

Technological Gap: The Education Case of the State of Puebla, Mexico

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Abstract - *The teaching-learning process may have several obstacles; one of those would be a cultural situation of students but also the ICT (information and communication technologies) resource distribution per children. When we refer to cultural situation, we mean the language or dialect that they speak. In the state of Puebla, Mexico, there are primary schools in which courses are taught to students who do not speak Spanish and they only speak their own dialect. On the other hand, the use of information and communication technologies in primary schools in Puebla is a fact but a main concern in schools is that the languages in which are operated is Spanish. The present article will also deal with the distribution of enciclopedia sets per children population in the 217 communities of the state of Puebla. To analyze this situation, we find that turns out to be very important and with a negative effect on both the implementation and acceptance of a multimedia program in these schools, generating a technological gap between students. The government efforts are being decimated because of this cultural divide prevalent in many communities in the state of Puebla, Mexico.*

Keywords: Primary schools, information technology, resource distribution, cultural gap, technological gap.

1 Introduction

Various studies have demonstrated the importance and the impact of diverse material resources and equipment of different types [1] to improve efficiency, the learning process and teaching results [2]. According to the Director of UNESCO, Mr. Koichiro Matura, in his discourse delivered on the 19th of December 2007, "...the information and communication technologies have the power to increase learning access, especially for vulnerable communities in remote areas...", additionally, "...these new technologies can help governments to monitor, manage and apportion educational services in a more efficient way..." he acknowledges information and communication technologies as a basic tool to close the digital divide [3] between cities and countryside, as defined by Inclán [3] as well as between nations.

The basic public educational sector in Mexico is one of the least favored with respect to the use of information technologies which is unacceptable if the digital divide is to be closed [4]. It is undeniable that in a nation of well-educated citizens there is a profound contribution to the development of a knowledge-based society [5], of a more just and participative society. However, insufficient availability and utilization of information and communication technologies, the low budget increases in educational resources [6] and the inefficient use of available resources [7] are characteristic for the Mexico educational system, which still has not completely manage to appropriate ICT in spite of the presence of approved programs by the UNESCO as in the case of the enciclopedia system, the program of Physics Education with Technology and the Program of Mathematics Education with Technology whose objective is to incorporate the use of information and communication technologies in the teaching of physics and mathematics in secondary public schools.

This paper will try to portrait the current situation in Puebla's primary school system with respect to the inclusion and use of the information and communication technologies as an educational tool in teaching and learning process, especially the use of the enciclopedia system in the 5th and 6th grades of primary schools since very few publications have touched on the problem and have seldom taken it into consideration as a factor in educational quality improvement. Consequently, there has been negative impact on productive tasks and the creation of new forms of social interaction in Mexico which could be the foundation of understanding the importance which ICT has in today's education [8].

The initial step of this paper is to offer an exploration of the operation of the Mexico educational system, thereafter information related to the enciclopedia program, the equipping of classrooms for the 5th and 6th primary grades between the 217 counties of the State of Puebla with this tool will be presented. A model will be developed with the objective of analyzing the impact of the number of systems in relation to the localization of primary schools, according to total indian population numbers per county, per school modality (state, federal, indigenous and indigenous shelter) and the number of enciclopedia sets according to children

population in the state of Puebla. Finally, conclusions will be offered.

2 Literature review

The Mexico educational system is based on the General Educational Law which, in turn, is based upon Article 3 of the Mexican Constitution. In it are established the general provisions, organization and general structure of the Mexico educational system. In the institutional framework are basic education, middle schools and higher education, each with its different levels and modalities.

In primary education, three modalities are recognized: the General Primary School (urban and rural), the Indigenous Primary School and the Community Primary School. Primary education consists of a 6 year cycle and is obligatory for all Mexicans. For purposes of this paper, general state, federal state, indigenous and indigenous shelter schools in the 217 counties of the state of Puebla will be dealt with.

During the schoolyear 2005-2006, approximately 32 million students were enrolled in the Mexico School System in all of its different levels, types and modalities in 230 000 education centers. The largest number of students, nearly 25 million, were enrolled in basic education (secondary and primary schools) this also includes secondary schools for the working population. This level represents 80.4% of total student enrolment in 92.3% of the school installations (214,394).

