Contextual Attribute Variables in the Use of ICT in Primary Level Students from Southern Sonora, Mexico[*]

Variables atributivas contextuales de estudiantes de primaria sobre el uso de las TIC, en el sur de Sonora en México

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Resumen: El objetivo de este estudio es establecer la relación entre las variables atributivas contextuales en el uso de las TIC por parte de estudiantes de quinto y sexto grado, a través de un modelo de regresión logística. A partir de una muestra no probabilística de 1865 estudiantes de 14 escuelas primarias del sur de Sonora en México, se seleccionó en forma aleatoria una muestra de 522 estudiantes, una sub muestra de 261 estudiantes que utilizan las TIC y otra sub muestra de 261 estudiantes que no las utilizan. Las variables predictoras: tipo de escuela, Internet en casa y tener cuenta de correo electrónico, muestran diferencias significativas entre los estudiantes que hacen uso básico de las TIC y los que no.

Palabras clave: Tecnologías de la Información y Comunicación, Estudiantes de Educación Primaria, Variables atributivas, Modelo de regresión logística.

Abstract: The aim of this study is to establish the relation between the contextual attribute variables in fifth and sixth grade students' use of ICTs through a logistic regression model. A sample of 522 students was randomly selected out of a non-probabilistic sample of 1865 students in 14 primary schools from southern Sonora, Mexico, from which two sub-samples were selected, one made of 261 students who use ICTs and another made of 261 students who don't. Results showed that the predictor variables: *type of school, Internet at home and having an e-mail account*, show significant differences between groups of students who make basic use of ICTs and those who don't.

Keywords: Information and Communication Technologies, Primary Education Student, Contextual attribute variables, Logistic regression model.

INTRODUCTION

nformation and Communication Technologies (ICT) refer to a number of computer technologies used to support teaching and learning, communication and collaboration, self-expression, creation, among others (United Nations Educational, Scientific and Cultural Organization- Institute for Information Technologies in Education [UNESCO-IITE], 2012). In the same sense, ICTs contribute to: "universal access to education, equality in education, quality teaching and learning, and professional development of teachers, as well as more efficient education system management and administration" (UNESCO, 2017, par. 1).

There are currently agreements between leaders of organizations around the world, in which ICT integration is necessary for success because they offer opportunities for learning in an increasingly connected society, in which learning to work with other people implies a more interactive society through frontier technology resources; therefore, collaboration has become a transcendental competency for the current knowledge society (Claro, 2010; García-Valcárcel, Basilotta and López, 2014; Necuzzi, 2013; Saez, 2012; Ulate, 2013; UNESCO-IITE, 2012; Zylca, Christoph, Krohene, Hartig and Goldhammer, 2015).

According to a UNESCO analysis of the Latin American region (Lugo and Schurmann, 2012), in the last two decades, three models are outlined for the integration of ICTs in the classroom, whose main purposes are to equip basic education schools in regard to: a) the laboratory model, where the classroom will be set up with computers so that teachers take their group of students from the traditional classroom to work in the computer lab; b) model where the computers are taken to the traditional classroom to be accessed directly during class, however, access for students is limited because the classrooms are equipped with one or two computers; and c) the third model is the one-to-one (1 to 1 or 1: 1, derived from Negroponte's one laptop per child model), where each student and teacher has access to a laptop or digital tablet to support their teaching work.

With reference to the above, the development of skills in the use of ICT has acquired more importance in different countries, Mexico among them, this last country is where the three models described have been adapted, that is, in the six initiatives implemented by the Government of Mexico in order to promote the integration of ICT in Basic Education: *Red Escolar* [School Network], Enciclomedia, *Habilidades Digitales para Todos* [Digital Skills for All] (HDT), Mi Compu.Mx, México Digital with the *Programa Piloto de Inclusión Digital* [Digital Inclusion Pilot Program] (PPID) and @prende 2.0 with the *Programa de Inclusión y Alfabetización Digital* [Digital Inclusion and Literacy Program] (PIAD) and in the *Programa de Inclusión Digital* [Digital Inclusion Program, PID] (SEP, 2016).

