

The Physical Education Infrastructure Supported with the Multiple Contributions Fund of Technological and Polytechnic Universities in Mexico from 2000 to 2018

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Abstract

This article describes the application of the Higher Education Multiple Contributions Fund for the Technological and Polytechnic Universities in Mexico from 2000 to 2018. This information was obtained from the Ministry of Public Education and from the General Office of Technological and Polytechnic Universities. The variables for this analysis were: the federal resource investments on physical infrastructure conducted for each fiscal year for the aforementioned period, and the evolution of enrolled students. A quantitative method was used, non-experimental, transactional, descriptive. The analysis universe was 179 universities from the technological and polytechnic universities. There was a comparison conducted of the resources invested in the Multiple Contributions Fund on infrastructure and the yearly enrolled students in the subsystem. Based on this information, this paper describes if there is a relationship between the increase of students enrolled and the authorization of federal resources for the Higher Education Multiple Contributions Fund. The results obtained in the years from 2000 to 2018 were taken into consideration where the number of students enrolled in universities increased by 851%, and the cost per student invested in the fund decreased -88.04%. Results indicate that there is no relationship between the application of investment in education infrastructure and the evolution of enrolled students.

Keywords

Education Infrastructure, Federal Resources, Higher Education, Technological and Polytechnic Universities

1. Introduction

The purpose of this review is to describe the investment of federal resources in the universities of the Technological and Polytechnic University Subsystem (CGUTyP) in Mexico, and its relation with the growth in the number of enrolled students in those technological and polytechnic institutions from 2000 to 2018.

The global economic competition in which Mexico is involved, requires that students enrolled in technological and polytechnic universities have specialized work competencies in order to be immersed in the work market (Schwab, 2016). Therefore, it is crucial to analyze the correct application of public policies in higher education at a federal and state level to determine whether the education infrastructure investment programs match the demands and needs of the enrolled students (Sarur Zanatta, 2018).

The rapid growth in the number of enrolled students in the technological and polytechnic universities in Mexico, together with the lack of state and federal public investment in academic facilities has caused a lack of facilities and equipment that are so necessary in order to be able to offer top notch higher education regarding the competency based education model. Therefore, our objective would be to observe the lack of public investment for infrastructure in the 2000-2018 timeframe with the purpose of providing information for the development of universities (ASF, 2014).

The source population are the higher education institutions of the Technological and Polytechnic University Subsystem (CGUTyP) in Mexico, based on information from 2000 to 2018. This document is supported on the results obtained from official information provided by the Ministry of Public Education.

Mexico has been a permanent member of the United Nations Educational, Scientific and Cultural Organization (UNESCO) since 1946, and together with the Ministry of Public Education aligning its programs in order to strengthen education, science, and technology through inclusive and quality education, among other things. The purpose of the UNESCO is to establish social responsibility in higher education institutions by providing proposals for programs, goals, and actions to be followed, in order to achieve pertinence in areas where new public institutions are established through the academic programs (UNESCO, 1998). The purpose of this is to have the adequate physical infrastructure and education services necessary to guarantee the minimal conditions to generate more solid and inclusive growth, to elevate education quality and coverage, and to establish the timely measuring mechanisms of results through indicators (UNESCO, 2017). In accordance with Objective 4 of the 2030 Agenda (UN, 2015) for the sustainable development which seeks to guarantee inclusive and equal education, and Goal 4.A which indicates the need to build and improve education facilities in such a way that they are inclusive (UNESCO, 2017).

This research was conducted with a quantitative methodological approach with a descriptive analysis to validate the application of the investment of the Multiple Contributions Fund (Hernández, Fernández, & Baptista, 2014). We

analyzed the authorization of resources to the Higher Education Multiple Contributions Fund (FAM) in technological and polytechnic universities, and we also investigated the increase of enrolled students in the universities from 2000 to 2018.

The FAM provides federal resources for physical infrastructure in public education schools at the Basic, Middle, and Higher education levels. For this research we only took into consideration as reference the resources authorized for the higher education levels and, those granted to the Technological and Polytechnic University Subsystem.

To assess efficiency thoroughly, we analyzed the direct relationship between the variables herein, with the FAM Fund objective, which seeks to provide infrastructure to higher education (SEP, 2017).

The FAM program was analyzed, by relating the information contained in the Annual Authorized Budget for Higher Education Infrastructure in the CGUTyP, and the number or yearly enrolled students recorded in the education subsystem.

This data was analyzed, observing if the granting of resources to the CGUTyP, is related to the increment of enrolled students, looking for a relationship if a variable increases, the other one will increase, too. If there is a higher number of enrolled students, the number of resources should be larger (Delgado, 2018).