14,548,194 students were enrolled in primary education (13,371,543 in public schools and 1,176,651 in private schools) in 98,045 schools (90,896 public schools and 7,149 private schools). 5,979,256 students were enrolled in the secondary education system, (5,531,111 in public schools and 448,145 in private schools) in a total of 31,667 schools (28,246 public and 3,766 private). At the high school level a total of 3,658,754 students (2,924,529 in public schools and 743,225 in private schools) attended 12,841 schools (7,590 public and 5,257 private).

The efforts to create a wide infrastructure coverage at the different education levels has been impressive but still not sufficient during various federal administrative periods [9]. For example; 90% of the resources destined for the education sector in 2006 were for current operation costs and only the small remainder went forward investment and innovation.

Various studies offer information with respect to the impact of the quantity and quality of educational resources used [10]. In this context, in a study covering the year 2004 education inequalities in Mexico [11] it is pointed out that the use of some inputs are related with the yield, as was the case of the use of computers in Spanish and mathematics courses where the impact was positive.

In Mexico's National Development Plan for 2007-2012 it is acknowledged as well that there are still lags in the educational system such as the lack of opportunities to access to quality education as well as in advances in technology and information. Therefore, the Plan establishes a collection of objectives and strategies to foment development. Objective number nine: "Elevating the quality of education postulates a series of considerations to achieve this objective which is designed to comply with a combination of strategies. Strategy 9.3 recognizes that educational methodologies must adapt themselves to a changing world to assure the integration of knowledge through new information technologies. Respectively, strategy 9.4, objective 10 and strategy 10.1 describe the importance of the apportionment of resources in an efficient and equitable manner (through our model we will demonstrate that the apportionment of resources in the State of Puebla for equipping classrooms with the enciclopedia system is done differently) to reduce regional inequalities, modernizing and broadening educational infrastructure.

The stated objective of the National Development Plan recognizes the necessity of spurring development and utilization of new technologies in the educational system to permit the integration of the students into the knowledge society. Therefore, strategy 11.1 has been designed specifically to reinforce the use of new technologies in the teaching process and in the development of abilities in the use of information and communication technologies starting at the basic education level.

In this same context, the State Plan for the Development of the State of Puebla 2005-2011, recognizes the necessity to broaden educational infrastructure to guarantee equal opportunity of access to and continuance in the system for all Puebla citizens. Consequently, at the administrative level effective deconcentration is fundamental in establishing an integral administrative modernization program which contemplates efficiency in planning structure and the operation of the department. In the diagnosis of the Primary educational level it was established that deteriorating infrastructure still prevails and that there is scarcity of resources. In that sense, if students or children find out that conditions of ICT in schools are not appropriate for educational purposes, then they will have to solve their problem by using home computers. From 2001 through 2004, there has been a substantial increase in the use of computers in Mexico by children above 6 years old [12] at home, which means that more than 25% of the total of children population uses a computer at home. In 2011, 33.5% of total population of the state of Puebla was considered as a computer user [13]; below national mean (41.9%).

For its part, the National Institute for the evaluation of education (INEE), an organization created in Mexico for the evaluation of quality in the Mexico educational system has conducted various studies [26] [27] [28] [29], which reveal the state of school resources available in the matter of

information and communication technologies for primary and secondary schools, plus physical space, teaching aids (which includes the availability of computer science teachers) the number of computers and/or other electronic devices, study programs and financial resources.

In the context of the above, we acknowledge that the current educational policy of the Mexican government has evolved, passing from being an indicator of social welfare to being a product adapted to serving that which determines the new political and economic order [14]. As shown, the technological revolution is an element which has obliged nations to adapt their public policies [15] in light of this factor and educational policy [16] it cannot and must not be disregarded in this context that the educational context has changed [17]. The democratization of education, for its part, appears to be part of the objective of the new economic policy with the eagerness to reduce social inequalities by bringing education to all corners of nation [18].

Emphazing just how much attention must be paid to the incorporation of information and communication technologies in education, various programs of Mexico's federal government (Ernesto Zedillo, Vicente Fox and Felipe Calderón) have acknowledged its importance and consequently programs like enciclomedia (during the administration of Vicente Fox) were created for basic education. That is to say, the investment which the government must make in order to adopt new information technologies in the educational sector is essential [15] and not to be delayed [19]. The assignment of this resource must be made in such a way, that it does not contribute to the broadening of social inequalities. In that, special care must be taken in deciding which order and how the government will employ this resource and where it will come from [18].