Problem

At present, international organizations such as UNESCO and the educational systems of various countries in the Americas, Europe and Asia (Canada, the United States, Mexico, Chile, Colombia, Peru and Spain) have been concerned with the integration of ICTs into all their educational models. Along these lines, the Organization for Economic Co-operation and Development (OECD, 2015) states that many Latin American basic education schools have not harnessed the potential of ICT in classrooms to bridge the digital divide, which is related to the lack of investment that governments should make in this area.

However, a study conducted by the European Union, in which the participants were divided into three profiles according to their use of ICTs: 1) High access / use in school and home, 2) Low access / use in school and high access / use in the home, and, 3) Low access / use in school and home; showed that the majority of students from first to eighth grade of general school, in most of the participating countries, are located in profile 2, that is, Low access and use in school, high access and use in the home (European Commission, 2013).

The Majority of students from Mexico can be considered to be located in profile 3. According to the statistics of the *Instituto Nacional de Estadística y Geografía* [National Institute of Statistics and Geography] (INEGI) from 2013, only 30% of households had a computer and Internet connection, the age range of 23% of the users of these ICTs is between 12 and 17 years old and the places of access are at home (computer 58.9% and the Internet 55.9%), very few at schools: computers 21.6% and Internet 15.8% (INEGI, 2014).

In Mexico, the *Reforma Integral de Educación Básica* [Comprehensive Reform of Basic Education] (RIEB) through the 2011 primary education curriculum and agreement 592, states that "the vision of a population that uses digital media and

environments to communicate ideas, information and interact with others" (SEP, 2011a, p. 89), also specifies that this implies understanding the workings of ICTs in elementary school.

Additionally, the 2011 curriculum for Basic Education is still in force, and in a very pertinent way, the *Secretaría de Educación Pública* [Ministry of Public Education] (SEP, 2011b) includes the use of digital skills in the primary education graduate profile. In this regard, the new educational model proposed by the SEP (2017) highlights the importance of teacher training in the use of ICTs because, in the classroom, it contributes to the development of digital skills, competencies for "research, understanding and critical analysis of information" in students (p. 120).

In addition to the programs, initiatives, strategies, reforms and educational models proposed by the SEP in Mexico, several researches have been developed with the purpose of identifying the degree of integration of ICTs in basic education and especially at primary level; and a few others, focused on identifying the use of ICTs and the development of digital skills in teachers and students in primary schools (Torres and Valencia, 2013; Torres, Angulo, Valdés and García, 2013; Martínez and Eudave, 2014; Castro, Cedillo and Valenzuela, 2015). Several studies have also been conducted in the state of Sonora (Torres et al., 2013; Mortis, Cuevas, García and Cabero, 2014; Glasserman and Manzano, 2016; Cuevas, Angulo, García, and Navarro, 2016; García, Mortis, Simental and Valenzuela, 2016; Villegas, Mortis, García and del Hierro, 2017).

With similar purposes to those exposed. In one research (Mortis et al., 2014) carried out on basic education students in the southern region of the state of Sonora, it was found that the students of private schools are perceived more competent than the students of public schools, they dominate the following technological competences: a) communication and collaboration, b) information research and management; and, c) the concepts and workings of ICTs. In this sense, another study (Cuevas et al., 2016) carried out with students of basic education, it was found that the students are perceived with levels ranging between moderate and very high, while their teachers affirm that they have high levels of some technological abilities such as the production of documents written with a word processor.

In others studies, Glasserman and Manzano (2016) developed a diagnosis on the degree of integration of laptop computers into the pedagogical practices of the teachers in Sonora who participate in the MiCompu.Mx program, in which it was found that the equipment delivered (laptop and electronic tablets). Similarly, the results of Villegas et al. (2017) indicate that fifth and sixth graders make moderate use of ICT in general and for communication at school; no significant differences were observed in gender and among those who have or do not have a

computer or electronic tablet at home, but among those who do not have Internet access at home.