2. The Higher Education System in Mexico

In Mexico, higher education institutions (IES) through the National Association of Higher Education Universities and Institutions in the Mexican Republic (ANUIES) have a permanent collaboration with the Ministry of Public Education (SEP) to design public policies and their implementation to generate development of the physical infrastructure in education. The ANUIES seeks to establish public policies so that in the year 2030, all IES have physical infrastructures in education that are resilient, thus seeking to improve scientific research and the quality of higher education through an optimal strategy for the design of physical infrastructure (ANUIES, 2018).

The Sub secretary of Higher Education (SES) is the area of the Ministry of Public Education in charge of promoting a quality education that will allow the development of competitive professionals that are committed with regional and national development, in order to contribute to the construction of a fairer society (SES, 2021).

In Mexico, the Higher Education Subsystem is composed of these public subsystems: 1) Universities: Federal Public Universities, State Public Universities (UPES), State Public Universities with Solidary Support (UPEAS), Technological Universities, Polytechnic Universities, Intercultural Universities. 2) Technological: Instituto Politécnico Nacional, Tecnológico Nacional de México: Federal Technological Institutes, and the State Technological Institutes. 3) Public Normal Schools. 4) Public Research Centers. 5) Other public institutions. By May

2019, the Technological and Polytechnic University Subsystem was composed of 117 technological universities, and 62 polytechnic universities distributed throughout 25 states in the Mexican Republic (SES, 2021).

Technological universities were created in 1994, and polytechnic in 2001. They are an educational project to offer programs in engineering, bachelor's degrees, and postgraduate specialized studies. Their programs are designed based on the education model centered in work competencies and are focused on research applied to technological development through agreements with the productive and social sectors (CGUTyP, 2020). Due to their geographical location, technological and polytechnic universities cater to segments in the population that are socially and financially disadvantaged (Cámara de Diputados, 2011).

3. Higher Education Multiple Contributions Fund Program (FAM)

There has been an improvement in the public financing mechanisms to grant public resources. The government has defined programs to distribute financing by taking into consideration criteria that will consider quality and efficiency controls of the institutions (Márquez, 2004). Regarding this matter, the Ministry of Public Education (SEP, 2014) promotes extraordinary biddable subsidies such as the Higher Education Multiple Contributions Fund (FAM) with the purpose of elevating the quality of public universities, by consolidating their development and training of more and better professionals in the country. The monetary amount delivered to institutions is closely related to strategic planning and to the results of the quality evaluation of the academic programs of the different higher education institutions (Corrales, De la Garza, Gutiérrez, & Arcos, 2012). It strives to address the demand of public education services. This form of financial funding responds to the problem of a lack of federal resources to address the needs in education institutions (CONEVAL, 2019).

The FAM was created in 1995, and it was through the Fiscal Coordination Law that in 1997; through the General Branch 33 "Federal Contributions for Federal Entities and Municipalities". It established that federal contributions are resources that the federation transfers to the public revenue systems of each state with the purpose of providing construction, repairing, maintaining, rehabilitating, and purchasing equipment for education spaces in public state universities. The FAM originated from the decentralization of functions of the federal government, and the putting in service of the Administration Committees of the State School Construction Program in 1998 (Scott, 2004).

Since 2003, Public State Universities and of Solidary Support (UPEAS), request their physical infrastructure through the Integral Institutional Strengthening Program (PIFI), through which the growth and consolidation of the physical faculty is measured, also taking into consideration its academic justification. By the year 2012, it was done through the direct designation of resources, and it was published in the Federal Official Journal.

The FAM amount is authorized through the Federal Expenditure Budget (PEF) and the Ministry of Public Education (SEP) is the authority responsible for allocating the corresponding resources to each state. The Education Physical Infrastructure Institutes (INIFE), or a similar entity, and the Higher Education Institutions for every state are the operating institutions of the FAM (ASF, 2017).

In the case of the CGUTyP, the authorization and dispersion of FAM resources is in charge of the Office of the General Coordination of Technological and Polytechnic Universities (CGUTyP). This general coordination is in charge of managing the transference of resources to the state governments in order to benefit education institutions. This is done through the application of a master infrastructure plan for each education institution with the purpose of developing the physical construction of facilities, workshops, necessary equipment, and also acting as an instrument to develop academic activities and operation processes of quality standards.