The focus of this paper is the primary school and the incorporation of information and communication technologies through the enciclomedia program in the classroom. Information and communication technologies have been incorporated in the primary school in different ways around the world as well as in its different levels [20] [21]. Some schools have established laboratories and/or computer rooms, multi-media rooms and/or audiovisual rooms, computers and/or audiovisual equipment in the classrooms [22] with the intent to have equipment which could help the educational community to develop abilities to compete in the marketplace and have better working conditions in the future [18] but, people might choose not to use them for reasons other than the lack of technological skills [23]. Therefore, the digital divide can also be expressed in terms of the abilities needed to take advantage of the information and communication technologies [24] such as the use of English language as the most common used in the internet. In this sense, there are countries that the official spoken language is not English but dialects are or something between an official language and dialects.

Enciclomedia is an educational strategy which originated in 1998 and consists of a system of articulated resources which, through digitalization of textbooks and the incorporation of various multimedia resources like videos, photos, maps, graphs, encyclopedias [3] and electronic blackboards [20]. Enciclomedia has linked its lessons in order to contribute to the qualitative improvement of education in public schools in Mexico and is now totally linked to fulfill the educational objectives. It is an innovative way of using technology in the school and thereby can contribute to overcome current issues in education in Mexico. For example, teachers can consult ENCARTA to dispel any doubts that may have arisen among the students during class or the teachers can flesh out the information they are imparting to the students about pre-hispanic cultures with videos of the principal archaeological zones, students can also find interactive exercises on mathematics among others.

The gradual incorporation of information and communication technologies into the classroom, the modernization of pedagogical practice, the production of new educational materials are characteristic of this system.

Enciclomedia began to be used in classrooms of the 5th and 6th grades of primary schools of the 2003-2004 schoolyear and has still not reached its end. At present, it consists of two stages: in the first stage (school year 2004-2005) 21,434 electronic blackboards were installed in classrooms in 7,211 schools as well as in 548 teacher training centers. 670,062 students in the general primary system, 15649 in the indigenous primary system and about 25,000 teachers have benefitted from the enciclomedia system. In its 2nd phase, school years 2005-2007, 150,000 electronic blackboards have been installed in the same number of schoolrooms in Mexico [25].

3 Objectives, variables, hypotheses and data

3.1 Objectives

Some factors affect the broadening of the digital gap in developing countries. One of those factors is the way in which educational resources are distributed in public schools but also the social access. The objective of this paper is to analyze the relationship between the equipping of classrooms with Enciclomedia in public primary schools in the State of Puebla and its geographic location, its modality, the size, the type of indian population in every county in the state of Puebla and distribution of Enciclomedia sets per children population.

3.2 Variables

3.2.1 numeq (Number of classrooms equipped with Enciclomedia)

Numeq has been selected as a dependent variable relative to the number of classrooms of the 5th and 6th grades of Primary Schools in the State of Puebla equipped with Enciclomedia. The independent variables in their different modalities which will be considered are:

3.2.2 primest (State Primary School)

This variable refers to the State Primary modality in the State of Puebla. It is a dummy type of variable because the presence of the State Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.3 primfed (Federal Primary School)

This variable refers to the Federal Primary modality in the State of Puebla. It is a dummy type of variable because the existence of Federal Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.4 primindi (Indigenous Primary School)

This variable refers to the Indigenous Primary modality in the State of Puebla. It is a dummy type of variable because the existence of the Indigenous Primary in the database is expressed with a 1 and the other modalities with a 0.

3.2.5 Dist (Distance in km. Between the City of Puebla and the surroundings counties)

This variable refers to the existing distance in kilometers between the Capital City of the State Puebla and its counties.

3.2.6 habindi (Indian Inhabitants)

This variable refers to the total of Indian inhabitants for all the municipalities of the State of Puebla.

3.2.7 numdial (number of dialects spoken in State of Puebla)

This variable refers to the total number of dialects spoken in all the municipalities of the State of Puebla.

3.2.8 popinf (number of children population)

This variable refers to the total number of children population in all the municipalities of the State of Puebla.

3.3 Hypotheses

H_1 = The number of Enciclomedia sets depends on the distance between the capital city of Puebla State and the municipalities.

H_2 = The number of Enciclomedia sets depends on the total of Indian inhabitants for all the counties of the State of Puebla.