Likewise, García et al. (2016) also carried out research with fifth- and sixth-grade elementary students in schools of a municipality in southern Sonora; which shows that these students have an acceptable command in the basic use of ICTs, a low level use of basic Microsoft Office programs and a high proficiency in the use of Internet.

Throughout the background and approaches made, it has been observed that there are no studies in the state of Sonora, specifically in the southern region, that define the attributive variables in primary students that influence the basic use of ICTs, that is, the characteristics that influence students to use ICT in academic activities. In view of this, the pertinence and feasibility of carrying out a study to document this educational situation was examined, taking as the guiding principle of this empirical study the following research question: how are the attributive variables of fifth and sixth grade students related to the basic use of ICTs?

Literature Review

The integration of ICTs into primary education training processes continues to face major challenges because the effectiveness of ICT use in the classroom depends on several factors: a) adequate functioning of available digital computing resources, connectivity and Internet access (Trigueros, Sánchez and Vera, 2012; Necuzzi, 2013; Santiago, Caballero, Gómez and Domínguez, 2013; Sunkel, Trucco and Espejo, 2014); b) the skills and abilities of all those involved in the training process, that is to say, the digital skills of students (Claro, 2010; Trigueros et al., 2012; Aesaert, Van Nijlen, Vanderlinde, Tondeur, Devlieger and van Braak, 2015; Fajardo, Villalta and Salmerón, 2016); c) pedagogical practices that encourage the interaction of students with ICTs are required (Saez, 2012; Necuzzi, 2013; Santiago et al., 2013; , 2015); and d) lack of leadership or policies that encourage the use of ICT in the classroom (de Pablos, 2009; Hadjithoma and Karagiorgi, 2009; Claro, 2010; Ulate, 2013; Díaz-Barriga, 2014).

In the same vein, ICTs provide current and relevant information, which leads to a greater ambition, in students, in the search for information and access to the vast knowledge in the web, which can positively influence the academic performance of primary education students, because they develop higher order skills: in the management, organization and evaluation of information (information literacy); and, they encourage retention, that is, they contribute to the understanding and transference of knowledge (Coll, Mauri and Onrubia, 2009; Claro, 2010;

Cituk, 2010; European Comission, 2013; Necuzzi, 2013; Llorente et al., 2015), besides a greater motivation towards learning contents seen in class (de Pablos, 2009; Ortiz, Peñaherrera and Ortega, 2012).

In this regard, the *Instituto de Tecnologías Educativas* [Institute of Educational Technologies] (2011) indicates that, in recent years, learning technologies based on collaboration and social interaction that can improve the quality of learning, have been developed. However, this potential will only be developed with the application of appropriate methodologies and teachers' selection of activities that integrate dynamic learning.

Recent research in Belgium states that the factors related to ICT self-efficacy in primary school students are related to: professional development, experience, competencies, teachers' use and attitudes towards ICT; cognitive and motivational traits (learning styles, analytical intelligence and motivation towards learning), socio-cultural and economic traits (age, gender and socio-economic status), experience, students' use and attitude towards ICTs; besides the availability of ICT in their homes, parents' attitude towards ICT and the support given to their children (Aesaert and van Braak, 2014; Aesaert et al., 2015).

As for the level of proficiency in ICT use, the results of several studies indicate that students in basic education have: a low level of basic digital skills, high-order skills (Aesaert and van Braak, 2015; Fajardo et al., 2016), and Internet use (Torres and Valencia, 2013), low to average scores (Aesaert et al., 2015, Garcia et al., 2016), others reveal high, high average, and very high performance levels (Aesaert and van Braak, 2014; Martínez and Eudave, 2014; Cuevas et al., 2016; Chávez, Cantú and Rodríguez, 2016).