Firstly, for the allocation of FAM resources, the CGUTyP established 3 parameters: the first one establishes the growth stages for each institution. First, with the construction of a two-level Academic Teaching Unit for a 900-student capacity. A second one, related to a Laboratory and Workshop Unit, and the third one being that an Information and Documentation Center (Library) is provided. Once these facilities are in place, a professional training service is provided following a series of quality standards. The second parameter is to fulfill the infrastructure limitations that some institutions have due to an extraordinary growth in the number of enrolled students. The third parameter is to strengthen the bilingual international and sustainable models (CGUTyP, 2018). The construction of the physical infrastructure is done through the National Institute of Education Physical Infrastructure (INIFED, 2015).

4. Method

The analysis method used is exploratory, quantitative, non-experimental, transactional, of a descriptive scope, where the following variables are analyzed: the designation of public federal resources from the Higher Education Multiple Contributions Fund (FAM), and the assessment of the number of enrolled students in the CGUTyP. The analysis technique was developed in three stages: first stage, in which an exploratory technique was used to analyze a short studied issue (Hernández et al., 2014), in which a lot of doubts arrive. The second stage, where the descriptive method was used and in which data was obtained; and the third stage where there was a cross comparison made between results for the provision of data.

The descriptive method is specified by properties, characteristics and people's profiles, groups, communities, processes, objects, or any other phenomenon subject of analysis. It has as purpose its utility to show angle or dimension precision of a phenomena, community, context, or situation (Hernández et al., 2014).

This research applied an exploratory approach, where we obtained statistical data, and it is also descriptive because it establishes FAM investment data.

The data provisioning procedure was conducted by the reading and processing of statistical data sources related to public finances and governmental spending.

We analyzed the data provided by the Ministry of Public Education (SEP) and the General Coordination of Technological and Polytechnic Universities (CGUTyP), resulting from the Tables of the Quality Evaluation Model of the Technological Universities Subsystem (MECASUT) and the Tables of the Quality Evaluation Model of the Polytechnic Universities Subsystem (MECASUP) (CGUTyP, 2017), and of the data provided by the Budgets Sub direction of that same entity. An input was made, data analysis, a coding and migration was made to the statistical program statistical package for the social sciences (SPSS). Reports were emitted for data analysis and result in forms.

The application of this research is quantitative, determination of assignation behavior in budget charges is shown by statistical data of technological and polytechnic universities in regard to the year period 2000-2018.

The limitation of the analysis corresponds solely to the funding provided by the CGUTyP, during the fiscal years from 2000 to 2018. The analysis technique is descriptive, the study universe is 179 universities belonging to the Technological and Polytechnic University Subsystem in Mexico (Hernández et al., 2014).

5. Results

The Resources of the Multiple Contributions Fund Invested during 2000 to 2018

From the information obtained through the interpretation of results, taking as reference the 2000-2018 period, related to the annual resources assigned to the FAM in the CGUTyP, we observed that the annual investment has not increased in the number of projects. Therefore hindering the FAM fund to fulfill its objectives.

According to Ministry of Public Education (UTSEP, 2018), during the 2000 to 2018 period, the transference of federal resources to the federal state funds to benefit the technological and polytechnic universities was of \$16,015,986,857.17 (Sixteen billion fifteen million nine hundred eighty-six thousand eight hundred fifty-seven and 17/100 pesos MXNcy) (See **Table 1**).

Data shows that the dispersion of the Multiple Contributions Fund authorized for 2000 was of 756 million pesos, with a maximum increase in 2014 of 1164 billion pesos. On the other hand, for 2018 the dispersion was of 860 million pesos, a very similar amount to the resources authorized in 2000.

The Higher Education Multiple Contributions Fund and the Annual Growth Rate of Investment in the Technological and Polytechnic University Subsystem

Table 1. Annual allocation of resources and projects authorized by the higher education multiple contributions fund in the technological and polytechnic university subsystem for 2000 to 2018.

Fiscal Year	Authorized FAM Resources	Number of Projects	Fiscal Year	Authorized FAM Resources	Number of Projects
2000	\$756,831,894.00	74	2010	\$1,055,917,239.00	68
2001	\$543,962,326.00	43	2011	\$1,256,174,879.00	75
2002	\$496,373,300.00	53	2012	\$1,051,500,000.00	72
2003	\$678,933,616.00	49	2013	\$1,146,000,000.00	84
2004	\$496,459,474.00	59	2014	\$1,164,000,000.00	87
2005	\$575,813,009.00	63	2015	\$1,149,859,263.00	74
2006	\$591,295,945.00	86	2016	\$698,018,074.82	62
2007	\$750,868,000.00	82	2017	\$763,228,973.61	96
2008	\$909,900,000.00	74	2018	\$860,202,065.74	80
2009	\$1,070,648,798.00	82			
			TOTAL	\$16,015,986,857.17	1363

Source: Own calculations using information about the historical approved investments in the General Coordination of Technological and Polytechnic Universities (UTSEP, 2018) and the Federal Expenditures Budget for the fiscal years of 2000 to 2018 published in the Official Federal Journal (DOF, 1999-2017).