H_3 = The number of Enciclomedia sets depend on the distance, Indian inhabitants, federal primary school, state primary school and indigenous primary school.

H_4 = The number of Enciclomedia sets depend on the number of dialects spoken in the State of Puebla.

H_5 = The number of Enciclomedia sets depend on the number of children population in the State of Puebla.

3.4 Data

The State Coordination of Distance Education of the Ministry of Public Education of the State of Puebla in Mexico (CETE-SEP) provided us with a database which contained the following information of the State of Puebla: County name and its localities (these data had to be verified individually to correct errors with respect to names and number of localities referred to), the number of classrooms equipped with Enciclomedia in the fifth and sixth grades of Primary School (2532 school rooms is the total of the sample), school modality (Federal Primary, State Primary, Indigenous Primary).

Herby item, this database displays 3 levels of Enciclomedia classroom equipment. The two first levels contain the information of equipment in Enciclomedia classrooms for fifth and sixth grades of Primary School in different stages (I and II) and the third level (III) has information of equipment for the first grade of Secondary. In this paper only level II of equipment for fifth and sixth grades of Primary School for the years 2005 and 2006 will be dealt with.

Added to the database mentioned above, are four more variables. The first variable is the distance in kilometers existing between the capital of the State of Puebla and the 216 counties in the rest of the State, the second variable is the number of Indian inhabitants in each county of the State of Puebla, the third variable is the number of dialects spoken in the State of Puebla. The dialects are: Náhuatl, totonaco, mixteco, mazateco, zapoteco, popolaca, chocho, otomí, tlapaneco, tepehua and the last variable includes the total number of children in the 217 municipalities of Puebla.

4 Descriptive Statistics

4.1 Research variables

Table 1 shows descriptive statistics for the research variables used in this paper. The number of observations is 217 that correspond to the total number of municipalities. The maximum classrooms equipped with enciclomedia systems are 650 and the mean corresponds to 27.68 enciclomedia sets per county. The major distance from the City of Puebla is 300 km. the average of distance is 120.27 km. The maximum Indian inhabitants in one municipality are 47,199. The mean of Indian inhabitants in all counties is 2,772 and the standard deviation is 5,591. The mean of children population in all the counties is 8,894.

Variable	Mean	Std. Dev.	Min	Max
numeq	27.68	48.81	1	650
dist	120.27	66.04	1	300
habindi	2,772	5,591	0	47,199
popinf	8,894	28,289	132	400,228

Table 1 Descriptive statistics for variables listed above

4.2 School modality

In table 2 is shown the descriptive statistics of the school modality variables used in this work. The average of state primary schools equipped with enciclomedia sets per county is 2.36 while in the federal primary schools are 6.51. Finally, there are more federal primary schools than state primary schools or indigenous primary schools.

Variable	Mean	Std. Dev.	Min	Max
primest	2.36	4.85	0	66
primfed	6.51	8.39	0	78
primin	2.61	5.34	0	38

Table 2 Descriptive statistics for modality

4.3 Dialects spoken

In table 3 is shown the percentages for each dialect spoken in the State of Puebla. The most spoken dialect is Nahuatl as shown in the table. The less spoken dialect spoken is Tepehua.

Dialect	percentage	Dialect	percentage
náhuatl	62.42%	popoloca	2.68%
totonaco	16.44%	zapoteco	2.01%
mixteco	8.39%	Chocho	0.67%
otomí	3.36%	tlapaneco	0.67%
mazateco	3.02%	tepehua	0.34%

Table 3 Dialects spoken in the State of Puebla

5 Models, methodology and results

5.1 Models

The following equations are the proposal models to prove the hypotheses postulated earlier:

$$\text{Model } \text{numeq} = \beta_0 + \beta_1 \text{dist} \quad (1)$$

$$\text{Model } \text{numeq} = \beta_0 + \beta_1 \text{habindi} \quad (2)$$

$$\text{Model } \text{numeq} = \beta_0 + \beta_1 \text{dist} + \beta_2 \text{habindi} + \beta_3 \text{primest} + \beta_4 \text{primfed} + \beta_5 \text{primind} \quad (3)$$

$$\text{Model } \text{numeq} = \beta_0 + \beta_1 \text{numdial} \quad (4)$$

$$\text{Model } \text{numeq} = \beta_0 + \beta_1 \text{popinf} \quad (5)$$

5.2 Methodology

The methodology that we follow is with a linear regression by ordinary least squares was utilized in such form as to permit arriving at the relationships.