Documented evidence in studies reveals that most of these students use ICTs intensively in their homes, but never or rarely at school (Claro, 2010; Torres and Valencia, 2013; European Comission, 2013; Martínez and Eudave, 2014; Piñeiro, 2014); their use of ICT is primarily for leisure activities and socializing (Ortiz, et al., 2012; Torres and Valencia, 2013; Martínez et al., 2014; Aesaert et al., 2015; Rohatgi, Scherer and Hatlevik, 2016) and in a very small amount for school activities (Ortiz et al., 2012; Torres and Valencia, 2013; Martínez and Eudave, 2014; Piñeiro, 2014).

However, in studies of other more developed countries with greater access to ICT at school and their homes, it was observed that secondary students have personal computers, smartphones and electronic tablets with Internet access, and use them for school activities and personal use, such as communicating with peers, friends or their own families (Zylca et al., 2015).

In terms of gender, the results of various researches indicate that girls have higher levels of ICT competence than boys (Lau and Yuen, 2014; Mortis, et al.,

2014; Aesaert and van Braak, 2015; Aesaert et al., 2015); unlike the findings of a study carried out in Spain by Ortiz et al. (2012), in which significant differences were found, in favor of children, in the use of various multimedia educational activities programs (JClic, Adibu, Pipo), made up of a set of computer applications that serve to carry out various types of educational activities: puzzles, associations, text exercises, crossword puzzles, alphabet soups, among others.

In addition, findings from various studies show significant relationships between the socioeconomic level or status and the type of school students attend to and their level of ICT competence, that is, the results show that the educational level of the mother is positively related to the technical ICT skills of the students and the ICT competences of higher order (Aesaert and van Braak, 2015; Aesaert et al., 2015).

It should be added that in private primary schools in Chile, the use of ICTs is given more importance, and their students have better scores or better use in their classes than the students in municipal or private schools who receive lower scores (Oddershede, Donoso, Farias and Jarufe, 2015); while in secondary schools in the state of Sonora, Mexico, students enrolled in private schools are perceived to be more competent in the use of ICTs than students attending public schools (Mortis et al., 2014).

Objective

To establish the relation between the attributive variables in the use of ICT in students of fifth and sixth grade of primary schools, through a model of logistic regression.

Method

A quantitative, non-experimental, cross-sectional, and explanatory study was performed.

Participants and sample

In a non-probabilistic way, 1865 students of fifth and sixth grade were surveyed in seven public elementary schools and seven private schools in a city in the northwest of Mexico. A random sample of 522 students was selected, out of which a sub-sample of 261 students who use ICTs was randomly selected, 136 (52.1%) of which were from public schools and 125 (47.9%) from private schools, in addition 143 (54.8%) were fifth-graders and 118 (45.2%) were sixth-graders, of which 133

(51%) were men and 128 (49%) were women, with a mean age of 10.9 (*SD* = .74). Likewise, another sub-sample of 261 students who did not use ICT was selected in order to carry out the analyzes in groups of similar size, having 225 (86.2%) public schools and 36 (13.8%) private schools, out of which 169 (64.8 %) were fifth-graders and 92 (35.2%) were sixth-graders, of which 150 (57.5%) were men and 111 (42.5%) were women, with a mean age of 10.7 (*SD* = .69).

INSTRUMENT

A self-report scale was used in which students were asked about their perception about the basic use of ICTs. This scale was made up of 11 items that were answered using a Likert scale with five response options: 1 (Never), 2 (Rarely), 3 (Regularly), 4 (Almost always) and 5 (Always). Regarding content validity, the instrument was evaluated by expert researchers and academics.

Regarding the construct validity, it was through an exploratory factor analysis, with the maximum likelihood method the unifactorial structure of the scale was reaffirmed ($X2$ = 9297.613, p < .000: *KMO* = .925), which explains 46.1% of the variance. The reliability of the scale measured with Cronbach's Alpha was .93.

