In the same way, analysis showed that 40.00% of the students (n = 32) consider that the realization of school activities through smartphones is frequent. Mobile devices play a fundamental role to update the course activities (Tachinamutu et al., 2022). Also, 22.50% of the students (n = 18) consider that the realization of school activities through smartphones is very frequent. Therefore, most of the participants have a favorable opinion about this aspect.

According to Asmianto et al. (2022), mobile devices allow the construction of new educational spaces that favor the learning and motivation of the participants. The results of machine learning on H2 are greater than 0.420, therefore, the use of mobile devices in the classroom positively influences the realization of school activities through smartphones.

On the other hand, the PM2 identifies 12 conditions about the use of smartphones. In this predictive model, the sex, age and career of the students determine how the use of mobile devices in the classroom influences the realization of school activities. In particular, the sex influences 2 conditions, age influences 12 conditions and career influences 2 conditions.

4.2. Laptops

This study shares the ideas of various authors (e.g., Deveci et al., 2018; Husna & Kuswanto, 2018; Nazar et al., 2022) about the role of laptops in the educational field to improve the learning conditions inside and outside the classroom. Analysis showed that 30.00% of the students (n = 24) consider that the search for information of the courses through laptops is occasional. As mentioned by Nazar et al. (2022), the incorporation of laptops in face-to-face sessions promotes the active role of students. Also, 28.75% of the students (n = 23) consider that the search for information of the courses through laptops is frequent.

Maloku, Ebner and Ebner (2018) argued that laptops favor the active role of students before, during and after face-to-face sessions. The results of machine learning on H3 are greater than 0.210, therefore, the use of mobile devices in the classroom positively influences the search for information of the courses through laptops.

On the other hand, the PM3 identifies 14 conditions about the use of laptops. In this predictive model, the sex, age and career of the students determine how the use of mobile devices in the classroom influences the search for information of the courses. In particular, the sex influences 2 conditions, age influences 14 conditions and career influences 8 conditions.

The findings of this study indicate that 30.00% of the students (n = 24, 30.00%) consider that the realization of school activities through laptops is occasional.

Also, 22.50% of the students (n = 18) consider that the realization of school activities through laptops is frequent.

Nowadays, educators organize creative school activities to facilitate learning at any time through mobile devices (Asmianto et al., 2022). The results of machine learning on H4 are greater than 0.260, therefore, the use of mobile devices in the classroom positively influences the realization of school activities through laptops.

On the other hand, the PM4 identifies 9 about the use of laptops. In this predictive model, the sex, age and career of the students determine how the use of mobile devices in the classroom influences the realization of school activities. In particular, the age influences 9 conditions and career influences 2 conditions.

In the 21st century, teachers are using new pedagogical models that promote the use of ICTs during the educational process (Abugohar, Yunus, & Rashid, 2018; Fokides & Mastrokoukou, 2018). In particular, mobile devices are transforming the organization of courses (Cavus & Ibrahim, 2017; Baydas & Yilmaz, 2016; Mendez et al., 2018). Finally, smartphones and laptops facilitate the creation of new educational spaces and improve the teaching-learning conditions through the search for information and realization of the school activities.

4.3. Conclusion

Educational institutions are promoting the use of ICTs in the school activities in order to improve the teaching-learning process and develop the students' skills. In particular, the use of mobile devices in the classroom positively influences the search for information of the courses and realization of school activities through smartphones and laptops. On the other hand, data science allows identifying 4 predictive conditions about the use of smartphones and laptops in the educational field through the decision tree technique.

The limitations of this quantitative research are the size of the sample, profile of the students and analysis of the impact of smartphones and laptops in the educational process. Therefore, future research may analyze the use of other mobile devices such as tablets in high schools and universities. Likewise, the sample may include students of medicine, psychology, engineering, philosophy and pedagogy.

Also, this study recommends that teachers organize and realize new activities inside and outside the classroom through mobile devices. In particular, smartphones and laptops promote the active role of students through the search for information and realization of the school activities. Finally, educational institutions have the opportunity to update the school activities and improve the learning process through ICTs. In particular, mobile devices such as smartphones and laptops facilitate the planning and organization of creative educational spaces.

Research and Publication Ethics Statement

This research complies with the ethical guidelines.

Statement of Interest

The author declares no competing interests related to this work.

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