The public expenditure of the FAM fund in the university subsystem, shows that the federal government has not increased the number of resources between school terms. Thus indicating that there is not a logical allocation of the funds. This, due to the fact that there have been increases and decreases between periods without a logical application of public resources.

During the period of 2000 to 2018, the annual growth rate of the fund has had several variations. This indicator shows the capacity that the subsystem has to support the demand for physical infrastructure. A positive growth rate indicates an increase in the capacity of the education system (UTSEP, 2018). Negative growth rates indicate a smaller attention between school terms (See Table 2).

Number of Enrolled Students in the Technological and Polytechnic University Subsystem for 2000-2018

Technological and polytechnic universities were created as a response to the increase in the national needs for higher education facilities. As a result of this, the number of enrolled students grew uncontrollably. Consequently, there was also an increase in the need for infrastructure and equipment necessary to ensure the proper performance of the education centers.

According to statistical information provided by the General Coordination of Higher University Education of the Ministry of Public Education (CGUTyP, 2018), by September 2018 there was a recorded number of 344,028 students enrolled in the technological and polytechnic university subsystem (See Table 3).

Table 2. The evolution of the annual growth of the higher education multiple contributions fund in the technological and polytechnic university subsystem (Annual Growth Rate).

Period	Annual FAM Investment Variation between School Terms
2000/2001	-39.13%
2001/2002	-9.59%
2002/2003	26.89%
2003/2004	-36.76%
2004/2005	13.78%
2005/2006	2.62%
2006/2007	21.25%
2007/2008	17.48%
2008/2009	15.01%
2009/2010	-1.40%
2010/2011	15.94%
2011/2012	-19.47%
2012/2013	8.25%
2013/2014	1.55%
2014/2015	-1.23%
2015/2016	-64.73%
2016/2017	8.54%
2017/2018	11.27%

Source: Own calculations using information about the historical approved investments in the General Coordination of Technological and Polytechnic Universities (UTSEP, 2018) and the Federal Expenditures Budget for the fiscal years of 2000 to 2018 published in the Official Federal Journal (DOF, 1999-2017).

Table 3. Evolution of the annual number of enrolled students by the month of September in the technological and polytechnic university subsystem (Annual Growth Rate).

Fiscal Year	Students in Technological Universities	Students in Polytechnic Universities	Total Students
2000	36,190	0	36,190
2001	42,609	465	43,074
2002	50,287	1636	51,923
2003	57,062	2489	59,551
2004	62,748	4742	67,490
2005	64,945	8205	73,150
2006	66,660	11,125	77,785

Continued

2007	72,276	18,044	90,320
2008	79,841	25,604	105,445
2009	107,639	31,540	139,179
2010	130,729	37,619	168,348
2011	149,354	45,090	194,444
2012	168,441	55,074	223,515
2013	190,188	64,842	255,030
2014	211,911	76,391	288,302
2015	230,524	88,811	319,335
2016	242,100	96,040	338,140
2017	246,338	98,112	344,450
2018	245,864	98,164	344,028

Source: Own elaboration with unpublished information, and information published obtained from the MECASUT-MECASUP tables from the years 2012 to 2018, the information was provided by the CGUTyP-SEP (CGUTyP, 2012-2018).

Regarding the growth in the number of students enrolled, it went from 36,190 students in the year 2000 to having 344,028 students in 2018.

The Number of Enrolled Students and the Annual Growth Rate in the Technological and Polytechnic University Subsystem for 2000 to 2018

Findings show that due to the rapid increase in the number of enrolled students in the university subsystem, there was a larger budget allocated to the construction of new academic facilities and equipment. However, the increase in the number of enrolled students was much higher, therefore education facilities resulted insufficient.

Regarding the annual national growth rate in the number of enrolled students from 2000 to 2018, there has been an average yearly increase of 13.55%. Regarding the growth percentage of the accumulated number of enrolled students, there has been an 851% increase, considering as initial reference the year 2000 to 2018 (See **Table 4**).

Cost per Student for the Higher Education Multiple Contributions Fund (FAM)

Another indicator that was analyzed was the cost per student regarding the designation of the FAM program. This proved that since there was such an enormous growth in the number of enrolled students, the indicator resulted in a significant decrease in the amounts allocated per students, thus proving a lack of resources due to the level of enrolled students in the subsystem.