PROCEDURE AND ANALYSIS

1. The schools were selected according to convenience criteria, for this the databases of public and private schools of the Ministry of Education and Culture, the *Buscador de Escuelas en Línea* [Online School Searcher] (SEC, 2018), were downloaded, with the following characteristics: a) greater number of students, and b) distributed in different geographical areas of the city.

2. Once the purpose of the study was presented to the authorities of the basic schools under study, their authorization to access them was requested.

3. Before applying the instrument to the fifth and sixth grade students, the purpose of the study was explained to the teachers and a representative of the parents, who gave their consent.

4. Upper elementary students were selected because they are old enough to access and use ICT for academic purposes.

5. A team of trained applicators, seniors of the B. A. in education applied the instruments.

6. Data analysis procedure: univariate statistics and a multivariate dependence method were used, since they provide a joint and integrated vision to describe and explain the reality that is analyzed.

a. First, a contingency table was created, whose objective was to estimate the existing relationship between a series of predictor variables (Type of school, I have Internet access at home, I have an e-mail account) and a single non-metric variable variable (use, does not use technology).

b. Subsequently, the variables that were significant in the previous analysis were subjected to a logistic regression analysis to study the odds ratio of the criterion variable based on the predictor variables, where the guidelines and assumptions presented in Cea (2004) were followed. The entire analytical procedure was carried out with the Statistical Package for the Social Sciences (IBM SPSS version 20).

Results

Table 1 shows that the predictor variables display significant differences among groups of students who use and do not use basic ICT. In the group that uses them, there is a greater proportion of students in public schools, with those with Internet access at home and those with an email account.

Table 1. Frequencies of the predictor variable of the Basic ICT Use in primary students

VARIABLE		USE ($n = 261$)		DO NOT USE ($n = 261$)	
		N	%	n	%
Type of school					
	Public	136	52.1	225	86.2
	Private	125|	47.9	36	13.8
I have Internet access at home					
	No	25	9.6	56	21.5
	Yes	235	90.4	205	78.5
I have an e-mail account					
	No	40	15.3	90	34.5
	Yes	221	84.7	171	65.5

*** $p <.001$.

The $R2$ value of .24 shows that the predictor variables integrate a model with a better predictive power than the base model. The Hosmer-Lemeshow test ($X2=$ 4.49, $df=$ 6, $p=$ .611) was not significant, indicating that there are no differences in the current distribution and predicted dependent variable values.

It can be seen that the value of Beta coefficient is negative with respect to the *type of school* variable, therefore the value of OR implies that the probability of belonging to the group that makes *basic use of ICT* increases to the extent that they belong to a private school. With respect to the positive *Beta* coefficients, the value of OR implies that the probability of belonging to the group that use ICT increases as long as they have an email account, with respect to the predictor variable *I have Internet access at home*, it was not significant in the final model (see Table 2).

Table 2. Logistic regression analysis for the prediction of basic ICT use summary

VARIABLES	B	ES	OR	95% C.I.
Type of School	-1.743	.22	.17***	[.11, .27]
I have Internet access at home	.511	.27	1.66	[.96, 2.87]
I have an e-mail account	1.11	.23	3.04***	[1.90, 4.84]

p < .01. * *p* < .001.

The predictive variables allow for appropriately classifying 67.8% of the students who use and do not use ICT in a basic way, which is considered acceptable for such analysis (Cea, 2004). It should be noted that the variables present slightly better power to identify those who do not use them than those who do use them (see Table 3).

Table 3. Analysis of the classification in the groups who use and do not use

CURRENT GROUP BELONGING		PREDICTED GROUP BELONGING			
		DO NOT USE		USE	
	n	*n*	%	*n*	%
Do not use	261	181	69.4	80	30.6
Use	261	89	34.1	172	65.9

Note: Globally classifies 67.8% of the students correctly

DISCUSSION AND CONCLUSIONS

The integration of ICTs in primary education students and in the learning process requires that teachers and students are competent in technology in at least a basic use of ICT, there are attribute variables for this that were considered as possible predictors of the basic use of ICT, as were the type of school, having computers, accessing the Internet in their homes and having an email account.