5.3 Results

5.3.1 Hypothesis 1

In table A1, there is a relationship between the number of enciclomedia sets and the distance between Puebla City and the remaining municipalities. The furthest (300 km far away from Puebla city) the less primary school equipped with the enciclomedia system.

5.3.2 Hypothesis 2

In table A2, we can demonstrate that the municipalities with more inhabitants deserve more equipped classrooms with enciclopedia system.

5.3.3 Hypothesis 3

The number of Enciclopedia sets is related to the distance, the number of Indian inhabitants and the school modality (Table A3).

5.3.4 Hypothesis 4

In table A4, we can demonstrate that the municipalities with most spoken dialect deserve more enciclopedia sets.

5.3.5 Hypothesis 5

Findings in table A5 show that the more children population in municipalities the more enciclopedia sets they get.

6 Conclusions

The National Development Action Plan of México has included within its action initiatives, the incorporation and use of information and communication technologies in the education sector, particularly for the basic education, with the proposal of introducing the student to the Knowledge society. In table 2 it can be seen that there are a larger number of Federal Primary Schools equipped with Enciclopedia in the State of Puebla with 78, while in the Puebla State Plan for Development no mention is made of information and communication technology in the education sector and it can be seen that only 66 State Primary Schools are equipped with Enciclopedia. As Stiglitz [22] has indicated, the assignation of this resource must be made in such a way as to not contribute to the widening of the social inequalities, wherefore special care must be taken in deciding which order the government apply this resource, as well as from which sources it will come, so that the way in which this resource is distributed to primary schools in the State of Puebla does not contribute to the broadening of the digital gap between Federal Primary Schools and State Primary Schools. Apparently, results from hypothesis 5, indicate that children deserve more enciclopedia sets but the bad resource distribution is a fact in the state of Puebla.

It can be said in Table A1, that the farther away any of the 216 municipalities are from the State Capital, the lower the number of Primary Schools with Enciclopedia equipment, this point is particularly important for decision makers in so far as in equipping classrooms with Enciclopedia [30], without regard as to what might be the motive for why the most distant Primary Schools are less equipped, the end result is that these areas have less access to information and communication technology, and from that we can conclude

the State Plan for Development in Education and the National Plan for Development in Education are not pursuing the same objective, at least in the incorporation of information and communication technology in Primary Schools. In Table A2 we show that the number of Indian inhabitants with respect to the number of equipment sets have a positive relationship, this means that a major number of Indian inhabitants the government provides more enciclopedia sets for that kind of population. But at the same time, government realizes that municipalities with more Indian population should have more enciclopedia sets.

Finally, the municipalities with more than two spoken dialects are the most favored with enciclopedia sets, in order to reduce the cultural and technological gap.

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Appendix

Table A1. Stata's results for model 1.

numeq	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
		0.050112			0.018371	
dist	-0.080403	3	-1.6	0.11	-0.1791773	3
_cons	37.34764	6.872129	5.43	0	23.80227	50.89301

Table A2. Stata's results for model 2.

numeq	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
		0.000439			0.005017	
habindi	0.0058843	8	13.38	0	3	0.0067512
_cons	11.36197	2.739836	4.15	0	5.96159	16.76235

Table A3. Stata's results for model 3.

numeq	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]		
dist	0.064067	5	-5.42	0	0.087361	-0.0407734	
habindi	0.001575	3	7.81	0	0.001177	8	0.0019727
primest	5.233161	0.2128716	24.58	0	4.813534	5.652789	
primfed	2.278273	0.1175275	19.39	0	2.046595	2.509952	
primindi	0.892540	3	4.88	0	0.531676	3	1.253404
_cons	1.515214	1.682382	0.9	0.369	-1.801216	4.831645	

Table A4. Stata's results for model 4.

numeq	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
				0.00		
numdial	15.42128	5.638245	2.74	7	4.307964	26.53459
_cons	6.49981	8.403063	0.77	0.44	-10.06312	23.06274

Table A5. Stata's results for model 5.

numeq	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
		0.000035				0.001714
popinf	0.0016445	6	46.16	0.000	0.0015742	7
_cons	14.03861	1.048015	13.40	0.000	11.97291	16.10431