Regarding the average cost per student invested by the fund, it was determined by dividing the cost of the total fund over the total number of enrolled students. It averaged \$20,012 pesos in 2000, whereas in 2018 it was only of \$2497 pesos. This resulted in a decrease of 88.04% (See **Table 5**).

Table 4. Annual growth rate in the number of enrolled students and the growth percentage of the accumulated number of enrolled students in the technological and polytechnic university subsystem (Annual Growth Rate).

Fiscal Year	Enrolled Students	Average Annual Growth Rate of Enrolled Students	Accumulated Percentage of the Growth in the Number of Enrolled Students
2000/2001	43,074	19.02%	19%
2001/2002	51,923	20.54%	43%
2002/2003	59,551	14.69%	65%
2003/2004	67,490	13.33%	86%
2004/2005	73,150	8.39%	102%
2005/2006	77,785	6.34%	115%
2006/2007	90,320	16.11%	150%
2007/2008	105,445	16.75%	191%
2008/2009	139,179	31.99%	285%
2009/2010	168,348	20.96%	365%
2010/2011	194,444	15.50%	437%
2011/2012	223,515	14.95%	518%
2012/2013	255,030	14.10%	605%
2013/2014	288,302	13.05%	697%
2014/2015	319,335	10.76%	782%
2015/2016	338,140	5.89%	834%
2016/2017	344,450	1.87%	852%
2017/2018	344,028	-0.12%	851%
Total		Average Growth Rate for the Period 13.55%	Total Growth Percentage from 2001-2018 851%

Source: Own elaboration with unpublished information, and information published obtained from the MECASUT-MECASUP tables from the years 2012 to 2018, the information was provided by the CGUTyP-SEP (CGUTyP, 2012-2018).

Table 5. Average cost per student for the higher education multiple contributions fund in the technological and polytechnic university subsystem for 2000 to 2018.

Fiscal Year	Enrolled Students	Average Cost per Student for FAM
2000	36,190	\$20,912.74
2001	43,074	\$12,628.55
2002	51,923	\$9559.80
2003	59,551	\$11,400.88
2004	67,490	\$7356.04
2005	73,150	\$7871.67
2006	77,785	\$7601.67

Continued

2007	90,320	\$8313.42
2008	105,445	\$8629.14
2009	139,179	\$7692.60
2010	168,348	\$6272.23
2011	194,444	\$6460.34
2012	223,515	\$4704.38
2013	255,030	\$4493.59
2014	288,302	\$4037.43
2015	319,335	\$3600.79
2016	338,140	\$2064.29
2017	344,450	\$2215.79
2018	344,028	\$2500.38
TOTAL		-88.04%

Source: Own elaboration with unpublished information, and information published obtained from the MECASUT-MECASUP tables from the years 2012 to 2018, the information was provided by the CGUTyP-SEP (CGUTyP, 2012-2018).

6. Conclusion

Mexico is a member of the United Nations Educational, Scientific and Cultural Organization, and in spite of having signed the 2030 Agenda, the Ministry of Public Education did not align with the objectives of striving for an adequate physical infrastructure as well as education services that are inclusive and adequate for university students in this subsystem.

In the Technological and Polytechnic University Subsystem from 2000 to 2014, the trends showed a constant increase of authorized resources for the FAM subsidy, reaching in 2014 a maximum amount of 1.149 billion pesos. However, since 2015 and until 2018 there was a constant decrease, reaching in 2018 an authorization of 860 million, thus showing a 289 million pesos reduction, a 26% less in comparison to the historical maximum.

In real terms, the number of enrolled students in the technological and polytechnic university subsystem grew 851% during the period of 2000 to 2018, showing an annual growth of 19,112 students. The number of enrolled students in 2000 was 36,190 students, and in 2018 there were 344,028 students.

About the average cost per student for the FAM Fund in the technological and polytechnic university subsystem, results show that there is no direct correlation with the number of enrolled students. We found that whereas the accumulated number of enrolled students from 2000 to 2018 recorded an 851% increase, the average cost per student for FAM resources decreased 88%. It went from an amount of \$20,912 pesos in 2000 to an average of \$2500 pesos per student in 2018.

Despite the fact that there is a published formula for the distribution of the FAM subsidy for the technological and polytechnic university subsystem, the findings in the variation of authorized FAM resources between school terms in relation to the annual growth rate (**Table 2**), show that there is no logical allocation of this resource.

We also found that the granting of the resources in this subsystem is not correlated to the increase in the number of enrolled students between the periods. The enrolled student variable is not related to the annual authorized budget. There is an insufficient budget regarding the number of enrolled students.

In the observation of the trends contained in this information, we found that there is no continuity in the application of public education policies regarding FAM physical infrastructure.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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