The results show that the *type of school* is an attribute variable that allows predicting the basic use of ICTs, that is, being a student enrolled in a private school increases the likelihood of ICT usage. Although there is a greater proportion of students who have Internet access at home and those who have an e-mail account, among those who use ICT and those who do not, according to the analysis, these are not predictor variables.

This finding agrees with that of another study carried out in this same region. It was found that students from private secondary schools have greater mastery of technological skills than students enrolled in public schools (Mortis et al., 2014) and another carried out in Chile, where private primary schools attach greater importance to the use of ICTs, their students use them more and score higher in achievement than municipal or public schools (Oddershede et al., 2015).

Contrary to the results of other studies, the *gender* attribute variable did not prove to be a predictive variable for proficiency in the basic use of ICTs in primary school students. Thus, gender in other studies (Lau and Yuen, 2014, Aesaert and van Braak, 2015, Aesaert et al., 2015, Mortis, et al., 2014) was a determinant variable for mastery in ICT competencies, where girls were more proficient than boys, and boys were more proficient than girls in the use of various multimedia educational activities programs (Ortiz et al., 2012).

With regard to *type of school*, it should be emphasized that the results can be due to the fact that students enrolled in private schools belong to a high socioeconomic level and therefore, it is inferred that they have access to several ICTs from their homes. This is in line with findings from similar studies (Aesaert and van Braak, 2015; Aesaert et al., 2015), in which they conclude that the availability of ICTs in the homes of primary students is related to their self-efficacy in the use of ICTs. In these studies (Aesaert and van Braak, 2015; Aesaert et al., 2015) it has also been inquired about socioeconomic status and the results show that the educational level of the mother is positively related to students ICT technical skills and with the ICT competences of higher order.

Therefore, it is necessary to carry out more research that verify that the availability of ICT at the homes and the educational level of the mother are variables related to the basic ICT use mastery in primary school students. It would also be convenient to continue researching other variables that may influence the use of ICTs by primary school students, such as: parent attitudes towards ICT and the support they give their children in the use of technologies for their extra-class tasks.

It is also important to investigate the pedagogical use of ICT by teachers, since they should promote the development of skills in the use of ICT in their

students; to this end, the teachers must have a positive attitude towards them, be well trained to use them in a relevant way in the classroom and have accompaniment for their use in the classroom and with technical advice should they require it. It has already been explained that the results of several studies indicate that the pedagogical use of ICT depends on the mastery of ICT competences by students, but especially teachers (Ulate, 2013; Castañeda, Carrillo and Quintero, 2013; Santiago et al., 2013; Vargas-D'Uniam, Chumpitaz-Campos, Suárez-Díaz and Badia, 2014; Valdivieso and Gonzáles, 2016), since it is they who can help develop these competences in their students.

Finally, it is suggested to continue to inquire and document the factors that influence the use of ICT in the teaching-learning processes of primary education schools, because there is enough evidence that even in highly developed countries, that have economic resources to supply schools with technological resources (enough computers with Internet access for all students, as well as smart whiteboards, computer, Internet access and projector in every classroom, among others), primary school students continue to use ICT mainly in their homes and very little in their schools (European Comission, 2013; Claro, 2010; Torres and Valencia, 2013; Martínez et al., 2014; Piñeiro, 2014).

Therefore, according to the results of the study carried out by the European Commission (2013), the majority of students in the first eight levels of primary schools in Europe and the United States use ICTs mostly in their homes and a very low percentage use them in school. It is clear from the above that most students use ICTs for social or recreational activities, and very few for school activities (Ortiz et al., 2012; Torres and Valencia, 2013; Piñeiro, 2014; Martínez and Eudave, 2014; Aesaert et al., 2015; Rohatgi et al., 2016).

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